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Analysis of eucalyptus plantations on the Iberian Peninsula

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Abstract

This thesis analyses the prerequisites, profitability and competitiveness of eucalyptus plantation on the Iberian Peninsula and in Brazil. The thesis has a macro perspective and analyses a typical hectare of eucalyptus in each studied region.

A survey methodology was used as a strategy to cover a broad perspective using expert respondents.

The regions studied on the Iberian Peninsula were the ones found suitable for eucalyptus plantations from an economic point of view. The studied regions were Huelva in the South West of Spain, Galicia in the North West of Spain and Portugal. The quantitative study of Brazilian plantation conditions was limited to only study the economic aspects.

The quantitative study had two perspectives, one as a forest owner when the profitability at road side was analysed, and one as a pulp producer, when the wood cost at mill gate was calculated. When the profitability at road side was analysed, KPI´s such as NPV, IRR, B:C ratio and payback period were used. The wood cost was calculated both as EUR per m^3 of wood and EUR per tonne of pulp.

In the base case Portugal was the region with the highest profitability and Brazil had the strongest competitiveness. When considering a real appreciation of land of > 2 % in the Brazilian plantations, those plantations were the most profitable in this thesis. On the Iberian Peninsula, Portugal was found as the most competitive region, with a wood cost per tonne of pulp 50 % above the wood cost per tonne of pulp in Brazil. The plantations in Galicia and Huelva had good profitability, but poorer competitive strength compared to Portugal.

A problem on the Iberian Peninsula is the small sizes of the forest properties. In regions with high growth, the typical properties are only a few hectares in size.

Keywords: *Profitability, Competitiveness, Wood cost, Investment analysis, Silviculture costs, Spain, Portugal*

Sammanfattning

Uppstatsen analyserar förutsättningarna, lönsamheten och konkurrensstyrkan i eukalyptus plantager på den Iberiska halvön och i Brasilien. Analysen skedde i ett makro perspektiv, för ett typiskt hektar av eukalyptus i varje undersökt region.

En surveyundersöknings metodologi har används som strategi i arbetet med ett brett angreppssätt med expert respondenter.

De studerade regionerna på den Iberiska halvön var de som funnits mest lämpliga ur ett ekonomiskt perspektiv att odla eukalyptus på. Regionerna på den Iberiska halvön var Huelva i sydvästra Spanien, Galicien i nordvästra Spanien och Portugal. Den kvalitativa studien begränsades till att endast överväga de ekonomiska aspekterna i en brasiliansk eukalyptusplantage.

Den kvalitativa analysen hade två perspektiv, ett skogsägarperspektiv där lönsamheten vid bilväg i skogen beräknades, och ett massaproducentperspektiv där vedkostnaden vid industrigrind beräknades. Lönsamheten vid bilväg analyserades med avseende på NPV, IRR, B:C ratio samt payback. Vedkostnaden beräknades som både EUR per m^3 massaved och EUR per ton massa.

I huvudscenariot var Portugal den region som hade högst lönsamhet samtidigt som Brasilien hade den högsta konkurrensstyrkan. När en real värde ökning på > 2 % adderades till de brasilianska plantagerna, blev Brasilien den mest lönsamma regionen. På den iberiska halvön var det Portugal som hade den starkaste konkurrensstyrkan, med en 50 % högre vedkostnad per ton massa än den brasilianska. Eukalyptusplantagerna i Galicien och i Huelva hade god lönsamhet jämfört med de andra regionerna, men sämre konkurrensstyrka jämfört med Portugal.

Ett problem på den Iberiska halvön är att skogsfastigheterna är små. I de regioner där tillväxten är hög, är storleken på en typisk skogsfastighet endast ett par hektar.

Nyckelord: *Lönsamhetsbedömning, Konkurrensstyrka, Vedkostnad, Investeringsanalys, Skogsskötselkostnader, Spanien, Portugal*

Preface

I would like to start by thanking all people I have been in contact with during this study, you have all made this process a pleasure. I would like to address a special thanks to Dr Bengt Carlsson, who assisted me with his knowledge and his network of connections on the Iberian Peninsula. He was particularly helpful in the planning process of my field trip to Spain and Portugal in March 2012. I am also grateful for the warm welcoming the representatives at Altri and ENCE gave me, and for the discussions with Louis Carbonnier, who assisted me with his great experience of the forest sector on both the Iberian Peninsula and in Brazil.

I would also like to thank Professor Lars Lönnstedt, who was my supervisor at the Swedish University of Agricultural Science in Uppsala, Sweden, and Dr Jonas Jacobsson who was my external supervisor.

Uppsala 23 May 2012
Carl Kling

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Abbreviations

BEKP	- Bleached eucalyptus kraft pulp
B:C ratio	- Benefit cost ratio
Eucalyptus	- *Eucalyptus spp.*
Financial solidity	- Liabilities / Total Assets
ha	- hectare
IRR	- Internal rate of return
KPI	- Key performance indicator
LEV	- Land expectation value
MAR	- Minimum acceptable rate of return
m.a.s.l.	- Meters above sea level
NPV	- Net present value
MAI	- Mean annual increment, m^3 u.b. ha^{-1} $year^{-1}$
o.b.	- over bark
PV	- Present value
ROE	- Return on Equity, consolidated net profit / total equity
u.b.	- under bark
UWF	- uncoated wood free paper

Introduction

This chapter gives a background to why the subject for this thesis was chosen and presents the research frontier. The objective, research question, scope and restrictions are also presented.

The Iberian Peninsula is the only place in Europe where eucalyptus plantations for pulp production exists in large scale. After having visited Brazilian eucalyptus plantations with high growth and efficient silviculture in the summer of 2011, my curiosity drove me to investigate the profitability of European eucalyptus plantations and their competitiveness against the Brazilian equivalence.

The research frontier

In my research I have not found anything published about the profitability of eucalyptus plantations on the Iberian Peninsula. Nor are there publications about competitive advantage of eucalyptus plantations in either Spain or Portugal. In studies of the profitability and competitive advantage in eucalyptus plantations in other parts of the world, the researchers often mentions that there is generally little being published on the subject, due to that such studies are mostly made by private companies and is their private property, or created by consulting firms who sells their results.

Studies on profitability of eucalyptus plantations around the world often focus on South America and South East Asia, as areas for high growth and profitability. (Cubbage, Mac Donagh, o.a. 2007) Cubbage et al. showed that the IRR for eucalyptus plantations were > 20 % in Brazil, if the cost of land purchase was not included. If the land purchase were included the IRR dropped to < 10 %, in all of their studied objects. In Sedjo´s studies from 1983 (R. Sedjo 1983) and 2001 (R. Sedjo 2001) the profitability were higher in plantations in the Southern hemisphere than in plantations in the Northern hemisphere. In his study from 2001, the IRR for eucalyptus in central Brazil were > 20 % in plantations for pulpwood production. The differences in IRR between Sedjo´s earlier study from 1983 and the study from 2007 by Cubbage (Cubbage, Mac Donagh, o.a. 2007) is not very large, considering that the growth the researchers based their calculations on has increased by 60 %. The MAI has increased from 25 m^3 $year^{-1}$ ha^{-1} to 40 m^3 $year^{-1}$ ha^{-1}. The same difference does not appear in the IRR analysis. This is described by Cubbage, as a result of the increased costs in Brazilian eucalyptus plantations.

In a similar study by Cubbage from 2010, (Cubbage, Koesbandana, o.a. 2010) returns of global forest investment are compared to various risks and the prerequisites for conducting business. In areas with an IRR of > 12 % the general risk were higher, than the areas with an IRR of ≤ 8%.

Research published about eucalyptus forestry on the Iberian Peninsula is mainly about how plantations affect their environment. The focus is often on ground water, erosion, micro-bonding of carbon, the risk of wildfires or how to establish a new plantation after major disturbances, etc. There is also some research published about different types of optimizations for rotation cycles or multiple land usages with respect to different goals. These goals are usually a combination of high volume production of biomass and binding of carbon, but no studies have the economic profitability as a goal.

Objective

The objective is to provide general qualitative knowledge of the forest industry sector on the Iberian Peninsula and the prerequisites for eucalyptus plantations with the perspective of a financial investor.

The quantitative part aims to analyse the profitability and competitiveness of eucalyptus plantations on the Iberian Peninsula compared to Brazil, since Brazil is considered to be the benchmark for eucalyptus plantations in the world.

The profitability analysis will have a forest owner perspective and the competitiveness will be analysed with the perspective of a pulp producer.

Research question

Where are there a potential for eucalyptus plantation on the Iberian Peninsula? Which of the studied regions have the best profitability and competitiveness compared to Brazil?

Scope

The qualitative study will be limited to describe the prerequisites and forest resources on the Iberian Peninsula, and therefore Brazil will not be presented in this respect. The potential for eucalyptus plantations will be analysed from a macro perspective, the goal is to make a comparison.

In the quantitative study, the profitability and competitiveness will be calculated for a typical green field hectare of eucalyptus plantation, in each studied region, for a new forest owner, on good soil and with good silviculture.

The profitability will be analysed at road side in the forest, considering the NPV, IRR, B:C ratio and Payback period.

The competitiveness will be analysed as wood cost at mill gate. To compensate for the different consumption of wood for a tonne of pulp for *eucalyptus globulus* grown in Europe and *eucalyptus grandis* grown in Latin America, the analysed wood costs will be both EUR/m^3 of wood and EUR/ tonne of pulp.

Restrictions

All calculations are processed in real terms without taxes.

The analysis will be limited to two rotation cycles in each studied region.

Methodology

This chapter presents the methodology used while performing this thesis.

The study was performed with a survey methodology. The survey methodology as an approach is more of a research strategy, than a research method. Within the survey research, many different methods can be used. The strategy aims to do a mapping of what you are investigating, and provide a broad and comprehensive coverage of the investigated area. (Denscombe 2010)

"*Researchers who choose this approach may use a variety of methods: questionnaires, interviews, documents, and observation*." (Denscombe 2010)

A characteristic of the survey methodology as a strategy is its combination of broad coverage, focus on the snapshot at a given time and the dependence on empirical data. The approach involves accommodating empirical research, at a particular moment and to seek the most extensive and complete data as possible. (Denscombe 2010), s. 26)

The survey methodology allowed questions like, who, what, where, how many and how much. (Yin 2009)

Advantages

The study will focus more on the collected data than on the theory. The survey covered a broad and comprehensive manner, which allows one to take the claim that the requisites corresponding to the "real world". By using the survey methodology, the researcher is able to collect many data quickly at relatively low cost. (Denscombe 2010)

The methodology requires only a few 'expert' respondents to conduct the survey, which is useful when describing the characteristics of a large area, assuming that the sample is valid. (Denscombe 2010)

The methodology also allows the researcher to collect a wide range of information e.g., values, attitudes, and beliefs. A considerable flexibility is given to the analysis from the many questions asked during the interviews and field trips, about the given topic. (Denscombe 2010)

Disadvantages

As Denscombe mentions there is a disadvantage with the research strategy if the person performing the study is too busy producing data based on a broad coverage of the problems and becomes too fixed on collecting the data itself and does not take the implications of these data, the study's research question, problems or theories in sufficient account. (Denscombe 2010) The process of structuring and planning this thesis was an important part to be able to proceed accordingly. In that sense the risk of that the data got to speak for itself and the significance of it was not overlooked.

To prevent the risk of that the theories were drowned or lost in the collected data, the accuracy and truthfulness in answers were checked by triangulating the sources. It was done to since the selection of the respondents were made subjectively which in some cases can make it difficult to judge how truthful the answers are given. It reduced the risk of the analysis being superficial and that it would not give as extensive knowledge of the details that other methods would have given. (Denscombe 2010)

The respondents answers may in some cases depend on their honesty, ability, memory or motivation to respond accurately. It could even by possible that the respondents chose to answer in ways, which might present them in a more favourable light. (Dillman 2000)

To reduce the risk of a self-selecting bias, if the respondents who choose to respond in the survey may be different from those who choose not to participate. (Dillman 2000) To be able to make the assumption that the answers from the interviews are the general opinion, the experts were sometimes asked validate each other's answers.

Selection

Selection and qualitative studies

According to Denscombe M. there are sound theoretical reasons for using the means of non-probability samples and a small number of units in a survey, when the research process is more of a "exploring process" rather than a testing of hypothesizes. The selection of people, texts and phenomena investigated, is a result of the discoveries made during the study. The selection process includes a series of decisions based on the results of the previous phases of the study. The goal was to continue the investigation until the questions were answered and the matter resolved. In situations when there is no chance to make a large-scale study, one can instead look for clues that can explain the situation. (Denscombe 2010)

When conducting a study, using the survey methodology, it is most often not known in advance how many that can be included in the study. Despite this the sample in this thesis was not experienced as too small, which could have led to criticism. (Denscombe 2010)

Subjective selection

In light of what is already known about the given subject, the respondents have been handpicked in the selection process. This was possible because there have been some knowledge of the people and phenomena to be investigated. The selection of the respondents has deliberately been based on the likelihood for them to provide valuable data. (Denscombe 2010)

When making the selection, it is not necessarily to put the representativeness in the first room such as you would have done in a large quantitative survey. Rather, try to select as many respondents and sources as possible, and not just those that correspond to "the most" but also those who stand out, because they can be used to verify the reasonableness of one's assertions. This is also an argument for the use of a non-probability sample. Most often, it is not known from the beginning how many respondents that one should include in the study. This may lead to that the sample often becomes small, which can lead to some criticism. (Denscombe 2010)

Snowball sampling

The selection of respondents in this study has partly been determined in a process in which a person was allowed to refer to another (Denscombe 2010). In the initial stage of the study only a few people was included, but the numbers of respondents has increased over time.

Snowball sampling is fully consistent with a subjective selection. Some respondents have been asked to suggest people who meet certain eligibility criteria, qualifications and areas of interest. Snowball sampling is according to Denscombe M. a very useful technique to increase the number of persons in the sample and the issues related to the investigation. (Denscombe 2010)

Selection criterias

The operational criteria for selecting respondents in this study were that only respondents with known expertise or suggested respondents were approached. Appendix 4 summaries the types of information sources all data is obtained from. It also profiles the particular respondents selected for the study. Respondents from all categories presented in Appendix 4 are represented in the sample.

In the initial the face of the selection process, the respondents were asked to nominate others based on the criteria that they thought the suggested respondent could provide valuable data about their specific area of expertise. In this way the new respondents could be approached by referring to the nominator, adding creditability to my study in the eyes of the new respondent.

Validity and Reliability

Validity is about measuring what is intended to be measured. Reliability focuses on that the results are reliable, that they have the same or not too different results, if a new study is done. The errors that can occur in this context can be both random and systematic.

To raise the level of validity and reliability, the interview material was tested to see how the questions were received and perceived, in order to adjust the interview questions. To increase the reliability of the study, notes where taken during each interview, and were written out fair directly afterwards. The compilation of the interviews was also made as quickly as possible to minimize the risk of misunderstandings. The interviews were performed as similar as possible and the questions have been asked openly, so that each respondent freely could talk about their views on every issue. In the end of the interviews the respondents were asked if there was something they wanted to add to their previous answers. (Trost 2005)

Material and procedure

Material

The types of data sources used in this thesis are presented in Appendix 4 and are both primary and secondary. The primary data was collected from interviews and filed visits in Spain and Portugal, from e-mail correspondents and from telephone interviews. The respondents involved in the study are all experts within their specific area. The secondary data sources provided data from statistics of forest resources, along with data from literature and publications of the region and the issue.

If nothing else is mentioned in the report, the data is from primary sources and is not referred to. A more complete transcript of the interviews and filed visits together with more detailed information of each studied region is to be found in Appendix 1.

Procedure

The model in Figure 1 illustrates the process of conducting this study. After having defined the objective and scope, a pre-study of the forestry on the Iberian Peninsula was made through talking to experts and reading literature published regarding the issue. The pre-study set the frames for the completeness over the broad scope and were a crucial part of this study. As a starting point, it was important to visualize where on the Iberian Peninsula it may be applicable with eucalyptus plantations, in order to proceed with the study in each specific region.

The study is performed by assuming the prerequisites for a typical and representative hectare of forest on good soils, with good management, as Sedjo did in his study from 1983 (R. Sedjo 1983). To not deviate from scope of this study, the typical prerequisites for each region was analysed.

Both primary and secondary data sources were in the descriptive qualitative part, to give a more complete view of the prevailing situation. In the quantitative part, the collected data was analysed with help of the theoretical framework previously studied, which are recognized theories for a study like this. The answers from the inquired experts were matched with secondary data of the forest the resources on the Iberian Peninsula.

The output from the quantitative part, the result of this study, is a number of possible locations for eucalyptus plantations, ranked after their individual profitability and competitiveness. The results and process was then subject to a further discussion, and conclusions were later drawn of the discussion.

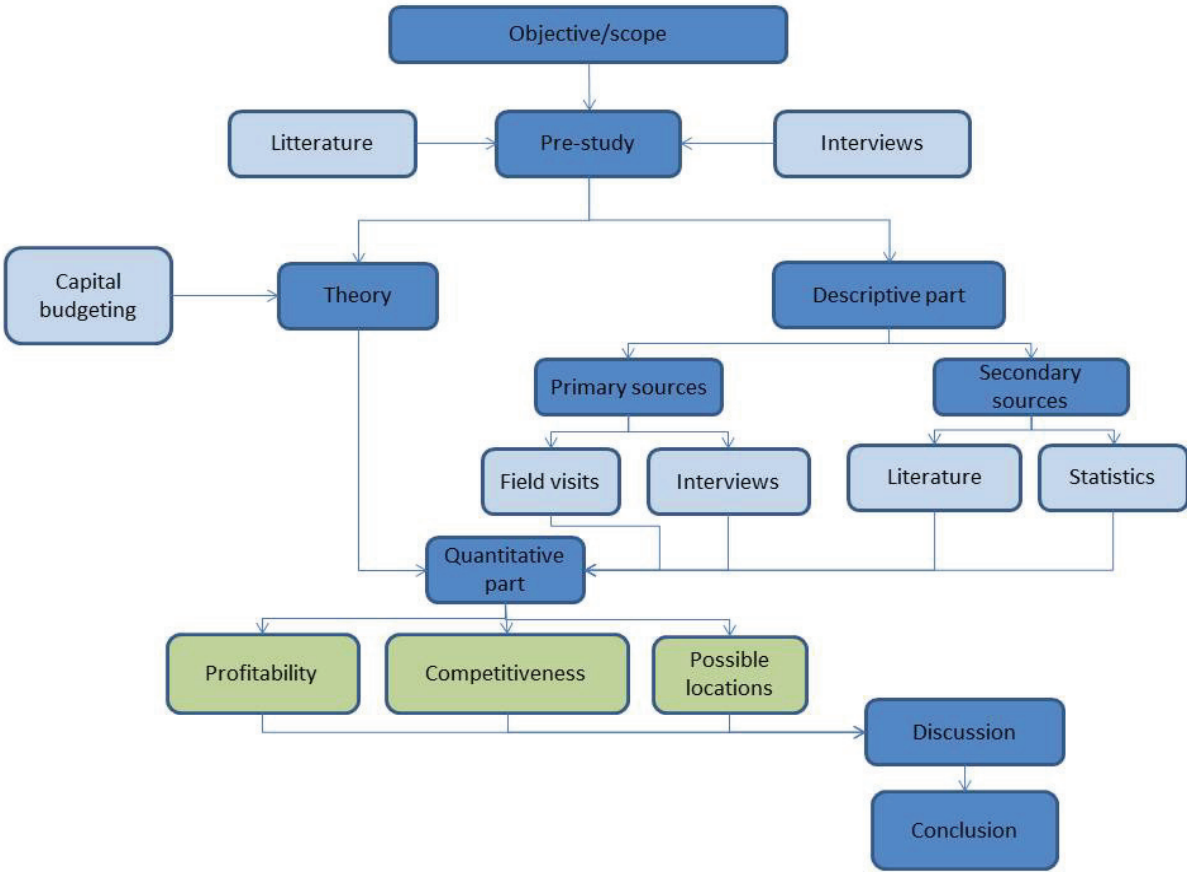

Figure 1. The model illustrates the flow in the process of conducting the study. (Kling, C. 2012)

The Interviews

The interviews had a semi structured layout, allowing the respondents to speak freely about their specific area of expertise. The topics and questions found in Appendix 2 were used to get the conversation in its right track.

Once contact had been established with the respondents, Appendix 2 was sent to most of the respondents, which explains the study more thoroughly and informed the approached person about the objective with my study. The next step was to determine the place and time for the

interviews. The meetings mainly took place during a two week field trip to the three studied regions on the Iberian Peninsula in March 2012. During 19 face to face structured conversations and during five telephone interviews and by field observations the primary data was collected. There have also been eight inquiries via e-mail.

The result from all contacts generated a large amount of qualitative data, from where the input data for the calculations where retrieved.

Data processing
The notes taken during the interviews were processed by reducing the data, so only the essential information remained (Lantz 2007). In this way, patterns were tried to be found, which could help create an overall picture of the collected material. Accordingly, the interview responses of all respondents were summarized to revile the prevailing opinion and knowledge about the plantation forestry on the Iberian Peninsula, together with the data from the secondary sources.

To avoid the problem with respondents answering in a way which may present them self in a more favourable light, the answers given by the respondents was summarized for each studied area and presented collectively, instead of referring to each specific respondent.

In the third part of the result chapters, the input data for the calculations are presented. The input data used is a compilation of the interviews, which complements each other and allows the scope to be followed. It allowed the analysis being made for a "typical" hectare of eucalyptus plantation in each of the four studied regions.

Calculations

All calculations have been made with costs and prices for one m^3 of eucalyptus wood under bark, u.b. The MAI presented is for commercial volume, m^3 u.b.

A discounting rate of 6.5% was used in the base case in this thesis.

When land was purchased, it was sold in the end of the last period, reducing the costs.
The definition of the costs is:

Costs at road side = Land cost + Silviculture costs + Harvesting costs +Forwarding costs
Costs at mill gate = Land cost + Silviculture costs + Harvesting costs + Forwarding costs+ Road transportation costs

Literature review

This chapter contains a literature review of previous studies connected to the objective.

No master thesis concerning investment analyses in plantation forestry have been found. The seven theses found regarding eucalyptus is all about soil carbon sequestration, fertilization, growth responses or social and environmental issues.

The five articles described below are articles who deal with investments analyses of eucalyptus plantations around the world. The search for publications was limited to only deal with items that somehow involves eucalyptus and profitability assessments.

Financial and economic profitability of reforestation in Thailand

Anssi Niskanen´s study from 1997 of the viability of reforestation projects in Thailand with different species, such as teak, eucalyptus or cassava, showed that reforestation with teak was the most profitable, followed by eucalyptus plantations. Eucalyptus plantation producing wood for industrial use which are grown intensively, had in the base case an IRR of 23.8 %. In Niskanen's calculations, the mean annual increment (MAI) was 25 to 31 m3 $year^{-1}$ ha^{-1} with rotation cycles between 5 to15 years. (Niskanen 1997)

Niskanen used the NPV, LEV, B:C ratio, and IRR, to rank the various investment opportunities in the study. LEV is the NPV with a correction for an infinite number of future rotation cycles.

Real options valuation of forest plantation Investments in Brazil

Markku Kallio et al. analysed eucalyptus plantations as an investment opportunity, in their study published in 2010. The study includes costs, prices, and rotation cycles imposed for eucalyptus plantations in 2008 (Kallio et al 2012). As in L.E. Pereiros study from 2006 (Pereiro 2006) the authors used the NPV and IRR to analyse the profitability of the various investments. The study concluded, that in spite of a number of uncertainties involved in investing in Brazil, it is still the most profitable option.

Impact of Australian tree species selection Research Centre, in China: an economic perspective

In the study from 1993, by McKenney et al, research on tree species selection and the choice of provenance is analysed. The objective was to study how the profitability of plantations of Australian tree species in Southern China is affected by choices of tree species. If the right provenience and tree species were selected the IRR obtained in the studied areas was between 27 to 45 % with an average of 34 %. McKenney et al. used rotation cycles from 7 to 15 years in their study of their plantations for eucalyptus pulpwood, depending on the local requisites. They did not include the cost of land purchase in their calculations. (McKenny et al 1993)

Timber investment returns for selected plantations and native forests in South America and the Southern United States

Cubbage et al. published in 2007 a study analysing the profitability of plantations and natural forests in South America compared to plantations and natural forests in the Southern United States. They concluded that eucalyptus plantations in South America were the most profitable option, with an IRR of 13n % to 23 %. At the time of the study, the growth was highest in Brazil, while Brazil also had the highest wood price for exotic species. (Cubbage et al 2007)

The authors calculated the profitability primarily without the cost of land purchase. If the cost for land purchase was not included the IRR were > 20 %, and if the land purchase was included the IRR was < 10 %, even if the land was sold in the end of the analysed period. Brazil and Chile had the highest land prices, which is why the difference between including the purchase of land or not made the largest difference in those countries. The B: C ratio calculated in the study for eucalyptus plantations in Brazil was 4.99 for e*ucalyptus grandis,* and 2.31 for *eucalyptus dunnii,* at 8 % discounting rate. (Cubbage et al 2007)

The study included a comparison of their own study with earlier studies made by Sedjo in 1983 (R. Sedjo 1983) and in 2001 (R. Sedjo 2001), who drew the same conclusion, that the IRR is significantly higher in plantations in the South hemisphere than in plantations in the North hemisphere. A difference between Cubbage´s and Sedjo´s results is that Sedjo found that eucalyptus pulpwood was more profitable, while Cubbage´s later study showed that eucalyptus for sawn wood was the most profitable alternative. The difference in IRR between Sedjo´s and Cubbage´s studies are not particularly large. The consistency in the result is explained by Cabbage, that though the growth has increased significantly from 25 m^3 $year^{-1}$ ha^{-1} to 40 m^3 $year^{-1}$ ha^{-1} in the South American plantations, the cost has also increased, which results in that the return does not differ greatly. (Cubbage et al 2007)

Global timber investments, wood costs, regulation, and risk

Cubbage et al. analysed in their article from 2010 (Cubbage et al 2010) the profitability in a forest plantation compared to the various risk factors and prerequisites for conducting business in a number of countries on several continents in the world. (Table 1)

If the cost for land purchase was excluded, the profitability of exotic plantations was highest in South America, more specific, in Brazil, Argentina, Uruguay, Chile, Colombia, Venezuela and Paraguay. In those countries, plantations of eucalyptus were more profitable than the cultivation of different pine species. The IRR of these eucalyptus plantations was usually > 20 %, compared with the pine plantations which had an IRR closer to 15 %. (Cubbage et al 2010)

When the profitability in forest plantations were compared against various types of risks, New Zealand, USA and Chile had the lowest risk in terms of political risk, commercial risk, risk of war or expropriation from the state. Those countries were also among the easier to conduct business in. In contrast, Venezuela, Indonesia, Colombia and Argentina were ranked as those countries with the highest risks according to Cubbage´s study. Brazil, Indonesia and Venezuela were the countries the scientists identified as the most difficult countries to conduct business in. (Table 1)

Table 1. Table of risk indexes for export transaction and direct investments in Brazil, Spain, Portugal and Sweden as a benchmark. The risks are rated from 1 to 3, except the Commercial risk which is rate from A to C. Source: (Ondd.be u.d.)

	Export transactions				Direct investments		
	Political risk						
	Short term	Medium/long terms	Special transactions	Commercial risk	War risk	Risk of expropriation and government actions	Transfer risk
Brazil	2	3	2	C	2	3	3
Spain	1	1	1	C	1	1	1
Portugal	2	1	1	C	1	1	1
Sweden	1	1	1	A	1	1	1

Calculation Methodology

This chapter gives a theoretical background to the calculations.

Basic assessment of global investments

Investment decisions should be taken after analysing series of future cash flows over time, for the period your investment intends to be active. This requires an assessment of future cash flows with respect to the risks and uncertainties that one might expect. (Chopra and Meindl 2010)

According to Cubbage´s study from 2007 (Cubbage et al 2007) and as Klemperer writes in *Forest Resource Economics and Finance* (Klemperer 1996), a typical capital budgeting methodology was used in this study and the criteria's for analysing the different options. The capital budgeting included the discounted cash flow (NPV), B:C ratio, IRR and payback period.

Cubbage (Cubbage et al 2007) said in their study that if the discounting rate is known, it is always best to use the NPV to rank their various investment options. The discounting rate is known when the investor has knowledge about their Weighted Average Cost of Capital (WACC). The purpose to discount a cash flow with the WACC is that the WACC consider the share of private equity and liabilities. In many cases, the discounting rate is however unknown and that is why many analysts use the IRR to rank the different alternatives instead. The IRR is also advantageous, because it allows the investor to compare investments in different businesses or assets to investments in forest plantations. The B:C ratio is easy to calculate, but is rarely used in practice, according to Cubbage.

Discounted cash flow

According to *Valuation - Measuring and Managing the Value of Companies* (Koller et al 2010) the model of discounted cash flow should be used to evaluate the profitability of investment projects.

An analysis of the discounted cash flow evaluates the present value (PV) of a future series of cash flows. A Net Present Value (NPV) analysis is based on the assumption that a dollar today is worth more than a dollar tomorrow. The NPV analysis makes it possible to evaluate various investment projects against each other, when income and expenses differ both in time and size. The NPV gives the value of the sum of cash flows under T number of periods. (Chopra and Meindl 2010)

C_0 = Cash flow period 0
Ct = Cash flow period t
r = discounting rate

$$NPV = C_0 + \sum_{t=1}^{T} \left(\frac{1}{1+r}\right)^t C_t$$

Internal rate of return - IRR

The internal rate of return, the IRR, is the definition of the discount rate an investment has when the NPV equals zero. The IRR provides a threshold rate for the investment, and one can see where the threshold is between a positive and a negative NPV. (Brealey et al 2011)

$$IRR = r \rightarrow NPV = 0$$

Benefit / Cost ratio

To be able to maximize the highest possible rate of return, yield per invested EUR, from a limited budget, the Benefit / Cost ratio (B: C ratio) measures how efficient the invested capital is used. The B: C ratio is the ratio of present value (PV) of all revenues divided by the present value of all costs incurred during the current period. (Zhang and Pearse 2011)

$$B{:}\,C\ ratio = \frac{\sum_{t=1}^{T}\left(\frac{Revenues}{1+r}\right)^{t}}{\sum_{t=1}^{T}\left(\frac{Costs}{1+r}\right)^{t}} = \frac{PV\ Revenues}{PV\ Costs}$$

If the B: C ratio is > 1 the investment gives an extra value per EUR invested, measured in present value. In such case, the investment is profitable, the investor becomes richer and the project should be undertaken. If the B: C ratio = 1, the revenues from the investment is equal to the cost of the investment, measured in present value. The investor will not get richer or poorer, and can remain indifferent to start the project. If B: C ratio <1, the investment project should be rejected, because every EUR invested generates a loss, measured in present value. (Klemperer 1996)

With the help of the B: C ratio, three different economic conclusions can be drawn, i.e. if the B: C ratio is 2.46:1 than the present value for of each invested EUR is 2.46. The B: C ratio also provides information about how much the discounted costs could increase before the NPV < 0, or how much the discounted earnings could fall before the NPV < 0.The interpretation of the B:C ratio is easier to interpret than the NPV. If the B: C ratio > 1 it simply means that the investment should be implemented. (Klemperer 1996)

However, it is important to remember that the B: C ratio is not directly linked to economic efficiency, because the wealth is not usually maximized when the B: C ratio is maximized. (Zhang and Pearse 2011)

Payback period

The payback period indicates how long time it will take for the investment to earn the money initially invested. To determine how long the payback period one has to accumulate the positive cash flow until the sum exceeds the cost. The payback period is measured in real terms and is not discounted. The timing of when revenues and expenses are equal is equal to the payback period length. A long payback period of an investment gives an indication of an increased risk for unforeseen events. (Klemperer 1996)

Wood cost

The wood cost is calculated per hectare, as the present value at mill gate divided with the discounted harvested volume. To convert the wood cost per m^3 of wood to wood cost per tonne of pulp the wood cost is simply multiplied with the consumptions of wood for a tonne of pulp.

$$Wood\ cost = \frac{PV\ costs_{at\ mill\ gate}}{PV\ harvested\ volume}$$

Capital budgeting - Klemperer´s model

David Klemperer has in *Forest Resource Economics and Finance* created a model which is designed to be used in the decision making of which KPIs that should be used in the analysis of various investment opportunities. The model firstly consider if the available capital is limited and if the various investment projects are mutually exclusive. If the various possible projects are mutually exclusive, the project with the highest NPV should be chosen. If capital is limited or not, only regulates the total budget for how many of the projects, judged as profitable that one can invest in. Klemperer´s model can be used to find out which KPIs to use when ranking the different possible investment, if a specific budget must be held with respect to limitations in available capital. (Klemperer 1996)

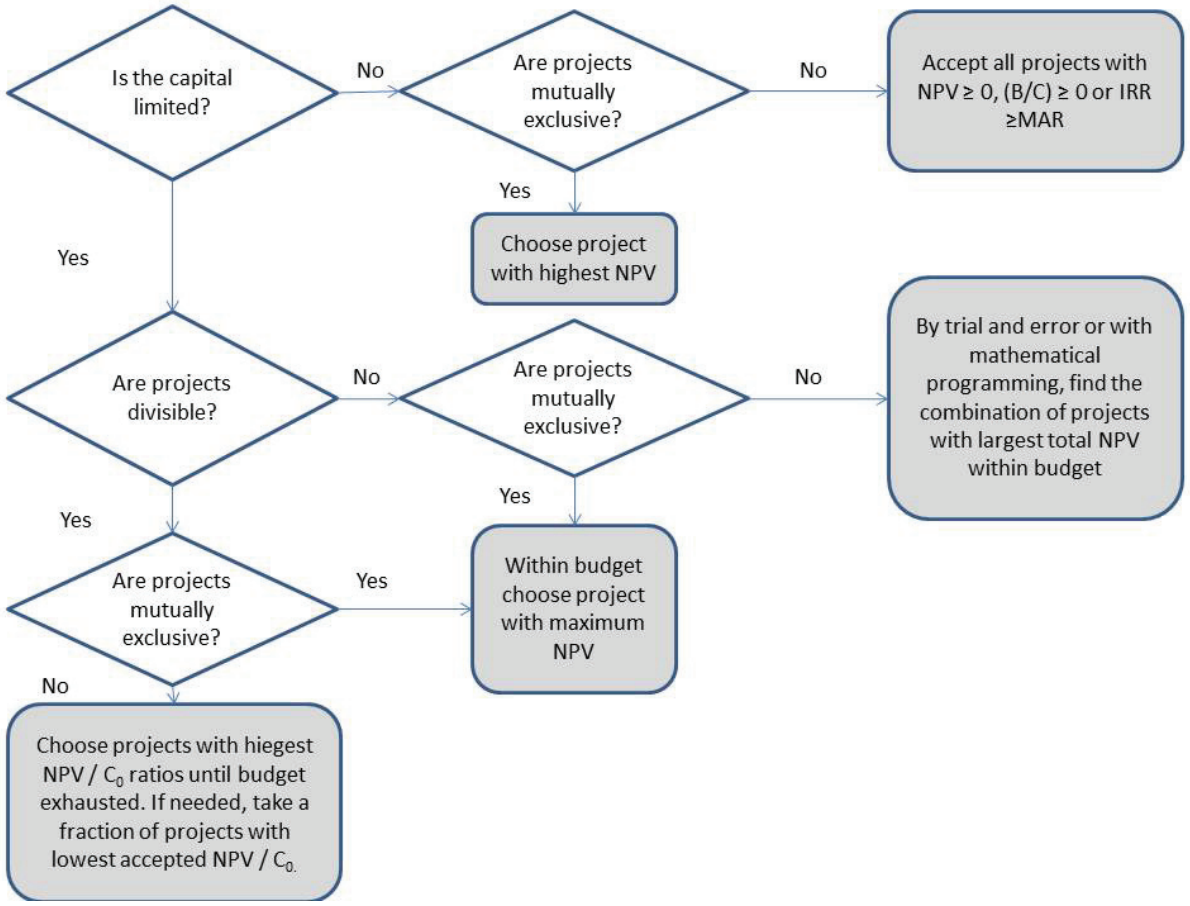

Figure 2. Klemperer's model of the decision making in capital budgeting. Source: (Klemperer 1996)

Klemperer´s model provides guidance on how the KPI´s that may be suitable for the analysis of forestry investments should be ranked. The objective with the model is to help one to determine how the various possible alternatives should be ranked, but it does not by itself propose a ranking. (Klemperer 1996)

Risk

By investing in fixed assets over long-term, the investment exposes the investor to various risks due to both biological and political factors. One way to address this risk issue is to correct the discounting rate by a risk premium in the NPV calculations. (R. Sedjo 1983)

If an investor operates in regions of political instability the political risk one might have to face, could be in cases when a government initially was in favour of foreign investors

suddenly could be replaced with a government that does not share the same positive attitude of the previous government. There could also be a risk with increasing taxes to discriminate foreign capital, the bureaucracy in the countries could be cumbersome and slow, as well as laws and regulations governing investments may be inconsistent or at risk that they will change unpredictably. The risk of political uncertainties are particular of interest to private investors in forestry due to that the minimum rotation cycles, at the best locations are six to seven years and often are several cycles required if the projects should be able to generate a desirable profit. The payback period should especially be considered if the cost of land purchase and land development is included in the calculations, since it increases the economic commitment. In general, private foreign investors tend to require a payback period of 3 to 5 years as a result of the high discount rates which is used in countries with high risk of changes in the political situation. (R. Sedjo 1983)

As in any economic activity, investors in forest plantations are also exposed to the risk of their ability to control the costs, the ability to forecast future earnings, and price fluctuations in a future market. (R. Sedjo 1983)

A background to the Iberian Peninsula

This chapter gives a general background to Spain and Portugal and a background to the forest industry sector on the Iberian Peninsula.

Spain

The kingdom of Spain has 17 autonomous regions (Figure 3) which together include 50 provinces. The population number was in 2011, 46.2 million living on an area of 50.6 million ha. The capital city is Madrid, with 3.3 million inhabitants. Approximately 77 % of the population lives in cities and the largest concentrations of people are at the Mediterranean coast, in Madrid, along the Bay of Biscay and along the Ebro Valley. (NE Spain u.d.)

Figure 3. Map of the autonomous regions in Spain. The Huelva province is located in the West part of Andalusia. Galicia is allocated to the North West part of Spain. Source: (Wikipedia u.d.)

Climate

The Huelva province in the West part of Andalusia has a typical Mediterranean climate with a drought season from April to October. The precipitation is 500 to 600 mm in the coastal region. The risk of frost is quite low in the winter with the coldest time in January.

Galicia has two major climate zones. The region is split in half with an angel of 45° cutting from the South East corner to the North West side. On the North side, the climate is a typical Atlantic Ocean climate with an even distribution of the precipitation and low amplitude in temperature. In the South part of Galicia, the climate is more Mediterranean and the area has a summer drought season.

Portugal

The republic of Portugal spread over 9.2 million ha, including the autonomous regions of Azores and Madeira, together covering 304 700 ha. In the whole of Portugal there was in 2011, 10.7 million inhabitants of which the autonomous regions contributed with 481 000 people. Most of Portugal's population live in the coastal region from Lisbon to the North. Approximately 55 % of the population lives in cities. The largest cities are the capital city Lisbon with 475 000 inhabitants and Porto with 234 000 inhabitants. (Nationalencyklopedin, Portugal u.d.)

Climate

The Azores high pressure gives Portugal a sunny and dry summer. The average temperature in the hottest month of August is 18° C on the coast and 20 to 25° C in the inland. In January, the average temperature is 11° C in the South West and 7° C in the North East. (Nationalencyklopedin, Portugal u.d.)

The precipitation is generally 700 to 1 000 mm per year, with an exception for the West side of the mountains facing the Atlantic where the precipitation is between 2 000 to 2 500 mm per year. In Southern Portugal, which has a pronounced summer drought the precipitation is 300 to 500 mm per year. (Nationalencyklopedin, Portugal u.d.)

The market and customer structure of the forest industry sector on the Iberian Peninsula

The map in Figure 4 shows the pulp mills consuming eucalyptus wood in their manufacturing process on the Iberian Peninsula. In Spain there are large eucalyptus consuming pulp mills in Huelva in Andalusia, in Galicia and in Asturias. In Portugal, the pulp mills are allocated to the central parts of the country and along the Northern Atlantic coast line.

The pulp and paper industry in Spain

In 2010, the production was 1.7 million tonnes of pulp and 5.7 million tonnes of paper and paperboard in Spain. It was produced at 12 pulp mills and 83 paper and paperboard mills. The raw material base of the Spanish paper production is to 80 % recycled fiber. (Aspapel u.d.) In 2010 36 % of the Spanish production of paper took place in the region of Aragon, 19 % occurred in Basque, 15 % in Catalonia, 10 % in Andalusia, and in each region of Galicia, Madrid, Asturias, Castilla Leon and Valencia, 5 % were produced. (Aspapel u.d.)

The pulp and paper industry in Portugal

In 2010 the Portuguese pulp and paper industry produced 1.94 million tonnes of wood pulp (FAO Foreststat Portugal Wood Pulp 2010 u.d.). In 2010 the pulp industry's raw material consumption was 6.4 million m^3 of which 5.3 million m^3, 83 %, consisted of eucalyptus wood. Of the produced paper, 36.5 % where produced with a blend from recycled fibre. The Portuguese forest companies exported 95 % of the pulp production and 82 % of the paper production. (Celpa 2 u.d.)

The Portuguese forest industry sector mainly consists of two groups. The first group is Portucel Soporcel and the second group is Altri. (Celpa PDF u.d.)

Figure 4. The map shows the location of the eucalyptus wood consuming pulp mills on the Iberian Peninsula. (Source: (Aspapel u.d.), (Celpa 2 u.d.)

The major eucalyptus consuming forest industry companies on the Iberian Peninsula

ENCE – Spain

Ence´s production capacity is 1.34 million tonnes of BEKP. Of the production of BEKP, 58 % is exported to the European market. ENCE also produces energy from renewable materials, with an output of 1.7 million MWh. (Ence Group u.d.)

ENCE manages more than 116 000 ha of forestland in Spain, Portugal and Uruguay. In Spain, the group manages 82 000 ha of which 60 % are owned and the rest is leased. ENCE manages 10 500 ha in Galicia and 45 000 ha in Huelva province in the Spanish autonomous region of Andalusia. In the Algarve region of Portugal, ENCE manages approximately 3 000 ha and another 30 000 ha in Uruguay. (Ence Forest u.d.)

The pulp production takes place in three production units in Spain. A common feature for all production units is that they have eucalyptus wood as primary raw material in their production. The annual production consumes 3.7 million m^3 of wood, while only 20 % of the wood consumed has a Spanish origin. Only in Galicia, ENCE consumes 700 000 m^3 of eucalyptus wood per year. (Ence Sales and Market u.d.)

Huelva

In the pulp mill outside the city of Huelva in Andalusia, in the South West of Spain, ENCE produces 410 000 tonnes of BEKP. (Ence Pulp u.d.)

Pontevedra

In the Galician city of Pontevedra, Ence produces 430 000 tonnes of BEKP. (Ence Pulp u.d.)

Navia

Ence´s most northern pulp mill is allocated to Navia in Asturias. The mill produces 500 000 tonnes of eucalyptus pulp for specialty paper, primarily intended for the European market. (Ence Pulp u.d.)

Sniace – Spain

The Sniace Group has a pulp mill in Torrelavega in Cantabria, on the northern coastline of Spain. The annual production of chlorine-free pulp of eucalyptus wood is 66 000 tonnes. The mill also produces 126 000 tonnes of lignin sulphate and 26 000 tonnes of viscose pulp.

Portucel Soporcel – Portugal

The Group produces 1.4 million tonnes of pulp, of which 1.1 million tonnes are used in their own integrated paper production, with an annual production of 1.6 million tonnes of paper. In the process there is also 2.5 TWh of energy produced from renewable materials. (Portucel u.d.)

Portucel Soporcel manages more than 120 000 hectares of forestland in Portugal, of which 73% are planted with eucalyptus. The group are currently investing in Mozambique and are now managing 360 000 ha of land intended for eucalyptus plantations. (Portucel u.d.)

The pulp and paper production is allocated to three different production sites in Portugal. A common feature for all production units is that they have eucalyptus wood as a primary raw material.

Setúbal

The integrated pulp and paper mill has a capacity of 530 000 tonnes pulp which to 40 % supplies their own paper production of 795 00 tonnes (UWF, uncoated wood free paper). With the new production line for paper, opened in 2009, Setúbal increased their production with 500 000 tonnes of paper. The effect of the expansion is that the paper production now consumes all pulp produced on site. (Portucel Mills u.d.)

Figuiera da Foz

The vertically integrated pulp and paper mill has a capacity of 560 000 tonnes of pulp which supplies the paper production of 800 000 tonnes of paper (UWF) to 100 %. All the produced paper is printing and writing paper in A4 and A3 format. (Portucel Mills u.d.)

Cacia

In Cacia, 285 000 tonnes of pulp for various types of specialty papers are produced, such as decorative paper, coated paper and tissue paper. (Portucel Mills u.d.)

Altri - Portugal

The Group has a production capacity of 900 000 tonnes BEKP. They are also producing energy from renewable materials in a 50 % joint venture, with an output of 55 MWh. The future plans are to expand the production to 120 MWh. (Altri n.d.)

Portucel Soporcel manages over 84 000 hectares of forestland in Portugal which supplies their own consumption to approximately 30 %. (Altri About u.d.)

The pulp and paper production is allocated to three different production sites in Portugal. A common feature for all production units is that they have eucalyptus wood as a primary raw material.

Celbi

The mill in Figueria da Foz was acquired from Stora Enso in 2006 and are producing 600 000 tonnes of BEKP. (Altri n.d.)

Celtejo

In 2010, the mill produced 133 000 tonnes of BEKP compared with a capacity of 140 000 tonnes. In 2008, the mill changed their production from unbleached pulp to bleach pulp. (Altri n.d.)

Caima

The Caima mill has a capacity of 150 000 tonnes of market pulp, which to 95 % is produced for the European export market. The mill produces chlorine-free bleached hardwood sulphite pulp. (Altri n.d.)

Financial results of the forest industry on the Iberian Peninsula

Altri had the highest return on equity in 2011. In the last three years it is only Portucel Sopoprcel who has not presented a negative ROE, along with the highest EBIT. (Table 2)

Altri have had the lowest financial solidity, far below the two other groups. (Table 2)

Ranked by sales, Portucel Soporcel is the largest of the three companies, and Altri is the smallest (Table 2). Porucel Soporcel´s sales are higher because they are mainly a paper producer while the other companies mainly produce pulp.

Table 2. Table of the ROE, EBIT, Financial solidity and Sales of Portucel Soporcel, Altri and Ence. Source: (Portucel Soporcel Financial Info u.d.) (Altri Financial info u.d.) (ENCE Financial info u.d.)

		2009	2010	2011
Portucel Soporcel	**ROE**	8.3 %	16.2 %	13.3 %
	EBIT (million EUR)	132.1	277.8	266.2
	Financial solidity	50 %	49 %	52 %
	Sales (million EUR)	1 095.3	1 385.5	1 484.3
Altri	**ROE**	- 18.9 %	53.9 %	16 %
	EBIT (million EUR)	12.6	109.1	60.9
	Financial solidity	5.1 %	9.7 %	12.5 %
	Sales (million EUR)	309.6	494.8	472.3
ENCE	**ROE**	- 13.4 %	8.4 %	5.7 %
	EBIT (million EUR)	- 72.5	117.3	80.1
	Financial solidity	47 %	58 %	53 %
	Sales (million EUR)	535.6	830.8	825.5

Trade flow of industrial round wood - non coniferous, on the Iberian Peninsula

Eucalyptus pulp wood on the Iberian Peninsula is in FAO´s trade flow statistics referred to as industrial round wood, non-coniferous. Please note that the scales are not the same on the graphs.

Spain

Spain's imports of industrial round timber has historically been on an annual level of about 1.5 million m^3, but decreased in 2009 to less than 1 million m^3. Spain's import comes mainly from Portugal and the imports from other countries are only marginal. In the beginning of the 21st century imports from France and Uruguay disappeared, which affected the total volume negatively. The increased import between 2004 and 2008 is mainly an effect of the increment of the import from Portugal with about 200 000 m^3. The declining import between 2008 and 2009 is mainly explained by a drastic reduction of imports from Portugal, by approximately 600 000 m^3. In 2007 the imports from Uruguay and the U.S. recovered and reached in 2009 a volume of about 200 000 m^3 each. (Figure 5)

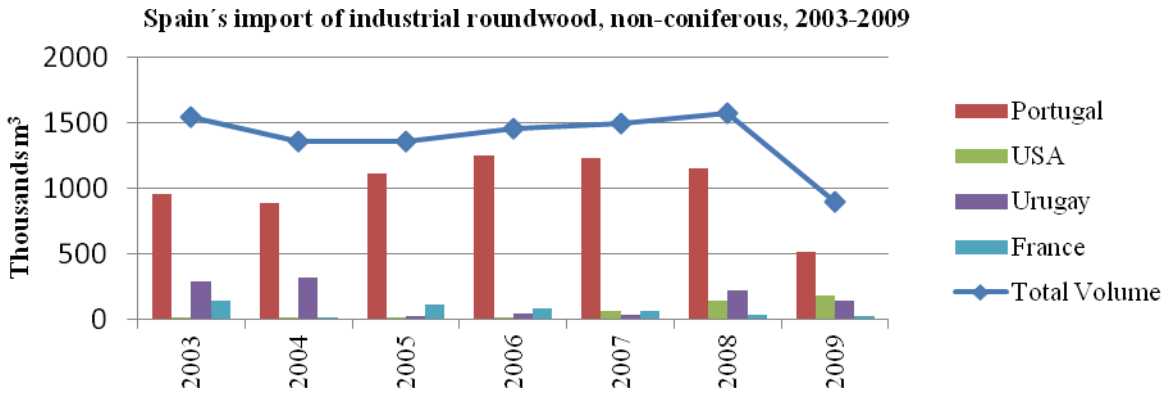

Figure 5. Spain´s import of industrial round wood, 2003-2009, non-coniferous. (Source: FAO Trade flow stat)

The Spanish export of industrial round wood, non-coniferous, significantly increased from 2007 to 2009 with about 500 000 m^3 compared to the period between 2003 and 2006. The increased export is mainly to Portugal but Morocco and Belgium has also started to import Spanish round wood. The export slowdown in 2006 was due to a reduction of the French exports in 2006 and 2007, but has since slowly begun to recover. (Figure 6)

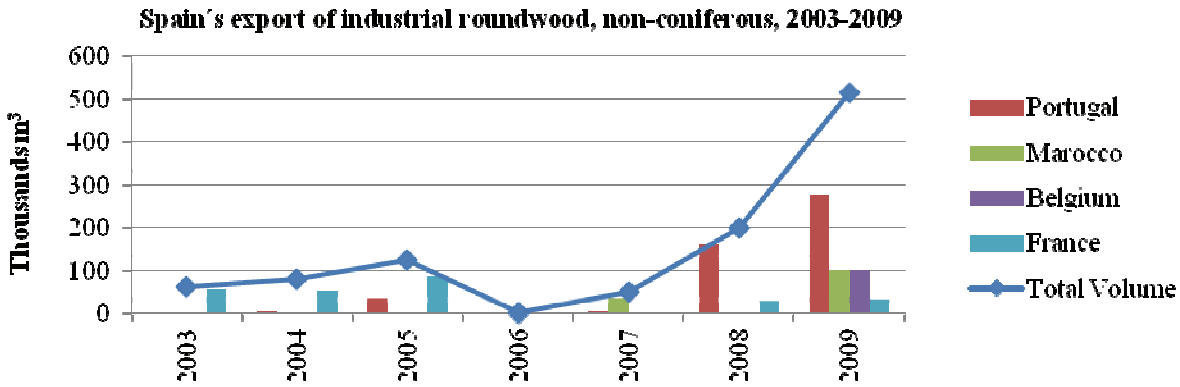

Figure 6. Spain´s export of industrial round wood, 2003-2009, non-coniferous. (Source: FAO Trade flow stat)

Portugal

Portugal's import of industrial round wood, non-coniferous, have four doubled from 100 000 m^3 to about 400 000 m^3 annually since the beginning of the 21st century. In 2006, Portugal's import really took off by a huge expansion of imports from Spain and Uruguay. In recent years the volumes from Uruguay has declined in favour of an increased import from Spain. In 2009 the bulk of Portugal's imports came from Spain. (Figure 7)

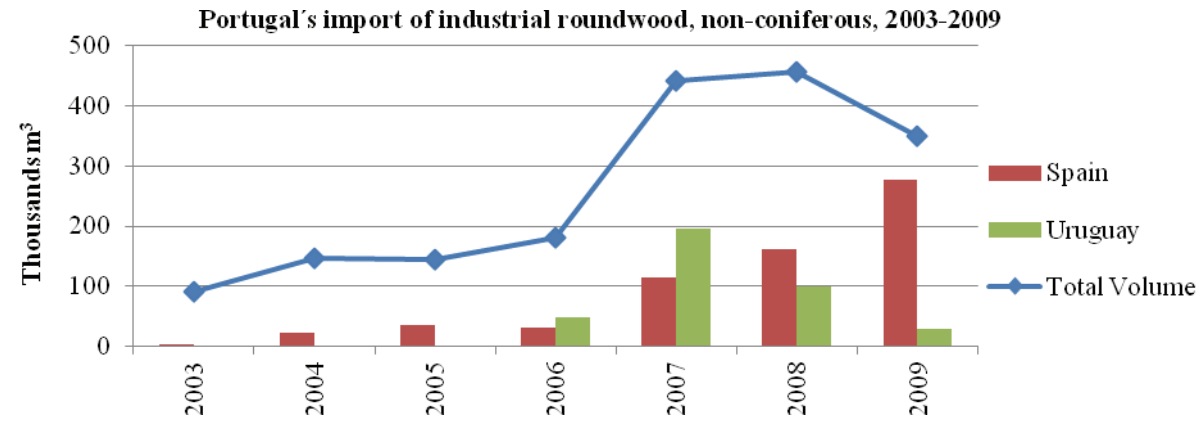

Figure 7. Portugal´s import of industrial round wood, 2003 to 2009, non-coniferous, (Source: FAO Trade flow Stat)

Portugal´s export is mainly for the Spanish market. Between 2008 and 2009, 700 000 m^3 of Portugal's total exports of industrial round wood disappeared as an effect of a reduction of the Spanish export with 600 000 m^3. While the export to Spain fell between 2007 and 2009, Morocco started to import about 100 000 m^3 per year. (Figure 8)

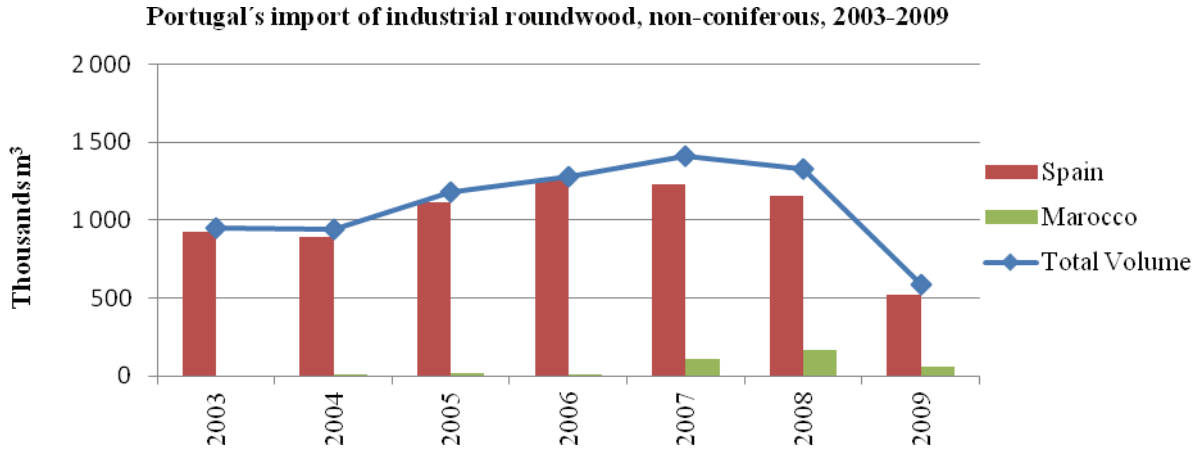

Figure 8. Portugal´s export of industrial round wood, 2003-2009, non-coniferous, (Source: FAO trade flow stat)

Prerequisites for eucalyptus plantations on the Iberian Peninsula

The following chapter presents the prerequisites for eucalyptus plantations on the Iberian Peninsula. The chapter also presents general information about the forest- and eucalyptus plantation resources. A more thorough description of each studied region is attached in Appendix 1. The sources used in this part of the study, is in the first hand primary data from the interviews and field visits and in the second hand secondary data, which is referred in Appendix 1.

Common data of the forest resources on the Iberian Peninsula

Totally on the Iberian Peninsula there are 21.6 million ha of forestland, equivalent to 36.2 % of the total area of 59.8 million ha. The 1.19 million ha planted with eucalyptus is 4.3 % of the forest area and 2 % of the total area. (Table 3)

Spain´s total area and forestland area is more than five times larger than Portugal´s. The forestland area of 18.17 million ha is 35.9 % of the total area of 50.6 million ha. The 540 000 ha planted with eucalyptus is 3 % of the forestland area in the country and 1.1 % of the total area. (Table 3)

Portugal´s total area of 9.24 million ha is to 37.6 % covered with forest. Of the 3.47 million ha of forestland, 647 000 ha is eucalyptus plantations, equal to 18.6 % of the forestland and 7 % of the total area in Portugal. (Table 3)

Table 3. A compilation of the forest resources on the Iberian Peninsula. Source: (Multiple references are found in Appendix 1)

	Iberian Peninsula	**Spain**	**Portugal**
Total area	59.8 million ha	50.60 million ha	9.24 million ha
Total area of forestland[1]	21.6 million ha	18.17 million ha	3.47 million ha
Share of forestland	36.2 %	35.9 %	37.6 %
Area of eucalyptus *spp.* *(in monoculture)*	1.19 million ha	539 937 ha	647 000 ha
Share of eucalyptus area of the total forestland	4.3 %	3.0 %	18.6 %
Share of eucalyptus of the total area	2.0 %	1.1 %	7.0 %

[1] FAO´s definition of forest land.

Forest resources – especially eucalyptus plantations

Huelva

The total forestland area within the region of Andalusia is 2.1 million ha, of which 196 600 ha is planted with eucalyptus. The standing volume of *E. globulus* is 2.39 million m^3 o.b. and 3.08 million m^3 o.b. is *E. camaldulensis*, a total of 5.47 million m^3 o.b.

In the province of Huelva there are 148 800 ha of eucalyptus plantations with a standing volume of totally 3.07 million m^3 o.b., with a breakdown of 2.25 million m^3 o.b. of *E. globoulus* and 0.82 million m^3 o.b. of *E. camaldulensis*. The standing volume of *E. globolus* in Huelva is therefore 94 % of the standing volume of *E. globolus* in Andalusia.

The area planted with eucalyptus has since 2008 decreased with 30 000 ha in Huelva. The on-going land transformation is mainly from eucalyptus plantation to plantations with olives, oranges or strawberries, caused by the infrastructure for irrigation, which is being built, to overcome the dry climate and summer drought. ENCE reforests about 3 000 ha with eucalyptus annually in the region.

Galicia

There is about 2 million ha of forestland in Galicia, of which 450 000 ha is eucalyptus plantations. The eucalyptus plantations are mostly found along the coastline, and the best MAI on the Iberian Peninsula is found along the northern coastline of Galicia where as much as 70% of the eucalyptus wood produced in Galicia is produced. The eucalyptus plantations along the western coastline have a Mediterranean climate with summer draught, affecting the MAI negatively.

Portugal

The eucalyptus plantations are mostly found in the central part of the country, along the Tagus River, and along the coast line north of Lisbon. Some eucalyptus plantations can also be found in the South West of Portugal, in Algarve. In spite that Portugal has some eucalyptus plantations in Algarve they were chosen to be neglected from this thesis, due to higher silviculture cost and long transportation distances to the pulp mills.

Risks

The young eucalyptus plants are easily damage by frost bites. This limits the extension of eucalyptus, since the planting season is in the winter to avoid planting in the summer drought season. Plants in lowlands and on high altitude are particular vulnerable due to a more severe micro climate.

The climate also affects the development and survivability of pathogenic agents, furthermore as severe climate conditions stresses the trees and makes them more vulnerable. A pest taking advantage of drought stressed trees is the *phoracantha* which is a problem in all areas with a draught season. The *phoracantha* attacks bark with low moisture content, and can kill the trees if the attack is large. In genetically improved clones and seedling of eucalyptus, the moisture content in the bark during the drought season is higher, making the trees more resistant. Another pest attacking *eucalyptus globolus,* in especially Portugal is the snout beetle, *Gonipterus*, who defoiliates the trees. Plantations on higher altitude then 500 m.a.s.l. are more attacked by the *Gonipterus* than plantations on lower altitudes. The combat the problem, *eucalyptus nitens* can be planted instead on the higher altitudes.

The summer draught increases the risk of forest fires. In all studied regions on the Iberian Peninsula, except in the northern part of Galicia, large effort have to be put in during the fire season, stretching from April to October. To reduce the risk of the fire spreading, it is important to reduce the amount of residuals on the ground and to create firebreak corridors. Putting out the fires early stop them from spreading, which make the monitoring in the field important.

Ownership structure of eucalyptus plantation

Huelva

The typical forest property is 70 to 100 ha in size in Huelva and properties of a couple of thousands of hectares do exist. Therefore it is the region with the largest average size on the Iberian Peninsula of the studies regions.

Galicia

Of the total forestland area of 2 million ha in Galicia, 98 % is privately owned, with a breakdown of 650 000 ha of common land, and 1 400 000 ha owned by private persons. Of the forestland owned by private persons, 300 000 ha is planted with eucalyptus and owned by 90 000 forest owners.

A typical forest property in Galicia is one to three ha, with an average of 1.5 ha. In the North part of Galicia the forest properties tend to be larger than in the South West of the province.

Portugal

The proportion of eucalyptus plantations owned by the pulp and paper companies in Portugal is 27 % versus the individual private forest owners who own 73 % of the plantations.

The typical property size is smaller in areas with better growth than in areas with less good conditions. In the North of Portugal, along the coast with the best MAI, the property sizes are as small as in Galicia. The forest properties become larger the further they are to the inland and the further they are to the South of the country.

Totally in Portugal, the average property size of mixed agriculture land and forest land is 7 ha. Nevertheless, most forest owners own properties in a range of 0 to 5 ha, while most forestland belong to properties larger than 100 ha.

Institutional framework – legislation and regulatory agencies

All companies using eucalyptus wood are certified by either PEFC or FSC, or both. To be able to deliver wood to the mills, the requirements for the certification schemes most be fulfilled. Those requirements are more of a constraint than the national legislation, regulating the eucalyptus plantations.

FSC in Portugal do not have the same requirements as in FSC Spain. The Spanish FSC certification is “tougher” than the Portuguese.

There is no law preventing companies from purchasing or owning forestland in either of the two regions in Spain or in Portugal. But in the other hand the area with eucalyptus is limited on a local level, municipal or regional.

Huelva and Galicia

In Spain, a national framework lays the basis for the individual forest laws in each autonomous region.

In Huelva, a project plan is required to be made and approved by the authorities before a new plantation project is started. In Galicia, the project plan is not mandatory yet, but the development in the legislations regarding forestry is soon to be altered. Resulting in that the same project plan that is required to be made if one wants to certify the forestland, shall be required if one wants to establish a new plantation of eucalyptus.

In areas with steep terrain terraces reduces to loss of surface water and makes it possible to mechanize much of the silviculture and harvesting operations. According to the forest law in both Huelva and Galicia, new terraces are not allowed to be built, it is only permitted to restore old terraces.

Eucalyptus is only allowed to be planted on land historically planted with eucalyptus, or in some cases on land previously planted with pine. The main attitude from the government is that the area with eucalyptus shall not increase.

Portugal

Portugal has a national forest policy and there are no regional differences of the laws regulating eucalyptus forestry within the country.

In Portugal, a project plan for the eucalyptus plantations project has to be approved by the authorities. The national "forest service" has an office turnaround time of 30 work days, for approving such project plans. It is possible to hand in an application before a property transaction, if a potential buyer wants to be sure that a project gets approved.

The maximum area of eucalyptus is locally regulated. In general, permission is therefore only given for new eucalyptus plantations on land previously planted with eucalyptus or land with maritime pine attacked by the pine wood nematode.

Taxes and subsidies

There are no special taxes on eucalyptus plantations in any of the studied regions on the Iberian Peninsula. Companies in the eucalyptus plantation business are taxed as any other company. Nor are there any subsidies for establishing eucalyptus plantations. (Appendix 1)

Structure of silviculture and harvesting resources

In both Spain and Portugal, the larger forest industry companies have outsourced most silviculture, harvesting and road transportation operations to mainly small sized contractors.

Huelva and Galicia

The contractors involved in silviculture operations do usually take care of one operation each, e.g. plantation or soil preparations and they are small.

The harvesting contractors are usually equipped with one to four machineries and have resources for both harvesting and forwarding. In some cases the contractors also have resources for road transportation of wood to the mill.

Portugal

The largest contractors involved in silviculture operations are the ones performing the soil preparation. They can in some case have up to 20 machineries dedicated to soil preparation.

The contractors performing the plantation and pre-commercial thinnings are small and usually take care of one type of operation. Nevertheless, there are contractors who take care of all silviculture operations.

The harvesting contractors usually have a few pieces of machinery, taking care of both harvesting and forwarding. Most contractors do also have resources for road transportation of the wood.

Input data

This chapter presents the input variables used in the calculations. The costs and prices are all in EUR per ha or in EUR per m^3 u.b. The silviculture costs are presented as a present value, along with the in the field observed costs drivers.

General inputs

In Table 4, the input variables used in the profitability and competitiveness analysis are presented. Brazil distinguishes itself with a MAI far greater than in Spain and Portugal, and with a shorter rotation cycle. The wood price in Brazil is less than half of the wood price on the Iberian Peninsula, while Brazil´s harvesting, forwarding and road transportation costs are close to half of the Iberian equivalence. The highest wood price, at road side, under bark, is found in Huelva, while Portugal has the lowest wood price. (Table 4)

The estimated land price on the Iberian Peninsula is very uncertain, which is why the more accurate cost for land leasing has been used in the analysis instead. The most accurate data of land costs in Brazil are the cost of land purchase, and therefore the land price has been used in this study's analysis. The land was sold at exit in the last period in the Brazilian example, and reduced that period´s costs. The land price on the Iberian Peninsula is only an assumption of various observations on site and should not be considered as the prevailing price of forest land. (Table 4)

The harvesting and forwarding costs are lowest in Portugal and highest in Huelva on the Iberian Peninsula. The harvesting costs in Portugal are somewhat a bit lower in the first rotation than in the second, due that the second rotation is grown from sprouts resulting in more dense stands. (Table 4)

Table 4. Table over input variables used in the calculations. The currency is EUR. Source: Interviews

	MAI (m^3 ha^{-1} $year^{-1}$)	Rotation cycle (years)	Wood price, (m^3 at roadside, u.b.)	Harvesting and forwarding costs (m^3)	Road transportation cost (m^3)	Land price (ha^{-1})	Land lease cost (ha^{-1} $year^{-1}$)
Huelva	10	12	52	16	8.5	3500	60
Galicia	15	10	50	14	8	3500	80
Portugal	13	11	43	9.5 / 12.5	7	3500	70
Brazil	42	7	24	6.5	3.6	2820	n/a

Silviculture costs

The silviculture costs vary between the different studied regions due to different reasons. In Table 5 the present value of all silviculture costs for the studied regions are presented. Huelva is the less expensive region to grow eucalyptus in, and Galicia is the most expensive, While Brazil is just slightly more expensive than Portugal.

Table 5. Table over the present value of all silviculture costs for each of the four studied regions. Rate 6.5 %.

	Present value of silviculture costs (EUR)
Huelva	1 778
Galicia	2 987
Portugal	2 001
Brazil	2 153

In the following text the cost drivers, observed in field visits are described, for each of the regions on the Iberian Peninsula.

Huelva

The Huelva region has the lowest silviculture cost of the regions on the Iberian Peninsula. It is partly due to a relative flat landscape, except for the North part of Huelva, and that the size of the typical forest property is the largest of the studied regions on the Iberian Peninsula.

Galicia

Galicia has the highest silviculture costs on the Iberian Peninsula. This is partly due to the smaller property sizes and steep terrain.

Portugal

Portugal has less steep terrain than Galicia, but more difficult terrain than in Huelva. The silviculture costs are higher than in Huelva, partly due to the higher growth, which makes the weed control more important, and fertilization more profitable, which increases the costs and the growth at the same time.

Brazil

In spite of lower labour costs in Brazil, the silviculture costs are relatively high due to an intense management regime, with more pest and weed control along with a more intense fertilization.

Competitiveness and Profitability Analysis

This chapter presents the profitability and competitiveness analysis for a typical hectare of eucalyptus plantation in three regions on the Iberian Peninsula and in Brazil. The profitability analysis is made at road side in the forest and the competitiveness analysis is made for all costs at mill gate. The land is leased on the Iberian Peninsula and purchased in Brazil. In Brazil, the land is sold at exit.

Profitability analysis

The best profitability on the Iberian Peninsula is achieved in Portugal with an IRR of 8 % and a NPV of 449 €/ha. The B:C ratio is 1.12 which gives a profit of 12 € per 100 € invested. The payback period is 11 year, equivalent to the length of the first rotation cycle. (Table 6)

The lowest profitability in all four regions is achieved in Galicia with an IRR of 7 %, and a NPV of 157 €/h, a B:C ratio of 1.05 but with a payback period of 10 years. (Table 6)

If the four regions is to be ranked depending on profitability, the result is different depending on if the ranking would have been in NPV, IRR or the B:C ratio.

If the NPV and IRR is considered, Portugal is the most profitable region with an NPV of 449 EUR per ha and an IRR of 8 %. Huelva has just slightly higher IRR than Brazil´s 7.3 %, even thou the NPV is 159 € lower. Portugal have the highest B:C ratio while Galicia and Brazil have the lowest.

If the regions would have been ranked regarding the payback period, Galicia would have been the most desirable option, while Brazil is the only region which requires two rotations cycles to be profitable.

Table 6. Profitability per hectare, at road side, with a discounting rate of 6.5 %.

	Profitability per hectare, at road side [(2)]			
	NPV (EUR)	**IRR**	**B:C Ratio**	**Payback** (years)
Huelva	290	7.6 %	1.08	12
Galicia	157	7.0 %	1.05	10
Portugal	449	8.0 %	1.12	11
Brazil	354	7.3 %	1.05	14

Cash flow analysis

The accumulated cash flow in Figure 9 shows that Galicia is the region with the earliest positive cash flow. Brazil is the only region where the cash flow is still negative after the first rotation cycle.

[2] *Land cost* + *Silviculture costs* + *harvesting costs* + leasing cost or purchase price

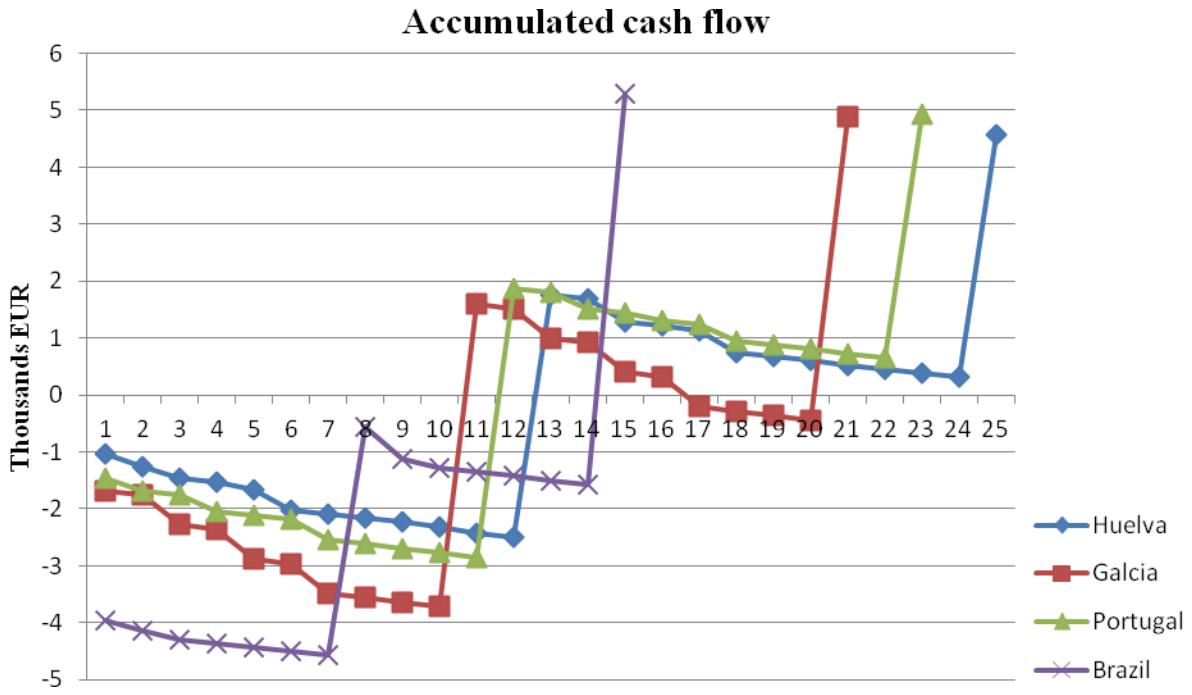

Figure 9. The graph presents the accumulated cash flow in all four regions.

Competitiveness analysis

The analysis was made as a present value of all costs for one hectare (PV costs) at mill gate and wood cost at mill gate measured in EUR per m^3 and per tonne of pulp.

The present value of all costs, PV costs (Table 7), is lowest in Huelva followed by Portugal. Brazil is the most expensive region to invest in. If the cost of 2 820 €/ha for purchasing land is reduced, the PV costs in Brazil is 3 833 €/ha, making Brazil cheapest region. The cheapest region to invest in is Huelva, more than 2 100 € less than Galicia, closely follow by Portugal, and more than 2 200 € than in Brazil. A graph of the annual cash flows for each of the four regions is attached in Appendix 3.

The wood cost per m^3 of wood is lowest in Brazil and highest in Huelva. Due to that the consumption of wood for a tonne of pulp is less on the Iberian Peninsula than in Brazil the wood cost differs less if measured per tonne of pulp instead of per m^3 of wood. The consumption of wood for a tonne of pulp is 2.8 m^3 for *eucalyptus globolus* grown on the Iberian Peninsula, and 3.5 m^3 of wood per tonne of pulp for *eucalyptus grandis* grown in Brazil.

The wood cost per m^3 of wood and per tonne of pulp do not differ much between Huelva and Galicia, only 0.7 EUR per m^3 of wood, in spite that the present value of all costs is 2 158 €/ha higher in Galicia than in Huelva. The higher MAI in Galicia compensates for the higher costs. (Table 7)

Brazil is the most favourable region to establish a eucalyptus plantation in, if the wood cost per m^3 of wood is considered. The wood cost per m^3 of wood is significantly lower in Brazil than on the Iberian Peninsula. Due to the differences in wood consumption for a tonne of pulp, the competitive strength the Brazilian plantation possess, is less if the wood cost is compared for a tonne of pulp instead of a m^3 of wood. Measured per m^3 of wood, the wood cost is 88 %

higher in Portugal then in Brazil, but measured per tonne of pulp the wood cost is 50 % higher. The wood cost in Huelva is 97.5 % higher than in Brazil and 95 % higher than in Galicia. (Table 7)

The wood cost per tonne of pulp is 40 € per tonne of pulp more expensive in Portugal than in Brazil. The wood cost per tonne of pulp in Huelva and Galicia is 78 € versus 76 € higher than in Brazil and 38 € versus 36 € higher than in Portugal. (Table 7)

Table 7. Present value of all costs at mill gate, (PV costs) and wood cost (EUR) per m^3 and per tonne of pulp. Rate 6.5 %

	Wood cost at mill gate		
	PV Costs (EUR)[3]	**EUR/m3**	**EUR/tonne of pulp**
Huelva	4 377	56.3	158
Galicia	6 535	55.6	156
Portugal	4 589	42.8	120
Brazil	6 653	22.8	80

[3] *Land cost + Silviculture costs + harvesting costs + road transportation to the mill*

Sensitivity Analysis

This chapter presents a sensitivity analysis made on factors that vary most within the studied regions. The objective with the sensitivity analysis is to make the calculation more applicable in various cases and to identify which factors the results is most sensitive for. In the analysis, the wood price, MAI and the discounting rate was altered.

In the sensitivity analysis, the factors most likely to impact the profitability and competitiveness have been altered.

The cost for establishing a hectare of eucalyptus plantation or harvesting and transporting the wood to the mill has regional differences, but locally it is not likely that such cost vary much. It is instead the wood price and MAI which is more interesting to alter when analysing the profitability. (Table 9)

The interest rate the series of cash flows is discounted with strongly influence the NPV and wood cost, which is why a sensitivity of the discounting rate have been made. It is also interesting to investigate how the rate affects the profitability, since it is in some cases can be used to compensate for various risks, as mention in the calculation methodology chapter. (Table 10)

The wood cost is the present value of all cost at mill gate is divided with the present value of the harvested volume. A higher harvested volume decreases the wood cost per m^3 of wood and per tonne of pulp. (Table 11)

Since most new eucalyptus plantations are being established on leased land, a sensitivity analysis of the profitability of buying land versus leasing land is interesting. (Table 12)

A change in the Wood price or MAI

Since a percentage change in the wood price or MAI affects the sales as much, Table 9 presents how the NPV or IRR is affected by a change in either MAI or in the wood price. The wood price and MAI in the base case are presented in Table 8. The NPV and IRR in the base case with a rate of 6.5 % are shown as a 0 % change in Table 9.

$$Sales = MAI \times Wood\ price$$

Table 8. The wood prices and MAI in the base case

	Wood price[4] EUR/m^3	**MAI**
Huelva	52	10
Galicia	50	15
Portugal	43	13
Brazil	24	42

Only Portugal is able to buffer against a negative change in the MAI or the wood price if the profitability is measured in NPV. All the four regions are more sensitive against negative

[4] wood price at roadside under bark.

changes than positive changes. With an increasing wood price or MAI, the difference between the regions decreases. With an extreme positive change in the wood price or MAI the NPV is significant higher in Brazil than on the Iberian Peninsula, despite that the IRR do not differ as greatly. (Table 9)

The IRR is ≥ 10 % with a +20 % change in all four regions equivalent to a MAI of 12 m^3 in Huelva, 18 m^3 in Galicia, 15.6 m^3 in Portugal and 50.4 m^3 in Brazil. (Table 9)

Table 9. Table of a change in MAI or Wood price from -50 % to +100 %. The NPV is in EUR at rate of 6.5%

Analysis of a change in the wood price or MAI								
	Huelva		Galicia		Portugal		Brazil	
Change	**NPV**	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**
-50 %	-1 732	-5.7 %	-2 625	-7.5 %	-1 717	-3.9 %	-3 149	-3.4%
-40 %	-1 328	-1.1 %	-2 050	-2.6 %	-1 284	0.1 %	-2 449	-0.6%
-30 %	-923	1.9 %	-1 475	0.8 %	-850	2.8 %	-1 748	1.7%
-20 %	-519	4.2 %	-900	3.3 %	-417	4.8 %	-1 047	3.8%
-10 %	-114	6.0 %	-325	5.5 %	16	6.6 %	-346	5.7%
0 %	**290**	**7.6 %**	**250**	**7.2 %**	**449**	**8.0 %**	**354**	**7.3%**
10 %	695	8.9 %	825	8.8 %	883	9.3 %	1 055	8.8%
20 %	1 099	10.1 %	1 400	10.2 %	1 316	10.5 %	1 756	10.3%
30 %	1 504	11.2 %	1 976	11.5 %	1 749	11.5 %	2 456	11.6%
40 %	1 908	12.2 %	2 551	12.6 %	2 182	12.4 %	3 157	12.8%
50 %	2 312	13.1 %	3 126	13.6 %	2 616	13.3 %	3 858	13.9%
70 %	2 717	13.9 %	3 701	14.6 %	3 049	14.1 %	4 558	15.0%
80 %	3 121	14.7 %	4 276	15.5 %	3 482	14.9 %	5 259	16.0%
90 %	3 526	15.4 %	4 851	16.4 %	3 916	15.6 %	5 960	17.0%
100 %	3 930	16.1 %	5 426	17.2 %	4 349	16.3 %	6 661	17.9%

NPV and wood cost, with a discounting rate of 4 % to 12 %

Plantations in Huelva, Galicia and Brazil have a positive NPV with a discounting rate ≤ 7 %, while the NPV is able to be positive in Portugal when the discounting rate is ≤ 8 %. (Table 10) None of the regions on the Iberian Peninsula is able to compete with the wood cost at mill gate in the Brazilian base case, even per tonne of pulp with a discounting rate ≥ 4 %. Neither are the two Spanish regions able to produce wood as cheap as Portugal, even when the discounting rate drops to 4 %. With a discounting rate of 12 % the wood cost differs 60 € per tonne of pulp between Huelva and Portugal, 101 € per tonne of pulp between Huelva and Brazil but only 51 € per tonne of pulp between Portugal and Brazil. (Table 10)

Table 10. Table of a sensitivity analysis of the NPV (EUR) and wood cost (EUR) at mill gate per m^3 of wood and per tonne of pulp, with a discounting rate of 4 % to 12 %

Rate		4 %	5 %	6 %	7 %	8 %	9 %	10 %	11 %	12 %
Huelva	**NPV**	1 272	815	447	149	-92	-287	-447	-576	-682
Wood cost	**EUR/m3**	49	52	55	58	61	65	70	75	80
Wood cost	**EUR/tonne**	138	145	153	162	172	183	195	209	223
Galicia	**NPV**	1 395	872	438	79	-219	-467	-673	-845	-989
Wood cost	**EUR/m3**	50	52	54	57	60	63	66	70	74
Wood cost	**EUR/tonne**	139	145	152	159	167	176	186	196	208
Portugal	**NPV**	1 541	1 040	628	287	6	-228	-422	-583	-718
Wood cost	**EUR/m3**	38	40	42	44	46	49	52	55	58
Wood cost	**EUR/tonne**	106	111	117	123	129	137	145	153	163
Brazil	**NPV**	1 725	1 117	590	134	-261	-605	-904	-1 163	-1 389
Wood cost	**EUR/m3**	19	21	22	24	25	27	28	30	32
Wood cost	**EUR/tonne**	68	73	77	82	88	93	99	106	111

Wood cost with an improving MAI

The MAI has to improve with > 100 % in Huelva and Galicia and ≥ 60 % in Portugal, if the wood cost per tonne of pulp should be or equal or less than the Brazilian base case. Such an improvement is equal to a MAI of more than 20 m^3 in Huelva, 30 m^3 in Galicia and 20.8 m^3 in Portugal.

If the MAI improves by 30 % in Huelva and Galicia, the wood cost decreases to a range making the regions more competitive against Portugal.

Table 11. Sensitivity analysis of how the wood cost (EUR) per m^3 of wood and per tonne of pulp changes with an improvement of the MAI from 0 % to + 100 %. The MAI in the base case is presented in Table 8

	Wood cost with improving MAI							
	Huelva		**Galicia**		**Portugal**		**Brazil**	
	EUR/ m3	**EUR/tonne of pulp**	**EUR/ m3**	**EUR/tonne of pulp**	**EUR/ m3**	**EUR/tonne of pulp**	**EUR/ m3**	**EUR/tonne of pulp**
0 %	56	158	56	156	43	120	23	80
10 %	51	143	52	145	41	116	21	73
20 %	47	131	47	133	38	106	19	66
30 %	43	121	44	122	35	98	18	61
40 %	40	113	41	114	33	91	16	57
50 %	38	105	38	106	30	85	15	53
60 %	35	98	36	99	28	80	14	50
70 %	33	93	33	94	27	75	13	47
80 %	31	88	32	88	25	71	13	44
90 %	30	83	30	84	24	67	12	42
100 %	28	79	28	80	23	64	11	40

Land lease vs. land acquisition with an appreciation of 0 % to 6.5 %

Since the base case, is made on the assumption that land is being leased on the Iberian Peninsula while purchased in Brazil, a sensitivity analysis of land purchased in all four region, with variable appreciation is presented in Table 12. In the base case for Brazil and in this analysis the land is being sold in the end of the last period, reducing the costs.

The profitability, measured in IRR, exceed the base case with land leased in Galicia if the annual appreciation is > 5 %. If the profitability in measured in NPV the base case is exceeded in Huelva with an appreciation of ≥ 5 % and ≥ 6 % in Portugal. (Table 12)

The sensitivity analysis concludes that an alternative where the land is purchased instead of being leased is less profitable, considering an annual appreciation of < 5 %. (Table 12)

The profitability in Brazil is strengthened by the appreciation of land, since the base case does not consider any appreciation at all. An appreciation of 6.5 %, which is equal to the discounting rate, allows the IRR to exceed 10 %. (Table 12) Such an appreciation makes the cost of purchasing land equal to the future income of the land being sold in the end of the analysis period.

Table 12. Table of the NPV (EUR) and IRR if land is purchased instead of being leased on the Iberian Peninsula. The table below shows the base case where land is leased on the Iberian Peninsula and purchased in Brazil

	Land acquisition - with appreciation							
	Huelva		**Galicia**		**Portugal**		**Brazil**	
real increment, (annually)	**NPV**	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**
0 %	-1 539	4.2 %	-1 200	4.8 %	-1 191	4.7 %	354	7.3%
1 %	-1 344	4.6 %	-995	5.1 %	-990	5.1 %	518	7.7%
2 %	-1 098	5.0 %	-747	5.5 %	-742	5.5 %	705	8.1%
3 %	-791	5.5 %	-449	5.9 %	-437	5.9 %	916	8.5%
4 %	-406	6.0 %	-90	6.4 %	-64	6.4 %	1 156	8.9%
5 %	74	6.6 %	342	6.9 %	392	7.0 %	1 429	9.4%
6 %	671	7.2 %	858	7.4 %	950	7.5 %	1 737	9.9%
6,5 %	1 022	7.5 %	1 153	7.7 %	1 273	7.8 %	1 906	10.1%

	Huelva		**Galicia**		**Portugal**		**Brazil**	
	NPV	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**	**NPV**	**IRR**
Base case with leased land on the Iberian Peninsula	290	7.6 %	250	7.2 %	449	8.0 %	354	7.3 %

Discussion

This chapter presents a discussion of how the methodology and theoretical background affects the results, as well as the results itself and the implications from the sensitivity analyses are also discussed.

Method, Theory, Literature, Data

The first questions that came up in the beginning of the process were: how are studies like this conducted? How are problems of this kind approached? when one is trying to describe the prerequisites for eucalyptus plantations on the Iberian Peninsula, their profitability and competitiveness versus Brazilian plantations? Using a survey methodology was the answer to these questions, since it allows the researcher to use various sources with an objective to give a broad coverage of the issue. The survey methodology as a research strategy was therefore well suited for this study.

An effect of using a survey methodology is that a large amount of data is collected which in some cases creates a problem of validating the data when inconsistencies occur. To be able to find out what data that reflects the reality, a methodology of triangulating the data sources were applied. The same questions were asked to several respondents, and in some cases the respondents were asked to comment on the previously collected data to raise the level of validity.

The most detailed available official data was of Galicia followed by Portugal. Those regions are the ones with the highest MAI on the Iberian Peninsula, and therefore larger resources are being spent on creating good and valid information. A difficult part in this study has been getting a breakdown of the area with eucalyptus plantations in Huelva.

From a perspective of a Swedish forestry student it was easier to study the prerequisites on the Iberian Peninsula than in Brazil, due to the closer distance and the more open wood market. Having visited Brazilian eucalyptus plantations in the summer of 2011 helped in the interpretation of the collected data about the Brazilian plantations. The processes of collecting data for a study like this require a good and personal contact with key respondents in each region. Without such contacts, this study would have been impossible to complete within the given time frame. The information collected during the field trip has been pricelessly valuable in this study, and the simple fact of being a forestry student also helped in this process since people have been really helpful.

The process of firstly dividing the study into one descriptive part and one quantitative part considering the profitability and competitiveness helped in creating a functional structure for the continuing process. Especially when no studies of the profitability of eucalyptus plantations on the Iberian Peninsula have been published previously. Therefore it was also important to use a sound and proven theoretical framework for analysing the economic aspects of the thesis. The process started with a broad and thorough study of secondary data sources, which identified the most interesting areas for eucalyptus plantations on the Iberian Peninsula. Through comparing officially published statistical data of forest resources with information published by forest industry organizations, and the different companies acting on the Iberian market, Galicia and Huelva in Spain and Portugal as one area were identified as possible regions for this study.

Regions close to Galicia such as Asturias and Cantabria along Spain´s northern coast line have been left out in this study since the largest activity in the forest sector in northern Spain is in Galicia. The prerequisites are not bad in those regions with standing volumes of eucalyptus of 5.8 million m^3 in Cantabria and 1.3 million m^3 in Asturias.

The first more descriptive part of the process aimed to find possible locations for eucalyptus plantations. The focus of this thesis has been to find obstacles and limitations to plantation forestry with eucalyptus.

In previous studies of the profitability in eucalyptus plantations, the cost for land purchase has not been included. Those studies have analysed the profitability of different types of land usages, for an existing land owner. This study has in the other hand, had a perspective of a potential forest land owner, and presents the profitability an investor could expect in Spain, Portugal or in Brazil. It is why the land costs were chosen to be included since it is an inevitable cost for a new actor in a market.

The discount rate of 6.5 % used in this thesis is low when compared to other studies on the issue. As Cubbage presented in his article from 2010, the political risk is substantially lower on the Iberian Peninsula than in Brazil. Therefore a lower discount rate was chosen for this thesis.

The overall perspective of this thesis has been a perspective of financial investor. Klemperer´s model can therefore be used as a tool to determine what KPI to use while ranking the different options, regardless of the individual goal of an investor. The model was brought in to the theory chapter to make the results more applicable to various scenarios and perspectives.

As land cost on the Iberian Peninsula, the cost for leasing land was used in the calculations, due to that most new plantations nowadays is on leased land. The most reliable data for land costs was for land acquisition in Brazil. In the Brazilian benchmark example, the land was sold in the end of the second rotation cycle, with no appreciation of the land in the base case. To speculate in land appreciation in Brazil, did not fit the objective of this thesis and neither where any reliable data for such an assumption acquired. The conclusion from the sensitivity analysis chapter is that the effect is small in the range of an appreciation of 0 % to 5 %. An appreciation equal to the discounting rate would make the impact of land acquisition irrelevant. As shown in the sensitivity analysis of land appreciation, the effect on the IRR and NPV for the Brazilian hectare with an appreciation of 6.5 % would be + 2.4 % to 10.1 % for the IRR, and + 1 552 EUR to 1 906 EUR for the NPV. As in Cubbage´s study from 2007 the IRR calculated in this thesis was < 10 % if the cost for purchasing land was included in contrary it was not > 20 % if the land cost was not included. Still an appreciation equal to the discounting rate had a huge effect on the NPV in all four regions, especially in Brazil.

When making calculations of eucalyptus plantations a problem with over and under bark volumes easily occur. The percentage of the bark is around 15 % of the wood volume. To determine the actual share of bark is difficult without further research. It is therefore crucial to be fully aware what unit the prices and costs are measured, if the accuracy of the calculation shall be sufficient.

Results

Eucalyptus requires a humid climate without frost. Despite this, *eucalyptus globulus* grows in areas with summer drought and frost in the winter on the Iberian Peninsula. The areas with the

highest potential for eucalyptus growth on the Iberian Peninsula are the province of Galicia, especially the North part and the North part of Portugal. Nevertheless, eucalyptus plantations with good profitability are also found in the South of Spain, in the Huelva province, where the climate is dry and in the central part of Portugal.

The best profitability on the Iberian Peninsula is achieved in Portugal, despite that the region has the lowest wood price. Portugal is also identified as the region with the highest competitive strength with almost as low wood cost for a tonne of pulp as in Brazil.

The profitability measured in NPV, IRR and B:C ratio is the lowest in Galicia of the studied regions, despite the fact that the region has the highest MAI and highest potential for a higher MAI. The likelihood for a positive change in MAI locally, is the greatest in Galicia and Northern Portugal. It is interesting to analyses where the highest potential is, since the calculations in the base case are made for a typical hectare of eucalyptus. It is not unlikely with plantation with a MAI of 20 m^3 in Galicia, equivalent to a +30 % change in MAI, resulting in a NPV of 1 976 € instead of 250 €, and an IRR of 11.5 % instead of 7.2 %. In such case, Galicia is the most profitably region in this study.

The largest areas with eucalyptus are found in Portugal and Galicia. A problem for the forest industry companies in the region is the low self-sufficient rate in the mills. It is partly a reflection of the difficulties of purchasing land, due to the small sizes of properties and strong desire to own land by private persons. It shall also be mentioned that the wood prices and the total consumption of wood were lower when current forest industry companies established there businesses, making it less interesting to own land.

The research of the institutional framework and legislating was limited to only check if there were any laws against eucalyptus plantations or laws preventing companies from purchasing or owning forest properties. This research reviled that there are no laws towards companies buying or leasing land in any of the studied regions on the Iberian Peninsula. Nevertheless, the area with eucalyptus plantations is regulated, with a goal to limit the extent of eucalyptus plantations locally. Common for all three actors is that they are FSC and/or PEFC certified. The certifications schemes are more restrictive than the national forest laws. For a new wood supplier it is advantageous to follow the certification schemes while negotiating about a wood delivery contract.

Eucalyptus plantations on the Iberian Peninsula face a public relations problem and are not generally seen as a *"good"* species for plantation. It is being claimed that the eucalyptus plantations consumes a lot of water and increases the risk of forest fires. All this results in no subsidies for establishing new plantations and they are taxed in the same way as other ordinary businesses, while forest plantation with native species sometimes is subsidised and given tax-benefits.

There are available resources for silviculture and harvesting operations in all studied regions.
The summer draught is a problem for the all regions on the Iberian Peninsula, except in the very north of Galicia. The drought itself lowers the MAI and creates a risk of forest fires during the summer season. The cost for monitoring and extinguish forest fires shall therefore not be neglected. It is a cost not considered in this thesis.

When reflecting over the results from this study, it is important to clarify that the calculations have been made pre-tax and without and administrative expenses. Those costs were left out

because they highly depend on the individual forest owner's organization and capability, and have nothing to do with the actual forest management.

Since the consumption of wood for a tonne of pulp on the Iberian Peninsula is lower than in Brazil, the eucalyptus plantations on the Iberian Peninsula have an advantage. The lower consumption, levels out the advantage the higher MAI in Brazilian plantations gives.

The wood cost in Galicia and Huelva are almost the same despite higher costs in Galicia. The two regions have a significant higher wood cost compared with Portugal, and have therefore a competitive disadvantage. The wood cost in Portugal is not far from the wood cost in Brazil if measured per tonne of pulp. The MAI in the Portuguese plantation have to increase by > 20 % for the wood cost to be as competitive as the base case in Brazil. Therefore, Portugal has the highest potential for a low wood cost per tonne of pulp on the Iberian Peninsula.

Sensitivity Analysis

In all cases the calculations are more sensitive against negative changes in the variables than to positive. This should encourage potential investors in any of the studied regions to be cautious when making own calculations. A higher MAI than used in the base case of this study directly makes a positive impact in the profitability and competitiveness in all four regions.

The sensitivity analysis of land acquisition versus land leas can be used as a tool to compare the plantations on the Iberian Peninsula to Brazil, despite that the land was leased on the Iberian Peninsula and acquired in Brazil. Therefore the cash flow of the land cost differ greatly (Appendix 3). Considering that the base case was made without any appreciation for land in Brazil, the NPV and IRR from the sensitivity analysis with a land appreciation is probably a better reflection of the reality in Brazil.

The sensitivity analysis of land lease versus land acquisition reviled that it is more profitable to lease land on the Iberian Peninsula than to buy land, even if an appreciation of the land is included.

Possible upside

The bio energy sector could create a market for biomass from stumps and harvesting residuals. It is possible to consider a scenario where the cost for soil preparation is paid by harvesting the stumps. Possible incomes from harvesting residuals have not been taken into consideration in the profitability analysis. It is possible to imaging a scenario were incomes received in the beginning of the first rotation cycle from stumps and from harvesting residuals would improve the profitability analysis.

With a perspective with a higher resolution than in this thesis, it is possible to assume a better growth in Portugal and Galicia, especially in the North part of the regions, on an individual property level.

Possible downside

As in many lines of businesses, there is always a risk of decreasing prices. Due to the relatively high wood prices on the Iberian Peninsula and on-going research of lowering the cost in the whole supply chain, there is a risk of decreasing wood prices over time in Spain as well as in Portugal.

The attacks by the *Gonipterus* in Portugal and Galicia lead to that more *Eucalyptus nitens* is being planted instead of *Eucalyptus globulus. E. nitens* do not give the same low consumption of wood for a tonne of pulp as *E. globulus* and is not preferred in the pulp process. If the area with *E. nitens* is extended it could lead to an overall lower profitability for the wood producers and lower competitive strength for Iberian eucalyptus wood since the wood of *E. nitens* has a lower price.

In areas with a dry climate, the consumption of wood for a tonne of pulp is probably higher than the consumption used in this thesis. It is not an unimaginable scenario to add 0.2 or 0.3 m^3 of wood per tonne of wood in such areas.

There are some connection between more intense silviculture costs and areas with good growth. Therefore, one shall consider raising the silviculture costs when making profitability analyses on properties with a high MAI.

Theory criticism

The profitability and competitiveness analysis in this study do not revile the whole truth. The same criticism that has been opposed to Klempere´s model for capital budgeting should be made for the results in this study. The results should therefore only be used to rank the different options against each other. The aim was to compare and not optimize the different regions and to calculate an overall profitability and competitiveness, for a typical hectare in each region.

Areas for future studies

Topics for future studies on the issue could be a sensitivity analysis of how increased silviculture costs effects the profitability, as well would studies of optimal rotation cycles be interesting. To be able to compute an optimum for the rotation cycles, a function for the volume increment is needed. Indications picked up during the field visits testify of that the economical optimal rotation cycle might be longer than those used in this study. The rotation cycles in this study are those used most frequently today, but due to the wood deficit in the area, it is imaginable that the plantations are being harvested prematurely. Since the analysis period was two rotations in this thesis equal to 14 year in Brazil and 20 to 24 on the Iberian Peninsula, an analysis of the regions in this thesis with the same length could be interesting i.e. three rotations in Brazil, equal to 21 year.

The model built for calculating the profitability in this study could be extended if it were to be used in a specific investment project.

Since the silviculture costs vary e.g. due to different growth, precipitation and sloping terrain, it is important to visit and study each specific area if an investor is interested in entering the eucalyptus plantation market on the Iberian Peninsula.

Conclusion

This chapter presents the main conclusions drawn from the analysis of eucalyptus plantations on the Iberian Peninsula.

According to this study it is more profitable to conduct business in Brazil than on the Iberian Peninsula, if one has the perspective of a pulp producer, due to the lower wood costs. Thou the wood cost are lower in Brazil, the profitability with a perspective of a forest owner is greater in Portugal, due to relative good growth and medium sized costs and higher wood price than in Brazil.

From the perspective of a forest owner, the profitability one can obtain in either Spain or Portugal is quiet reasonable, regarding the lower political risk, and closeness to Europe.

An obstacle on the Iberian Peninsula is the small properties. As the sensitivity analysis showed, a higher MAI results in better profitability. There are a potential for a higher MAI in all areas, with a downside of that the properties with better MAI also tend to become smaller, when the interest for them increases.

Another problem is that the area with eucalyptus is limited on a local level, despite that there are no legal obstacles against new eucalyptus plantations, assumed that the prevailing legislation is followed.

References

Andersen, H. *Vetenskapsteori och metodlära.* Lund, Sverige: Studentlitteratur AB, 1994.

Brealey, Richard A., Steward C. Myers, and Franklin Allen. *Principles of Corporate Finance* . New York, USA: McGraw-Hill Irwin, 2011.

Chopra, S, and P. Meindl. *Supply Chain Management, Strategy, Planing, and Operation.* Upper Saddle River, USA: Pearson Education, 2010.

Cubbage, F. Koesbandanaa, Sadharga. Mac Donaghb, Patricio. Rubilarc, Rafael. Balmellid, Gustavo. Morales Olmose, Virginia. De La Torref, Rafael. Murarag, Mauro. Hoeflichh, Vitor Afonso. Kotzei, Heynz. Gonzaleza, Ronalds. Carreroa, Omar. Freyj, Gregory. Adamsk, Thomas. Turnerk, James. Lordl, Roger. Huangm, Jin. MacIntyrea, Charles. McGinleyn, Kathleen. Abta, Robert. Phillipsa, Richard.. "*Global timber investments, wood costs, regulation, and risk*." Biomass and Bioenergy, 2010: 1667-1678.

Cubbage, F, Mac Donagh, Patricio. Sawinski, Ju´ nior Jose´. Rubilar, Rafael. Donoso, Pablo. Ferreira, Arnaldo. Hoeflich,Vitor. Morales Olmos, Virginia. Ferreira, Gustavo. Balmelli, Gustavo. Siry, Jacek. Noemi Ba´ez, Mirta. Alvarez, Jose´. *"Timber investment returns for selected plantations and native forests in South America and the Southerna United States."* New Forest, 2007: 237-255.

Denscombe, Martyn. *Forsknings-handboken - för småskaliga forskningsprojekt inom samhällsvetenskaperna.* Lund, Sverige: Studentlitteratur AB, 2010.

Dillman, D.A. *Mail and internet surveys - The tailored design method, 2nd ed.* New York: John Wiley Co, 2000.

Kallio, M, M Kuula, and S Oinonen. "Real options vaulation of forest plantation investments in Brazil." *European Journal of Oprerational Research*, 2012: 428-438.

Klemperer, W. David. *Forest Resource Economics and Finance.* Singapore: McGraw-Hill Book Co., 1996.

Koller, Tim, Marc Goedhart, and David Wessels. *Valuation, Measuring and Managing the Value of Companies.* Hodboken, USA: John Wiley & Sons Inc., 2010.

Lantz, Annika. *Intervjumetodik.* Uppsala: Studentlitteratur Ab, 2007.

McKenny, Daniel W, Jeff S Davis, John W Turnbull, and Suzette D Searle. "Impact of Australian tree speicies selection research in China: an economic perspective." *Forest Ecology and management*, 1993: 59-76.

Niskanen, A. "Finacial and economic profitability of reforestation in Thailand." *Forest Ecology and Management*, 1997: 57-68.

Pereiro, L.E. "The practice of investment vaulation in emerging markets: Evidence from Argentina." *Journal of Multinational Financial Management*, 2006: 160-183.

Sedjo, R. "The role of forerst plantations in the world´s future timber supply." *The Forest Chronicle*, 2001: 221-225.

Sedjo, R. *The Comparative Economics of Plantation Forestry, A Global Assessment.* Baltimore, USA: The Johns Hopkins University Press, 1983.

Trost, J. *Kvalitativa intervjuer.* Lund, Sverige: Studentlitteratur AB, 2005.

Wagner, John E. *Forestry Economics, A managerial approach.* Oxon, England: Routledge, 2012.

Yin, Robert K. *Case Study Research - Disign and Methods.* Fourth edition. USA: Sage Publications Inc., 2009.

Zhang, Daowei, and Peter H. Pearse. *Forest Economics.* Vancouver, Kanada: UBC Press, 2011.

Online sources

Aicep Portugal Global. n.d. http://www.portugalglobal.pt/EN/InvestInPortugal/Pages/InvestinPortugalTaxSystem1.aspx (accessed 02 01, 2012).

Altri. n.d. http://en.altri.pt/pulpandpaper/ (accessed 05 08, 2012).

Altri About. n.d. http://en.altri.pt/aboutaltri/ (accessed 05 08, 2012).

Altri Financial info. n.d. http://en.altri.pt/investors/Reports/ (accessed 05 16, 2012).

Aspapel. n.d. Aspapel (accessed 04 10, 2012).

Celpa 2. n.d. http://www.celpa.pt/index.php?language=EN (accessed 02 05, 2012).

Celpa PDF. n.d. http://www.celpa.pt/images/pdf/art209_pt_be_2009.pdf (accessed 02 03, 2012).

Country report FAO 2010. n.d. http://www.fao.org/docrep/013/al602E/al602e.pdf (accessed 02 20, 2012).

Country report FAO Spain 2010. n.d. http://www.fao.org/docrep/013/al631S/al631S.pdf (accessed 02 20, 2012)

ENCE Financial info. n.d. http://www.ence.es/en/accionistas_inversores.html (accessed 05 16, 2012).

Ence Forest. n.d. http://www.ence.es/en/forestal.html (accessed 05 08, 2012).

Ence Group. n.d. http://www.ence.es/en/grupo_ence.html (accessed 05 08, 2012).

Ence Pulp. n.d. http://www.ence.es/en/celulosa.html (accessed 05 08, 2012).

Ence Sales and Market. n.d. http://www.ence.es/en/celulosa_ventas_mercados.html (accessed 05 08, 2012).

FAO Forestat 2. n.d. http://www.fao.org/docrep/013/al602E/al602e.pdf (accessed 01 23, 2012).

FAO Foreststat EN. n.d. http://www.fao.org/forestry/fra/fra2010/en/ (accessed 01 20, 2012).

FAO Foreststat Portugal Wood Pulp 2010. n.d. http://faostat.fao.org/site/626/DesktopDefault.aspx?PageID=626#ancor (accessed 04 26, 2012).
Florestais, Direccao_geral dos Recursos. *National Forest Strategy - Portugal, Goverment Order No 114/2006.* Country Report, Lisbon: Direccao_geral dos Recursos Florestais, 2007.
Investinspain.org. n.d. http://www.investinspain.org/guidetobusiness/en/3/3.pdf (accessed 02 02, 2012).
Magrama Andalusia. n.d. http://www.magrama.gob.es/es/biodiversidad/servicios/banco-datos-naturaleza/informacion-disponible/tablas_resumen_IFN3.aspx (accessed 05 14, 2012).
marm.es. 2012. http://www.marm.es/es/biodiversidad/temas/montes-y-politica-forestal/estadisticas-forestales/2008/default.aspx (accessed 02 17, 2012).
Nationalencyklopedin, Portugal. n.d. http://www.ne.se/lang/portugal (accessed 03 06, 2012).
Nationmaster. n.d. http://www.nationmaster.com/red/country/po-portugal/geo-geography&all=1 (accessed 02 20, 2012).
NE Spain. n.d. http://www.ne.se/lang/spanien (accessed 05 07, 2012).
Ondd.be. n.d. http://www.ondd.be/webondd/Website.nsf/HomePageEn(Visitor)?OpenForm (accessed 03 05, 2012).
Portucel. n.d. http://www.portucelsoporcel.com/en/group/index.php (accessed 05 08, 2012).
Portucel Mills. n.d. http://www.portucelsoporcel.com/en/group/mills.php (accessed 05 08, 2012).
Portucel Soporcel Financial Info. n.d. http://www.portucelsoporcel.com/en/investors/financial-information.php (accessed 05 16, 2012).
Portucel, shareholders. n.d. http://www.portucelsoporcel.com/en/investors/shareholders.php (accessed 04 10, 2012).
spain.es. n.d. http://www.spain.info/en/sobre_espanha/geografia/situacion_geografica.html (accessed 02 20, 2012).
Stat Portugal. n.d. http://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_princindic (accessed 02 20, 2012).
UNECE 2011. n.d. http://w3.unece.org/pxweb/dialog/varval.asp?ma=zzz_TM2011QuickStats_r&path=../database/STAT/26-TMSTAT1/000-TM1Others/&lang=1&ti=Forestry+Statistics+Overview (accessed 02 05, 2012).
UNECE Foreststat. n.d. http://w3.unece.org/pxweb/dialog/varval.asp?ma=zzz_TM2011QuickStats_r&path=../database/STAT/26-TMSTAT1/000-TM1Others/&lang=1&ti=Forestry+Statistics+Overview (accessed 02 05, 2012).
Wikipedia. n.d. http://en.wikipedia.org/wiki/Spain (accessed 02 20, 2012).
XUNTA pdf1. n.d. http://mediorural.xunta.es/fileadmin/arquivos/forestal/pladiga/2011/1_MEMORIA_Pladiga_2011.pdf (accessed 02 22, 2012).
XUNTO maps. n.d. http://mediorural.xunta.es/fileadmin/arquivos/forestal/pladiga/2011/3_MAPAS_PLADIGA_2011.pdf (accessed 02 22, 2012).

Personal interviews

Carlsson, Bengt, interview by Carl Kling. (19 01 2012).
Dans del Valle, Francisco, interview by Carl Kling. *Director, Asociacion Forestal de Galicia* (22 03 2012).
Leall, Luis, interview by Carl Kling. (15 03 2012).

Appendices

Appendix 1.

Spain

Forest resources
Spain has a total area of 50.6 million ha. (spain.es u.d.) Of that area 18.17 million ha are forestland, of which 12.92 million ha are productive forestland (UNECE 2011 u.d.)

Of the total area of forestland, 82 %, or 14.92 million ha is available for wood production. The standing volume in 2010 was 783.9 million. m^3 o.b. on forestland available for wood production. (UNECE 2011), and 912 million m^3 o.b if the volumes on all forestland was accounted for. The average standing volume per ha was in the same year 50 m^3/ha. Of the 912 million m^3 o.b., 96 % is of commercial tree spices and consists of 523 million m^3 (57 %) coniferous and 390 million m^3 (43 %) of deciduous species. (FAO Foreststat EN u.d.) In the same year (2010), the standing volume in Spain of eucalyptus was 53.47 million m^3 o.b. (Country report FAO SPAIN 2010 u.d.)

There are barely 540 000 ha of eucalyptus plantations in monoculture, in addition there are another 170 000 ha in mixture with conifers, over 50 000 ha in mixture with hardwoods, and nearly 60 000 ha in mixture with both coniferous and deciduous trees in Spain. (Table 13) (Aspapel u.d.)

Table 13. Table of the area with eucalyptus in Spain, with a breakdown of monoculture and mixed plantations. Source: (marm.es 2012)

Eucalyptus land	Area (ha)
Monoculture	539 937
Mixture with coniferous	172 308
Mixture with deciduous	52 139
Mixture with coniferous and deciduous species	57 735

Figure 10 presents the dominate trees species of the harvested volumes in 2008, divided for each Spanish province. The dark red colour, represents eucalyptus, and are found in the most North Western provinces, Galicia, Asturias and Cantabria, and as well as in the South West part of Spain, in Andalusia. The green colour of the provinces around Seville, illustrate the propagation of *Pinus pinea*.

Figure 10. Map of Spain, where the species with the largest percentage of the total volume harvested in each province is selected. The data is from 2008. (marm.es 2012)

The largest growing stock of standing volume of *eucalyptus spp* in Spain was in 2010 in Galicia. The Galician standing volume was 35 million m^3 o.b., in Cantabria and Andalusia, the standing volume of *Eucalyptus spp*. was significantly lower and about 5 million m^3 o.b. in each province. In the provinces of Extremadura and Asturias, there was about 2 million m^3 o.b. in each province. (Figure 11)

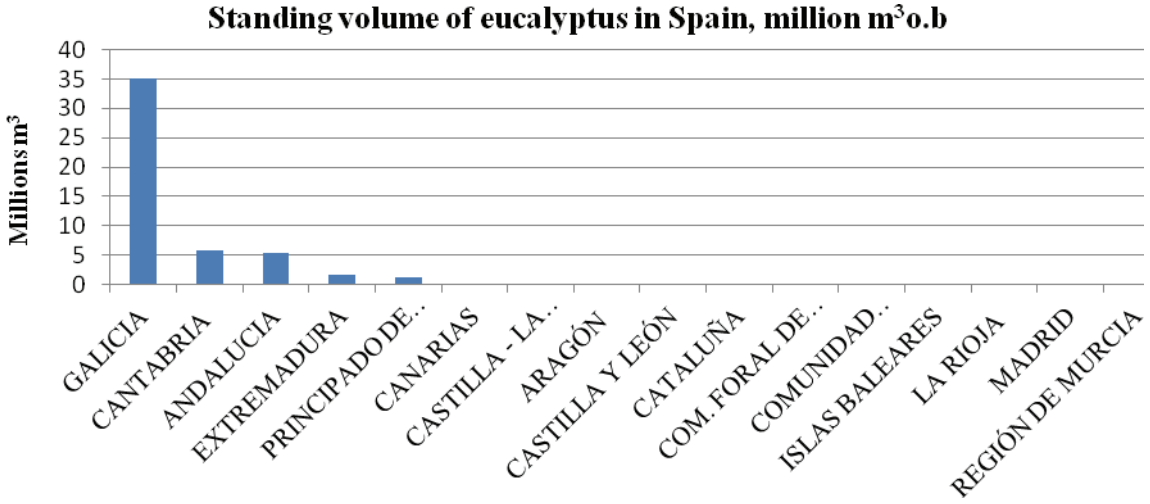

Figure 11. Standing volume of eucalyptus in Spain (2010) divided per province. Volume in Million m^3 o.b. (Source: marm.es 2012)

There are 2.1 million ha of forestland in Andalusia. (marm.es 2012)

In 2010, the annual timber growth on forestland available for wood production was 45.84 million m^3 o.b. of which 35.2%, 16.58 million m^3 o.b. was harvested. Of the harvested volume in 2010, 11.9 million m^3 u.b. was industrial round wood, while 2.1 million m^3 u.b. was harvested for firewood. (UNECE 2011)

In 2008 the highest harvesting levels in Spain, where found in Galicia and Asturias. Table 14 is a legend to Figure 12.

Table 14. Legend to Figure 12, the table shows what colour each range of harvesting volume has in Figure 12, in 2008. Source: (marm.es 2012)

Colour	***Harvesting (m^3 o.b.)***
Grey	n/a
Beige	< 50 000
Yellow	50 001 - 250 000
Orange	250 001 - 500 000
Light brown	500 001 - 1 500 000
Dark brown	1500 001 - 3 150 000

Figure 12. Map of the total harvested volume in Spain, in each province. The darker the colour is, the higher the harvesting is. Data from 2008, volumes m3 o.b. Source: (marm.es 2012)

Only 15% of the productive forestland, totalling 2.68 million ha, are planted forests. Of the planted area, 37% have been planted with introduced species. Between 2005 and 2010, the annual area planted grew by +1% in Spain. Since only 20% of forestland is being used for timber production, the conclusion can be drawn that the most part of the production forests in Spain have been planted. (FAO Forestat 2 u.d.)

Eucalyptus globulus is the dominant eucalyptus species in Spain with coverage of 90 % over *Eucalyptus camalduensis* with 10 % of the coverage. (UNECE Foreststat u.d.) *E. globulus* is preferred in the pulp process due the lower consumption of wood for one tonne of pulp. (Leall 2012)

E. Camalduensis, is by the Spanish foresters referred to as the 4x4 of eucalyptus species, due to its ability to grow in a wide variety of circumstances.

Forest resources in Huelva

The total standing volume of *eucalyptus spp.* is 5.47 million m^3 o.b. in Anadalusia. The breakdown between *E. globulus* and *E. camaldulensis* is 2.39 million m^3 o.b. of globolus and 3.08 million m^3 o.b. of camaldulensis. In Huelva there are 2.25 million m^3 o.b. of globulus and 0.82 million m^3 o.b. of camaldulensis on totally 148 800 ha. (
Table 15)

Table 15. Table of the standing volume o.b. in Andalusia and area with eucalyptus with a breakdown per province. Source: (Magrama Andalusia u.d.)

PROVINCE	**Volume,** Million m^3 o.b.		**Area,** Thousands ha
	E.globulus	***E.camaldulensis***	***Eucalyptus spp.***
Huelva	2.25	0.82	148.8
Sevilla	0.14	0.97	18.9
Almería	0	0.65	0
Cádiz	0	0.50	4.6
Córdoba	0	0.14	18.9
Granada	0	0	0
Jaén	0	0	0
Málaga	0	0.14	5.5
ANDALUSIA	2.39	3.08	196.6

The historical MAI has been 5 m^3 $year^{-1}$ ha^{-1}. The present MAI with good plants and intensive silviculture is between 7 to 20 m^3 $year^{-1}$ ha^{-1}. In extremely good conditions the second generation of genetically improved clones can produce up to 45 m^3 $year^{-1}$ ha^{-1} on sandy soils close to the coastline, if the silviculture is intensive.

The highest production is achieved in the area closest to the coastline on sandy soils. In these areas the MAI is 14 m^3 $year^{-1}$ ha^{-1}. The requisites can be described as good soils with bad climate.

North of the coastline is an area with shallow shale soils and very dry climate. This middle area has the lowest MAI and is not more than 6 m^3 $year^{-1}$ ha^{-1}.

In the North West part of Andalusia, more specifically in the North part of Huelva province, the precipitation is the highest within the region and the MAI is 9 m^3 $year^{-1}$ ha^{-1}. The growth is instead limited by the shallow, old and metamorphic soil.

In Huelva there are some plantations focusing on biomass production solely. In these plantations the production can reach 40 green tonnes per year with irrigation and 20 green tonnes without irrigation.

The irrigation is supplied by irrigation associations which are contacted to the existing web of infrastructure for irrigation. The irrigation allows production of oranges, olives and strawberries in the hot and dry summer season. The possibility for connection to the irrigation infrastructure creates a competition from agriculture for forest land and many former eucalyptus plantations has been converted to agriculture land due to low profitability.

The optimal rotation length is according to the forest companies in Huelva around 14 to 15 years but due to the risk of draught to plantations is harvested earlier. Because of this the rotation length is generally 10 to 12 years.

Forest resources in Galicia

The total area of Galicia is 2.96 million ha, which consists of forestland to 69 %, 2.04 million ha. In Galicia there is 174 000 ha of eucalyptus plantations in monoculture (Figure 13), which is equivalent to 5.9 % of the total forestland area in the province. The land in Galicia which is not covered by forest is mostly agricultural land. The agricultural land covers 844 000 ha in Galicia which is 29 % of the total land area. (Figure 13)

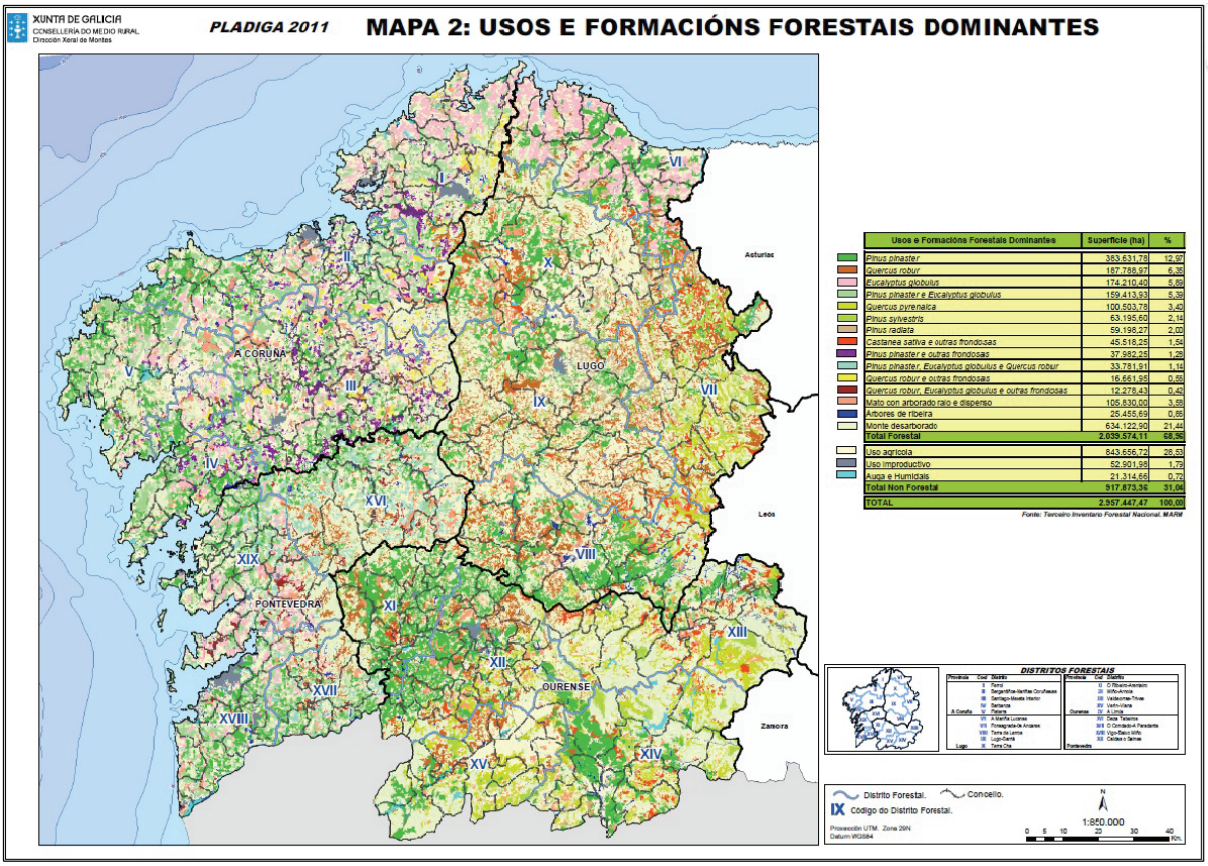

Figure 13. Map of Galicia. The pink colour illustrates eucalyptus plantations in monoculture. The distribution of those plantations is mainly along the coastline. Source: (XUNTO maps u.d.)

Risks
The two major risk eucalyptus plantations face is the risk of fires and the risk of the beetle *phoracantha*. Both are favoured by the low humidity and summer drought.

The growth in Huelva is mainly limited by two factors, draught and a pesticide called *phracantha.* The annual precipitation is around 500 mm per year with a draught season from May to October. This can in some cases limit the growth but keep up the survival rate in the plantations.

In Galicia there is a network of both a lookout tower for fire monitoring, and fire fighting resources, including reservoirs and resources for fire fighting by air, across the province. (XUNTO maps u.d.)

Forest ownership structure in Spain
The Spanish forestland is at a national level owned to 66 % privately owned, 29 % is common land and the other 5 % has some other ownership. Of the privately owned forest land, 97 % is owned by private persons. (FAO 2012)

The ownership structure in Huelva
ENCE has recently bought only one property and the price was 3 500 € / hectare.
Land lease 50-70 € /ha/year, (range 40 to 150 €/ha/year). Normally the lease contracts are on two rotations and the last and third rotation is usually left to the land owner.

The Galician ownership structure
There are about 650 000 forest owners in Galicia, who together with private companies owns 67.9 % or 1.386 million ha of the 2 million ha forestland in Galicia. If common land is included, 98 % of the forestland is private land in Galicia. A normal property size is 2 to 3 ha. (XUNTA pdf1 u.d.)

The private persons owning forest in Galicia, owns 300 000 ha of eucalyptus plantations. Private common land covers 150 000 ha of eucalyptus plantations. (Table 16)

Table 16. Table of the ownership structure in Galicia. Source: (Dans del Valle 2012)

	Amount of landowners		Areal (ha)		
	Total	Forest owners	Total	with eucalyptus	Typical size
Common land	3500	1000	350 000	150 000	200
Private land	400 000	90 000	1 400 000	300 000	1,5

The typical forest property size is 1 to 3 ha. ENCE´s properties are generally larger but with the downside that the average MAI is lower than the MAI within the area.

The properties are generally larger in the North of Galicia than in the South of Galicia.

Normally the lease contracts are on two rotations and the last and third rotation is usually left to the land owner.

Institutional framework
There is a national forest policy in Spain that came in to place in 1999. Each autonomous

region has different regional policies regarding the forests and independent laws, which all have the national forestry laws derived from 2003 as a framework. (FAO 2012)

There are no regulations preventing private land to be sold in Galicia or in Huelva. Nor are there any regulations preventing companies from owning or purchasing land.

Huelva
To be able to conduct forestry business within Andalusia without having to search permission for all different activities, it is required that a project plan is created. The plan has to describe all planned activities and the profitability for the plantation project. Each year a summary of all activities the past year has to be sent in to the forestry authorities.

Taxes and subsidies

Taxes
The general corporate tax rate in Spain is 30 %. There is also a municipal annual property tax on agricultural and forestry properties of 1.22 %. (Investinspain.org u.d.)

Subsidies
There are no subsidies available for eucalyptus plantations in either Galicia or Huelva.

Due to the European Union's 2020 goal of bioenergy, energy from biomass is subsidized in Huelva. At the moment, this subsidy is being returned the forestry sector and affects the wood prices of biomass assortments positively. Try outs with more dense stands with rotations cycles of 3 to 4 years, and sometimes even with irrigation are being planted in Huelva. ENCE had in the spring of 2012 300 to 400 ha of plantations for biomass production in Huelva. With intense silviculture and irrigation a production of up to 40 green tonnes of biomass can be experienced on good soils, and around 20 green tonnes without irrigation.

Structure of resources used for management, silviculture and harvesting
In 2010 190 900 people was employed in the forest industry sector in Spain. The numbers of employees in the wood product industry are clearly over-represented compared to the other forest industry segments. (UNECE 2011 u.d.) Within the forestry sector almost 16 % of the active persons are contractors, and within the wood product industry 21 % is contractors (UNECE 2011) (Table 17)

Table 17. Number of actives within the forest industry sector in Spain, 2010. (UNECE 2011)

	Total number of actives ***(Thousands)***	**Employed** ***(Thousands)***	**Contractors** ***(Thousands)***
Forestry	37.6	31.3	5.9
Manufacture of wood and articles in wood	109.9	87.1	22.8
Manufacture of paper and paper products	43.4	41.8	1.5

Silviculture

Galicia

It is hard work, and sometimes impossible to round up neighbouring forest properties, when performing silviculture activities.

Harvesting

Huelva

The harvesting cost, without the cost of road transportation to the mill is about 50 % of the total wood cost within the region of Huelva.

Costs inputs

Generally the silviculture costs are a bit higher in Galicia than in the South of Spain, due to smaller properties and terrain with steeper slopes. The cost for establishing a hectare of eucalyptus year 0 is almost 1 000 € in Huelva and 1 500 € to 2 000 €. In the calculations the costs year 0 in Galicia was set to 1 600 € / ha.

The cost for fertilizer is 30 € / ha for the machinery and + 350 kg of fertilizer /ha * 250 – 400 € per tonne. Per hectare ENCE calculates a cost of 147 € / ha every other year which is the cost used in this study.

The road transportation costs 3.5-11 € /m3 on the Iberian Peninsula. The exact cost used in each region is shown in Table 4 in the results.

The harvesting costs in Huelva is 14 to 18 € /m^3 and 12 to 15 € per m^3 in Galicia.

Market structure

Wood price

The wood price at mill gate is 60 EUR / m^3 u.b. in Huelva. In Galicia the wood price in March 2012 was between 47 € and 53 € per m^3 u.b. at road side.

Who are the buyers?

ENCE control 116 000 hectare of land of which they own 67 %. The remaining 33 % is leased land. ENCEce tree pulp mills consumes wood from an area of 350 000 ha with the current production.

80 % of the production of 1.4 m tonnes is exported, mainly to the European market.

The latest expansion in Ences pulp production from 1.1 m tonnes to 1.3 m tonnes is due to the conversion from batch boilers to continues-boilers in Navia, Asturias.

Ence´s standing volume, wood stock is 3.7 million m^3, a volume equal to 16 % of the total wood stock, standing volume in Spain.

They have a goal of becoming a 50/50 producer of pulp and energy in the future.

ENCE has a self-sufficient rate of 50 % if the volumes from Uruguay are included. They have a goal to have not purchase more land and binding capital and instead looking into lease land.

The Spanish wood buyers in Galicia nowadays have strong competition from Portuguese buyers.

Where are they located?
Ences mill are located in the Huelva province, outside the city of Huelva, outside city of Navia in Astusias and in the city of Pontevedra in Galicia.

How are the different round wood species sold, in what quantities and how?

The wood is sold per tonne or per m^3 under bark.

Another question is whether they are sold on long term contract, on a spot market or in some other way.
Wood is are regularly being trades on short term contracts. Forest tend to view their forests has a savings account.

In which units are wood generally sold?
The forest owners and harvesting and transportation contractors are mostly being paid per tonne of wood. This makes the supply chain very "hot", because green wood are more dense and heavier.

Which products are generally traded on the forest product market, any specific products, lengths, diameters?
One assortment of eucalyptus pulp wood is being traded, in 2,5 meter lengths. The development in the wood supply chain is to handle 5 meter logs instead.

In Huelva there´s a market for biomass and stumps. The pulp mill in Huelva consumes

There´s huge problems with sawing Eucalyptus Globlus, i.e. high risk of collapses, deformation, long drying time (in kilns 50-60 days), cracks, etcetera.

Profitability
In plantations with a MAI of 9 to 10 m^3 $year^{-1}$ ha^{-1} ENCE calculates a IRR of 9.5 %, and in plantation with a MAI of 6 m^3 $år^{-1}$ ha^{-1} the IRR is 5 to 6 %.

Portugal

Forest resources
In 2010 there was 3.46 million hectares of forestland in Portugal, equal to 37.6 % of the total area of Portugal. (Celpa PDF u.d.) The area available for wood production is 53 %, 1.82 million ha, of the forestland area. (UNECE 2011)

Of Portugal´s total area of 9 million ha, 1/3 is forest, 1/3 is agricultural land and 1/3 is scrubland. Of the forest land area, 23 % is eucalyptus plantation, 26 % is cork oak forests, 25 % is maritime pine plantations and the remaining 14 % is holm oak forests.

The forestland area consist of 647 000 ha with eucalyptus plantation in monoculture, or where eucalyptus is the dominant tree species. (Celpa PDF u.d.)

The area with forests increased with 63 000 ha between the inventory periods of 1995/1998 and 2005/2006. (Celpa PDF u.d.)

In 2010 the standing volume in Portugal was totally 184 million m^3 o.b., and compartmentalized per hectare the standing volume was 54 m^3 o.b. Of the total standing volume, 83 % where commercial tree species, and is divided between 91 million m^3 (49%) coniferous and 95 million m^3 (51%) non coniferous species. (FAO 2012)

The annual net growth of the standing volume was in 2005, 18,9 million m^3o.b., and 75.4 % of that volume, 14.3 million m^3 o.b. was harvested. Of the harvested volume in 2005, 10.3 million m^3 u.b. was industrial round wood and 600 000 m^3 u.b. fire wood (UNECE 2011)

Of the productive forestland, 25 % is planted by man, a total of 849 000 ha. Of this area 99 % is planted with for Portugal exotic species. Thou only 25 % of the forest area strives from planting activities, 59 % of the total forest area is primary used for wood or cork or cork production (Table 18). Between 2005 and 2010 the area with forest plantations increased by +0.9 %. (FAO Forestat 2 u.d.)

Table 18. Use of forestland. Source (FAO 2012)

	Primary intended usage (%)				
	Production	**Soil and water protection**	**Preserving of biodiversity**	**Social services**	**Multiple use**
Portugal	59	7	5	0	30
Spain	20	20	12	2	46

Figure 14 shows the development of the standing volume of eucalyptus between the inventory periods of 1995/1998 and 2005/2006. The standing volume has increased from 25 million m^3 o.b. to 28.4 million m^3 o.b. in plantation with monoculture. In stands where eucalyptus is the dominant tree species the standing volume has decreased from 6.6 million m^3 o.b. to 5.1 million m^3 o.b. The standing volume of eucalyptus in stands where it is dominated by some other species, the volume has increased from 3.3 million m^3 o.b. to 4.8 million m^3 o.b.

The graph to the right in Figure 14 shows that the standing volume per hectare of eucalyptus in stands where it is dominant is decreasing and that the volume per hectare of eucalyptus in monoculture or in stands where it is being dominated is increasing.

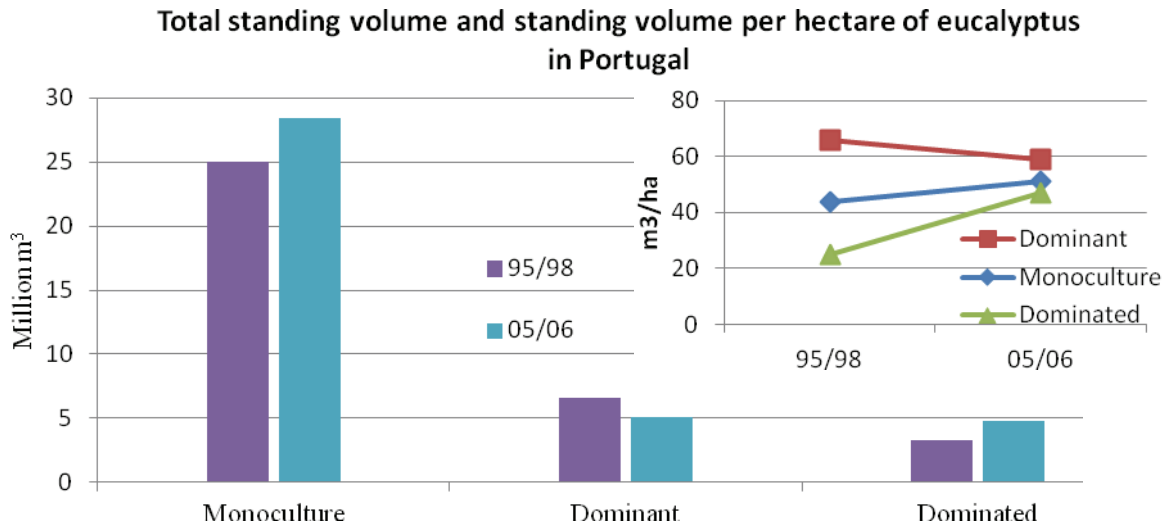

Figure 14. Portugal´s standing volume of eucalyptus o.b. The smaller graph on the right shows the development per hectare. The inventory periods are 1995/1998 and 2005/2006. Source: (Celpa PDF u.d.)

The propagation of eucalyptus has decreased between the inventory periods of 1995/1998 and 2005/2006, in all kinds of stands. (Figure 15)

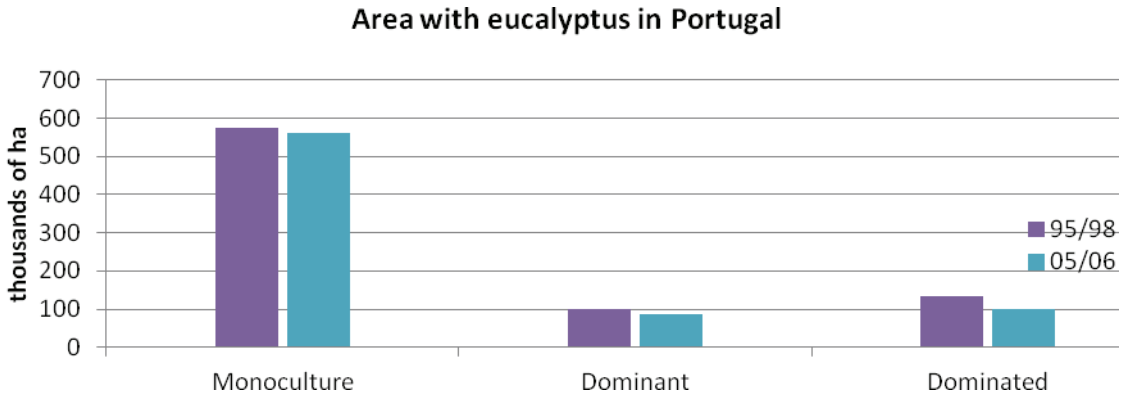

Figure 15. Propagation of eucalyptus in Portugal, in stands where the eucalyptus grows in monoculture, where it is the dominant tree species and in stands where it is dominated by other species. The inventory periods are 1995/1998 and 2005/2006. The scale is in thousands of hectares. Source: (Celpa PDF u.d.)

The map in Figure 16 shows the propagation of different tree species in Portugal. The yellow colour represents *eucalyptus spp.* The eucalyptus plantations are mostly allocated to the area along the coastline, North of Lisbon and along the river Tagus River, stretching North West from Lisbon.

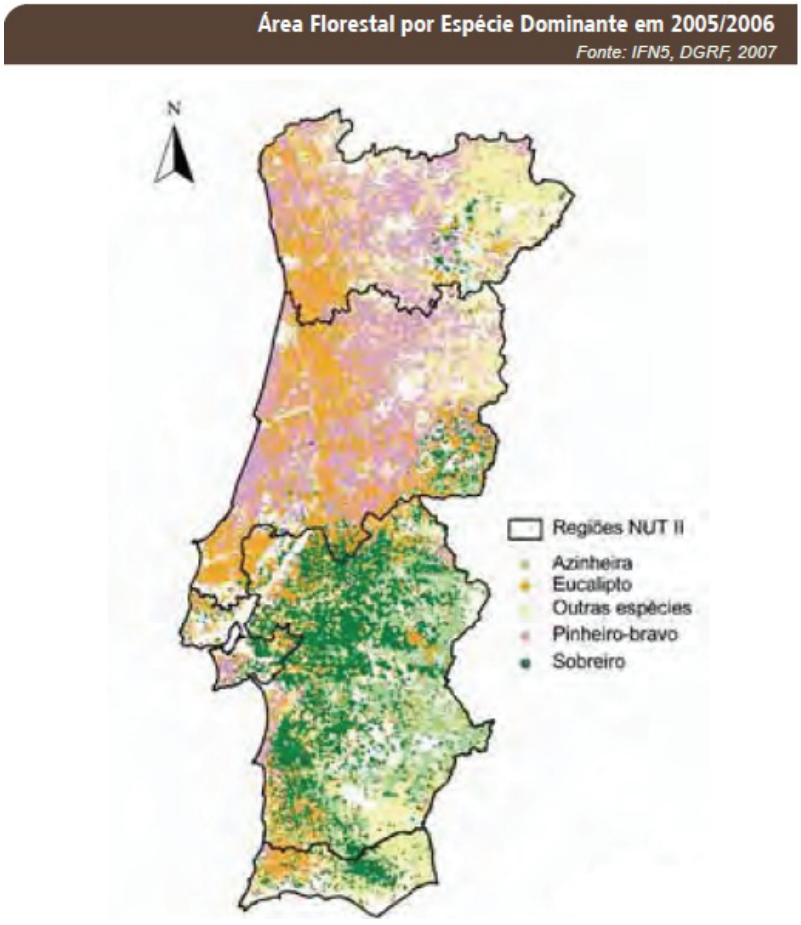

Figure 16. Map of Portugal, with a division of the dominant tree species. The light green colour represents quercus ilex, the yellow colour represents eucalyptus spp., the even lighter green colour represents other species, the pink colour represents pine and the dark green colour represents the propagation of cork oak. Source: (Celpa PDF u.d.)

The map in Figure 17 shows the eucalyptus plantations managed by the pulp and paper companies in Portugal. As shown in the map, the companies do not own much eucalyptus land along the coastline. Most of the company plantations are along the Tagus River.

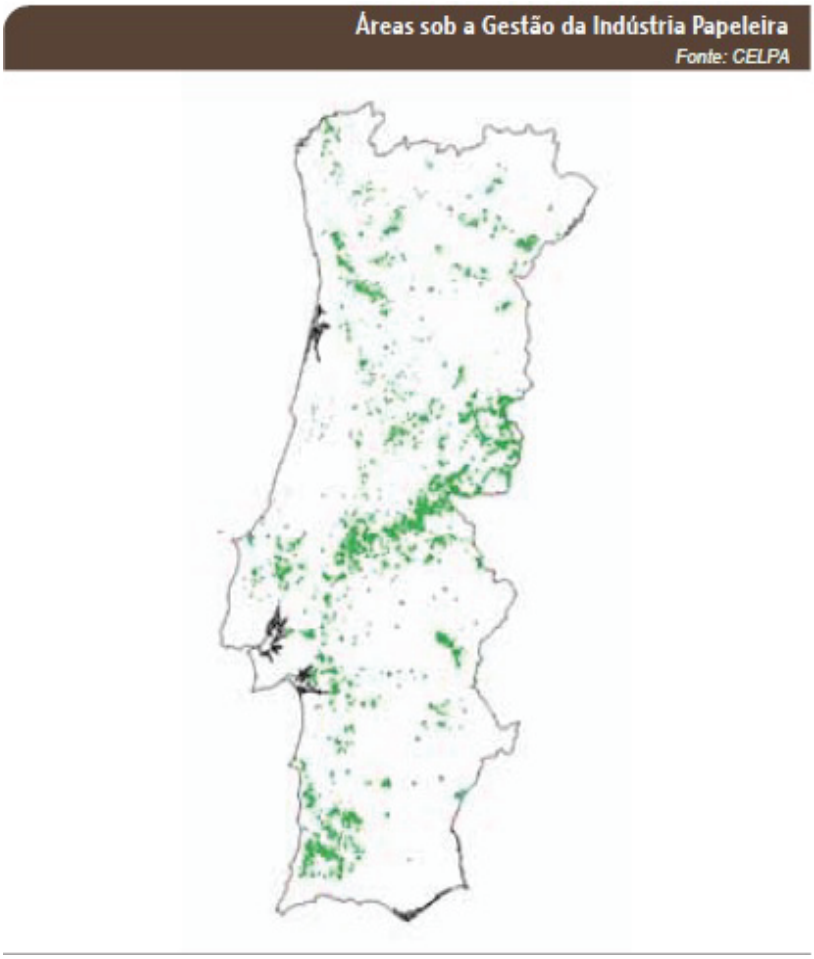

Figure 17. Map of Portugal. Eucalyptus plantations managed by the pulp and paper industry companies in Portugal are marked in green. Source: (Celpa PDF u.d.)

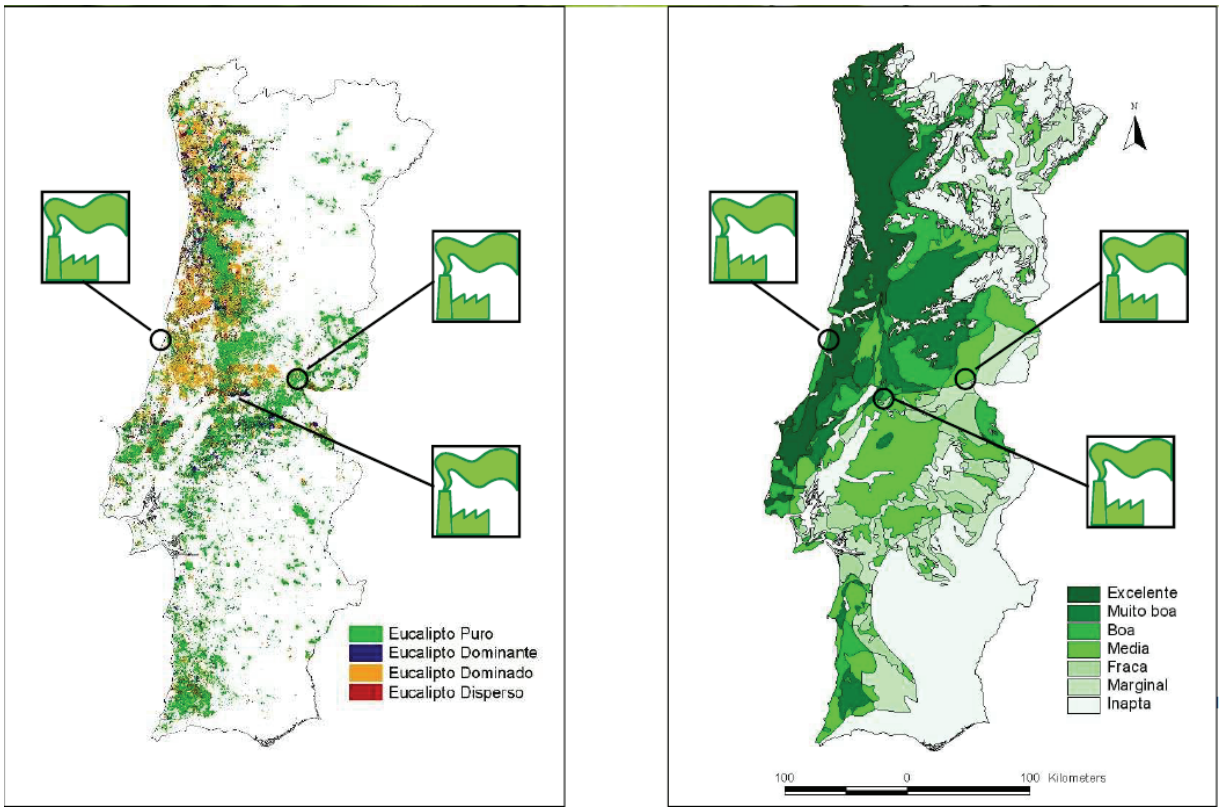

Figure 18. Maps of Portugal. The map to the left shows eucalyptus in monoculture in green. The map to the right shows the wood production of Portuguese eucalyptus plantations. The darker the colour is, the better the growth is. Source: (Leall 2012)

The best growth in eucalyptus plantations in Portugal is found along the coastline, North of Lisbon. In the other hand, that area is not the area in Portugal with the highest concentration of eucalyptus plantations in monoculture. (Figure 18)

Risks

Forest firers

Between 2001 and 2009, 1 % to 2 % of the area with eucalyptus has been hit by forest fires. An exception has to be made for the year of 2003 and 2005, when just over 8 % of the eucalyptus areas where hit each year. (Celpa, 2009)

The fire season is during the summer drought season, roughly from April to October. The rural population is very important for spotting new fire burst. The on-going depopulation of the countryside, are becoming a problem for the possibility to extinguish the forest fire fast, when they are still small in size. This is one of the explanations to why the frequency of forest fires has increased the last decades.

In Portugal the snout beetle, *Gonipterus,* attacks the eucalyptus and defoliates the trees, killing even mature stands.

Frost

Plantation at in higher altitude and in lowlands has some problems with frost bites. Juvenile plants are less resistant to frost than larger trees. Young plantations are especially vulnerable just after a pre commercial thinning.

Ownership structure
The Portuguese forestland is to 98 % privately owned, and the remaining 2 % is publicly owned land. Of the privately owned land, 89 % is owned by private persons, 5 % is owned by companies and institutions and 5 % is owned by the local indigenous population. (FAO 2012) Of the total area of Portugal about 90 % is privately owned, the reaming 10 % is the area required for publicly owned land, land for cities and infrastructure, or nature reserves along the coastline. Most of the publicly owned forest are along the coast and planted with maritime pine, to prevent the sand dunes from eroding into the ocean.

Most forest owners in Portugal own properties smaller than 5 ha, where eucalyptus is not the main species. Eucalyptus is mainly grown on properties with a dimension of 5 to 100 ha, which represents 19 % of the forest area in Portugal. (Table 19)

Table 19. Table of number of owner within different ranges of property dimensions, and main three species. Source: (Florestais 2007)

Property dimension	< 1 ha	< 5 ha	5 ha to 20 ha	5 ha to 100 ha	> 20 ha
Number of owners	31%	30%	14%	10%	15%
Area	10%	15%	12%	7%	55%
Main species	Maritime pine	Maritime pine /chestnut	Eucalyptus		Cork oak and holm oak

The total area of properties > 100 ha is larger than all area of properties < 100 ha. Most agriculture and forestry properties in Portugal are < 5 ha. Of such properties, there were 184 522 property owners in 1995. The number if owners were 2620 for properties > 100 ha.The average is 7 ha/holding. (Figure 19)

Ownership structure of mixed agriculture and forest holdings in Portugal

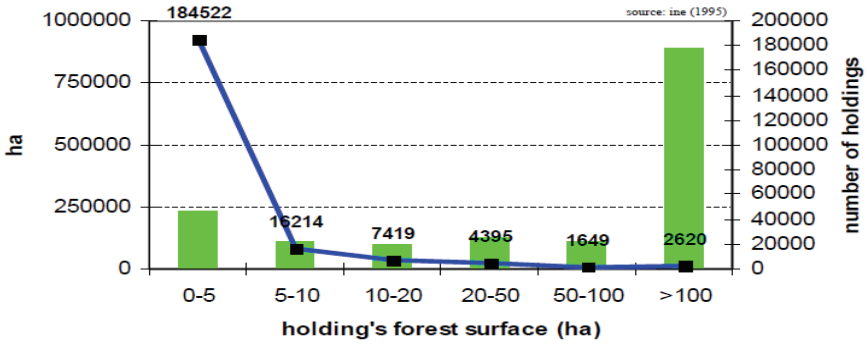

Figure 19. Ownership structure of mixed agriculture and forestry holdings in Portugal. Data from 1995. The green staples represent the accumulated area of properties within each size range. The blue line illustrates the total number of holdings within each size range. Source: (Leall 2012)

Institutional framework
Portugal has a national forest policy from 2006. There is no unified forest legislation, and the national forest law from 1996 is therefore incorporated in other legislations. (FAO 2012)

Before a new plantation is establish or on area is reforested a project plan for the plantation project has to be created. The project plan has to be approved by the Forest Service, which has an office turnaround time of 30 workdays.

New plantations have to either be on land planted with eucalyptus or on land where permission from the Forest Service has been given. Generally, such permissions are given on land with prior plantations of maritime pine, due to the pine wood nematode attacking pine plantations in Portugal.

Taxes and Subsidies

Corporate tax
The tax rate is at a fixed level of 12.5% on the tax income is less than less than € 12 500 and 25% on income greater than 12 500 €. Corporation tax is payable by all companies doing business within the country and has registered office or carries out its operations in such a way that it required a major management effort, (Effective management), on Portuguese soil. Only costs that are unavoidable in order to conduct his business, is deductible in Portugal. (Aicep Portugal Global u.d.)

Normally paid 1.5% in council tax of the company that has a permanent establishment in Portugal and whose principal business is the commercial, industrial or agricultural. Municipal authorities can in some cases reducing local taxation in cases where profits last year did not exceed € 150 000. (Aicep Portugal Global u.d.)

The activities were taxable profits exceeding € 2 million requires companies to estimate a further 2.5% on the chargeable gain that exceeds the aforementioned amount. (Aicep Portugal Global u.d.)

Municipal property tax
In Portugal, the property owner is obligated to pay taxes on all types of land assets. Agricultural and forestry property taxed at a rate of 0.8% of the declared property value. The profits in agricultural and forestry property transactions are taxed by 5 %. (Aicep Portugal Global u.d.)

Tax reliefs
Investments in forest plantations in excess of 5 million €, prior to December 31, 2020, can get tax reliefs. This assumes that they are relevant for the development of the region and in the interest of the national economy. Tax reliefs can also be given on projects that lessen regional disparities and create jobs, or if they are helping to support the technological innovation and national research. Tax cuts of 10% to 20% can be deducted from corporate income tax rate in up to 10 years. The extent of the tax cut is determined at the time of application. (Aicep Portugal Global STATE DEPARTMENT)

In areas that the Ministry of Finance are considering as inland, companies can get tax relief up to 15% of corporation tax. There are also opportunities to get up to 50% deduction from the employment tax, if the activity creates jobs in the inland region. (Aicep Portugal Global u.d.)

Subsidies
There are no subsidies available for eucalyptus plantations in Portugal.

Structure of resources used for management, silviculture and harvesting
A total of 92 800 persons were employed in the Portuguese forest industry sector in 2010 (Table 20). The numbers of employees in the wood product industry are clearly over-

represented compared to the other forest industry segments. In both the forestry sector and the wood product industry, almost 20% of the active persons are contractors.

Table 20. Number of actives, within the forest industry sector in Portugal, in 2010. Source: (UNECE 2011)

	Total number of actives *(thousands)*	**Employed** *(thousands)*	**Contractors** *(thousands)*
Forestry	12.8	10.3	2.5
Manufacture of wood and articles in wood	66.4	53.6	12.7
Manufacture of paper and paper products	13.6	13.1	0.87

Silviculture and harvesting

The silviculture and harvesting operations are being performed by small to medium sized contractors in Portugal. The largest contractors are those doing the soil preparation, because their machinery can be used in construction as well. There are full service silviculture contractors, but they are quite rare. Most contractors only take care of a part of the silviculture operation, i.e. plantation or soil preparation.

Who are the buyers?

Altri and Protucel Soprcel are the two major final consumers of eucalyptus wood in Portugal. Altri´s three mills have a self-sufficient rate of < 30 % in 2011, in 2010 they were self-sufficient to 30 %, but due to an increased production of pulp and energy the consumption has increased more than the available supply.

How are the different round wood species sold, in what quantities and how?

Wood is being sold as m^3 under bark or per tonne.

Profitability

The Portuguese foresters involved in this study uses a 7.5 % has discounting rate, when conduction calculation of their own.

Appendix 2.

Analysis of eucalyptus forestry on the Iberian Peninsula
The study aims to analysis the prerequisites for eucalyptus plantations in Spain and Portugal with a national/macro perspective, with a goal to be able to compare plantations on the Iberian Peninsula with plantations in Brazil. The report will consist of two parts, one descriptive part followed by an analysis of the profitability and competitiveness of greenfield plantations of eucalyptus on the Iberian Peninsula compared with eucalyptus plantations in Brazil.

Descriptive part
For each of the subheadings below this study aims to illustrate the prerequisites for eucalyptus plantations within each of the different regions suitable for eucalyptus on the Iberian Peninsula.

Forest resources – especially plantations

To be able to carry out the study I will need to know how large the current forest area is, including the distribution between different forests i.e. eucalyptus plantation, cork natural forests and other types of forest use. Along with a historical view of the forest recourses it would be interesting with a prognosis of the future development. Crucial for this study is to map out where the areas suitable for eucalyptus plantation in both Spain and Portugal are located and to find out both advantages- and disadvantages for different locations of eucalyptus plantations.

Plantation ownership structure

Questions that need answers are: What´s the ownership structure of today´s plantations? What´s distribution between private and public owned forestland, with a further breakdown of the ownership structure down to average property size, types of private ownership (private persons or corporate ownership) and the average total forest holdings per landowner.

It would also be interesting to know if the forest assets are financed with private equity or by loans. Is it possible to lease land on long term contracts? And if so, how common is it to lease land and establish plantations?

Institutional framework – legislation and regulatory agencies

How are legislation and regulation affecting forestry? What kind of permits, certifications, authorization from authorities is needed? Are there any requirements to be fulfilled to be able to buy or own forestland?

Taxes and subsidies

What taxes are involved in forestry on the Iberian Peninsula? Is it possible to withdraw any subsidies within the forest sector, i.e. for bio-fuel production or for afforestation projects or some such?

Structure of resources used for management, silviculture and harvesting

What resources are available for forest management, both silviculture and harvesting resources? What structure do they have? Are there mainly small private entrepreneurs or larger management companies as seen in Brazil? Do the larger forestland owners

take care of the forest management on their own or do they have it outsourced?

Market structures (products/customers)

- How does the market for round wood function?
- Is there a balance between supply and demand of wood?
- How large is the market?
- Who are the buyers?
- Where are they located?
- How are the different round wood species sold, in what quantities and how? Another question is whether they are sold on long term contract, on a spot market or in some other way.
- In which units are wood generally sold?
- Which products are generally traded on the forest product market, any specific products, lengths, diameters?

Profitability and competitiveness analysis
An analysis of profitability and competitiveness of green field plantations and (if possible) existing plantations on the Iberian Peninsula compared with plantations in Brazil.

For this analysis I will need to know how the management regimes and the MAI (mean annual increment, m^3) per hectare differ within each region of interest. I will have to be able to extract the costs connected to the different management regimes, and also have information about the wood market, and the price variations that adhere to each region. I will also need historical costs per hectare for forestland along with today´s prices and the price for leasing forestland.

Specific areas of interest
In both countries it would be valuable to get in contact with representatives from forestland owner organizations, representatives from the larger forest industry companies, with representatives from the forest agencies and with other people with specific knowledge about silviculture of eucalyptus and people with knowledge about the wood market.

Portugal
If it´s possible I´d like to visit and learn about the differences between forestry in the South compared with the North of Portugal. As I have learned so far, the ownership structure along with the MAI varies between the North and South, which would make a visit to both regions interesting.

Spain
In Spain it would be interesting to learn more about the area around Huelva in the South, and of the states of Galicia, Asturias, Cantabria and Vizcaya in the North (the area North of Portugal).

Appendix 3.

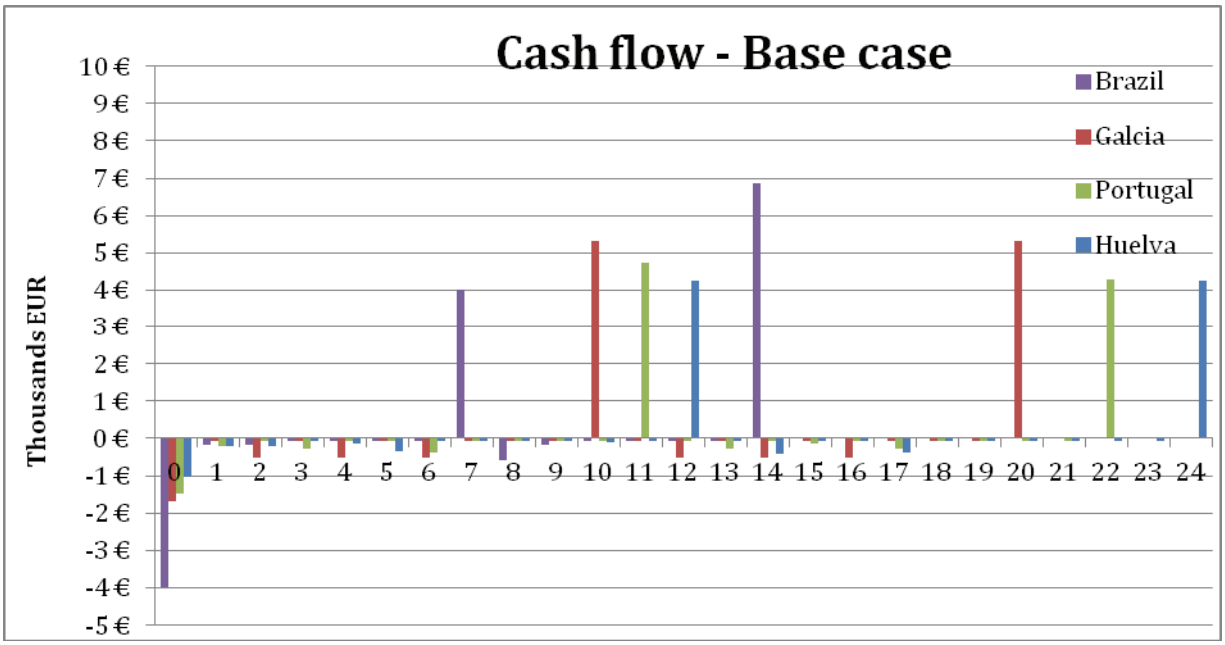

Figure 20. Graph of the base case cash flow, rate 6.5 %.

Appendix 4.

Table 21. Table of the types of data sources and interview respondents in this thesis

The data sources which were used in the study were from:
The European Union FAO Literature and Publications Field visits
Qualitative interviews with: Private landowners Forest Owners Associations Forest Industry Organizations FAO correspondents in Spain and Portugal Corresponding 'Forestry services" Forestry faculties on Universities Experts with knowledge of the forestry sector in the Iberian Peninsula.
Experts within each area were:
For the Iberian Peninsula: An independent consultant with long experience of the forestry on the Iberian Peninsula
For Spain: A Spanish forestry consultant. FAO´s statistical representative in Spain.
For Huelva: A silviculture expert Two harvesting experts An expert of Research and Development within eucalyptus plantations
For Galicia: Five harvesting experts The Director of a forest owner association A forest management director at the local government
For Portugal: A professor in Forestry at Instituto Superior de Agronomia, Departamento de Engenharia Florestal, in Lisbon. A phD student in Forestry at Instituto Superior de Agronomia, Departamento de Engenharia Florestal, in Lisbon. FAO statistical representative in Portugal. Two experts of Reserch & Devolopment of eucalyptus plantations A silviculture and harvesting managers at regional level An expert of wood supply and wood purchase A forest director for a district in central Portugal An expert of Research and Development within eucalyptus plantations Three representatives from the national Forest Service
An independent consultant with deep and profound knowledge about forest investments around the world, and with long experience of the forestry in Portugal.
For Brazil: A forest director in Brazil An independent consultant with long experience of the forestry in Brazil A senior forestry consultant with knowledge of the forestry in Brazil
In Sweden: Two independent consultants within the international forest sector A senior forestry consultant

Publications from
The Department of Forest Products,
SLU, Uppsala

Rapporter/Reports

1. Ingemarson, F. 2007. De skogliga tjänstemännens syn på arbetet i Gudruns spår. Institutionen för skogens produkter, SLU, Uppsala
2. Lönnstedt, L. 2007. *Financial analysis of the U.S. based forest industry*. Department of Forest Products, SLU, Uppsala
4. Stendahl, M. 2007. *Product development in the Swedish and Finnish wood industry.* Department of Forest Products, SLU, Uppsala
5. Nylund, J-E. & Ingemarson, F. 2007. *Forest tenure in Sweden – a historical perspective.* Department of Forest Products, SLU, Uppsala
6. Lönnstedt, L. 2008. *Forest industrial product companies – A comparison between Japan, Sweden and the U.S.* Department of Forest Products, SLU, Uppsala
7. Axelsson, R. 2008. Forest policy, continuous tree cover forest and uneven-aged forest management in Sweden's boreal forest. Licentiate thesis. Department of Forest Products, SLU, Uppsala
8. Johansson, K-E.V. & Nylund, J-E. 2008. NGO Policy Change in Relation to Donor Discourse. Department of Forest Products, SLU, Uppsala
9. Uetimane Junior, E. 2008. Anatomical and Drying Features of Lesser Known Wood Species from Mozambique. Licentiate thesis. Department of Forest Products, SLU, Uppsala
10. Eriksson, L., Gullberg, T. & Woxblom, L. 2008. Skogsbruksmetoder för privatskogs-brukaren. *Forest treatment methods for the private forest owner.* Institutionen för skogens produkter, SLU, Uppsala
11. Eriksson, L. 2008. Åtgärdsbeslut i privatskogsbruket. *Treatment decisions in privately owned forestry.* Institutionen för skogens produkter, SLU, Uppsala
12. Lönnstedt, L. 2009. *The Republic of South Africa's Forets Sector.* Department of Forest Products, SLU, Uppsala
13. Blicharska, M. 2009. *Planning processes for transport and ecological infrastructures in Poland – actors' attitudes and conflict.* Licentiate thesis. Department of Forest Products, SLU, Uppsala
14. Nylund, J-E. 2009. *Forestry legislation in Sweden*. Department of Forest Products, SLU, Uppsala
15. Björklund, L., Hesselman, J., Lundgren, C. & Nylinder, M. 2009. Jämförelser mellan metoder för fastvolymbestämning av stockar. Institutionen för skogens produkter, SLU, Uppsala
16. Nylund, J-E. 2010. *Swedish forest policy since 1990 – reforms and consequences***.** Department of Forest Products, SLU, Uppsala
17. Eriksson, L., m.fl. 2011. Skog på jordbruksmark – erfarenheter från de senaste decennierna. Institutionen för skogens produkter, SLU, Uppsala
18. Larsson, F. 2011. Mätning av bränsleved – Fastvolym, torrhalt eller vägning? Institutionen för skogens produkter, SLU, Uppsala
19. Karlsson, R., Palm, J., Woxblom, L. & Johansson, J. 2011. Konkurrenskraftig kundanpassad affärsutveckling för lövträ - Metodik för samordnad affärs- och teknikutveckling inom leverantörskedjan för björkämnen. Institutionen för skogens produkter, SLU, Uppsala

Examensarbeten/Master Thesis

1. Stangebye, J. 2007. Inventering och klassificering av kvarlämnad virkesvolym vid slutavverkning. *Inventory and classification of non-cut volumes at final cut operations.* Institutionen för skogens produkter, SLU, Uppsala
2. Rosenquist, B. 2007. Bidragsanalys av dimensioner och postningar – En studie vid Vida Alvesta. *Financial analysis of economic contribution from dimensions and sawing patterns – A study at Vida Alvesta.* Institutionen för skogens produkter, SLU, Uppsala
3. Ericsson, M. 2007. En lyckad affärsrelation? – Två fallstudier. *A successful business relation? – Two case studies.* Institutionen för skogens produkter, SLU, Uppsala
4. Ståhl, G. 2007. Distribution och försäljning av kvalitetsfuru – En fallstudie. *Distribution and sales of high quality pine lumber – A case study*. Institutionen för skogens produkter, SLU, Uppsala
5. Ekholm, A. 2007. Aspekter på flyttkostnader, fastighetsbildning och fastighetstorlekar. *Aspects on fixed harvest costs and the size and dividing up of forest estates.* Institutionen för skogens produkter, SLU, Uppsala

6. Gustafsson, F. 2007. Postningsoptimering vid sönderdelning av fura vid Säters Ångsåg. *Saw pattern optimising for sawing Scots pine at Säters Ångsåg*. Institutionen för skogens produkter, SLU, Uppsala
7. Götherström, M. 2007. Följdeffekter av olika användningssätt för vedråvara – en ekonomisk studie. *Consequences of different ways to utilize raw wood – an economic study*. Institutionen för skogens produkter, SLU, Uppsala
8. Nashr, F. 2007. *Profiling the strategies of Swedish sawmilling firms.* Department of Forest Products, SLU, Uppsala
9. Högsborn, G. 2007. Sveriges producenter och leverantörer av limträ – En studie om deras marknader och kundrelationer. *Swedish producers and suppliers of glulam – A study about their markets and customer relations.* Institutionen för skogens produkter, SLU, Uppsala
10. Andersson, H. 2007. *Establishment of pulp and paper production in Russia – Assessment of obstacles.* Etablering av pappers- och massaproduktion i Ryssland – bedömning av möjliga hinder. Department of Forest Products, SLU, Uppsala
11. Persson, F. 2007. Exponering av trägolv och lister i butik och på mässor – En jämförande studie mellan sport- och bygghandeln. Institutionen för skogens produkter, SLU, Uppsala
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