THE ECONOMIC IMPACT OF THE FOREST SECTOR IN URUGUAY: A COST-BENEFIT ANALYSIS

by

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(Under the Direction of Jacek P. Siry)

ABSTRACT

Uruguay is a South American country surrounded by Argentina and Brazil. Its economy has traditionally been based on agriculture. Since the 1960s, the government has been encouraging forestry as an alternative use for marginal agricultural lands in an effort to promote economic development, diversification, and environmental services. The Forestry Law of 1987 introduced subsidies and tax exonerations for the development of forest plantations and wood manufacturing industries. As a result, the new forest sector has been growing rapidly, attracting foreign investment. While several studies have examined the impact of individual forest firms, no study to date has examined the impact of the forest sector from the point of view of the entire economy. This research project evaluated the impact of the new forest sector by conducting a Cost-Benefit Analysis. The results indicate a positive net impact when compared with livestock: the Net Present Value for the forest sector was 630.2 million US$, and the Internal Rate of Return was 36.4%.

INDEX WORDS: Policy Evaluation, Uruguay, Forest Sector, Cost-Benefit Analysis.

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CHAPTER 1

INTRODUCTION

Incentives promoting investment in the development of forest plantations and wood manufacturing industries have been a controversial policy issue in recent decades. Most of the arguments rely on the misuse and depletion of natural resources due to government failures. Ineffective forest policies, the absence of logging controls, and external pressures such as rapid population growth have frequently resulted in resource decline and deforestation (Hyde *et al.* 1987; Repetto & Gillis 1988; Ascher & Healy 1990; Clapp 1995; Dore & Guevara 2000; Clapp 2001; Guldin 2003; Bacha 2004; Silva 2004). Some studies pointed out that economic incentives such as tax breaks, tax exonerations, subsidies, credit concessions, and pricing policies resulted in the misuse of forest resources as well (Repetto & Gillis 1988). One of the most important consequences of these failures is deforestation as many developing countries experience high deforestation rates (Repetto & Gillis 1988; Haltia & Keipi 1997; FAO 2005).

Unlike many developing countries experiencing deforestation, forest cover in Uruguay has been increasing (Nebel 2003). The majority of the land in Uruguay is privately owned and population growth is slow (INE 2006). In addition, the landholding concentration is not high. As a result, Uruguay does not have the characteristics that have led to deforestation in other countries. Further, Uruguay has used economic incentives to promote the development of forest plantations and wood manufacturing industries. Whether these incentives will result in deforestation or resource decline seems to be a non-controversial issue since effective regulations protecting native forest exists. In addition, forest plantations have been established on agricultural lands. Nevertheless, environmental groups have argued that monocultures composed

of either eucalyptus or pine will cause severe damage to the native forest (Guayubira 2006). In addition, those organizations claim that the forest sector does not generate economic benefits while providing low-quality employment (Carrere 2002).

The forest sector in Uruguay has been rapidly developing since the passage of the Forestry Law 15939 in 1987 (Durán 2004; Forest Division 2005). The Law established subsidies and tax incentives to support the development of forest plantations and wood manufacturing industries. This development is part of a broader trend in South America, where countries such as Brazil and Chile have long used economic incentives to attract domestic and foreign investment into their forestry sectors.

1.1 Objective

The objective of the project is to evaluate the impact of the new forest sector on the Uruguayan Economy by considering the costs and benefits associated with the policy that started with the Forestry Law 15939 promulgated in 1987.

1.2 Justification

The rationale for Law 15939 as discussed by members of Parliament was that the project will contribute to environmental, economic and social goals of the country. The existing studies have attempted to evaluate the policy and its impacts from the point of view of the government by focusing on fiscal impacts (González Posse & Barrenechea 1996); estimating tax balance, unemployment balance and product balance (Vázquez Platero 1996; Ramos & Cabrera 2001), or by studying individual firms (Metsa-Botnia 2004; World Bank 2005). These studies do not reflect the opportunity cost for the Uruguayan society of the resources used in the forest activity.

The current study uses a Cost-Benefit Analysis (CBA) to determine the impact of the new forest sector on the Uruguayan economy. It approaches the analysis from the point of view of the society, using shadow prices and a social discount rate.

The results of this project will be important for assessing the impact of a policy on the whole economy. The results will help in determination of whether (1) the incentives were efficiently used, (2) the incentives should be now terminated as the forest sector has already developed, or (3) the incentives should be refocused on different agents in the sector, i.e., small producers. In addition, the analysis of the sector will help in assessing further information needs. Finally, the discussion of forest policy evaluation methods from the standpoint of the country's economy will contribute to future studies.

The second chapter describes the methods of policy evaluation and discusses CBA along with the Social Choice theory and Welfare economics theories. In this framework, the rationale for establishing forest policies is discussed, and two South American forest sectors are briefly described: Chile and Brazil.

The third chapter describes the Uruguayan forest sector and examines forest laws and regulations. The silvicultural sub-sector has increased its share in agricultural GDP between 1990 and 2002, from 3.8% to 13.40%; and sawmills increased from nearly 0% of the manufacturing industry GDP[1] to 1.44% in 2003. Then a description of exports and imports is presented, with the emphasis on forest exports and its share in Uruguay's total exports, as most of the total production is exported. Favorable laws and regulations were key factors attracting foreing investor into the country.

[1] The GDP for sawmills was not included in the country's statistics before 2001 because its sharing in the industry's GDP was negligible.

The fourth chapter presents the analytical method, results and discussion. The CBA is discussed along with data and assumptions. The chapter addresses major issues with the use in the current study, including shadow pricing and its application for Uruguay, with emphasis in land and labor valuation. Finally, the CBA results are presented and discussed.

The fifth chapter summarizes the results and provides policy. Finally, several future research opportunities identified during this research are presented.

CHAPTER 2

POLICY ANALYSIS

Policy analysis considers a complex set of factors and therefore there are several ways to define the analysis (Patton & Sawicki 1993; Dunn 2004). Policy analysis is both descriptive and normative, because it has to describe the objectives, instruments, and results of the policy, and has to provide instruments to select the best policy. The choice of objectives and results involves balancing opposite interests and values such as efficiency, equity, security, and development (Dunn 2004). Furthermore, given their scarcity, the resources have to be allocated in order to consider different interests (Cubbage *et al.* 1993; Patton & Sawicki 1993). This allocation implies tradeoffs involved in following one policy or another.

A basic policy analysis process can be summarized in six steps: define the problem, establish the evaluation criteria, identify alternative policies, evaluate the policies, implement the policy, and monitor the implemented policy (Figure 1). First, the analyst has to define the problem, a process, which assumes that a problem exists and describe it with a focus on the central, critical factors. Problem structuring is the description and definition of the problem to be solved by the policy (Cubbage *et al.* 1993; Boardman 2001; Dunn 2004). Second, the analyst has to establish the criteria to evaluate alternative policies. The evaluation criteria chosen depend on the objectives of the policy and its effects on the population. The most common criteria used to evaluate a policy include cost, net benefit, effectiveness, efficiency, equity, legality, and administrative ease. Third, the analyst has to identify alternative polices according to their objectives and specific values and interests. A list of alternatives, including a thorough definition of each one, can reveal aspects of the problem not considered before. This description can lead to

a reformulation of the problem and return to the beginning of the policy analysis. Fourth, after selecting the alternatives, the analyst has to evaluate, with technical criteria, which alternative best achieves the objectives of the policy defined at the beginning of the policy analysis. Evaluation is the systematic assessment of the outcomes of a policy compared with a set of standards (Weiss 1998 in Bisang & Zimmermann 2006; Dunn 2004). It consists of the evaluation of the content of the policy, which includes programs and instruments (Bisang & Zimmermann 2006). The types of evaluation depend on the problem: the analyst can use quantitative methods of evaluation, qualitative methods of evaluation, or a combination of both. At this point, the analyst can find that there is information missing from the problem description, and then has to go back and redefine the problem. Fifth, after evaluating the alternatives and choosing the best one, this policy has to be implemented. Finally, the implemented policy has to be monitored in order to assess whether the policy worked properly and, if not, to identify the problems and correct them. Monitoring is the observation of previously defined indicators and produces information on the outcomes of the policy (Dunn 2004; Bisang & Zimmermann 2006).

The policy analysis is an iterative process: at each step there is feedback from the other steps, and the final step, to monitor the implemented policy, will be compared with the first step.

2.1 Policy Evaluation

2.1.1. History of Policy Evaluation

Formal policy evaluation began in the 1930s. On a systematic basis policies have been evaluated from the mid 1960s (Zerbe & Dively 1994; Rossi *et al.* 1999; Bisang & Zimmermann 2006). At that time the United States established two programs to fight poverty: the War on Poverty-Great Society initiative and the Executive Order establishing the Planning Programming

Budgeting (PPB) system, both programs mandated policy evaluation (Haveman 1987 in Rossi et al 1999; Rossi et al 1999; Bisang & Zimmermann 2006). The US General Accounting Office (GAO) was put in charge of these evaluation studies (GAO 1991 in Bisang & Zimmermann 2006). The Government Performance and Results Act, passed in 1993, required US executive agencies to evaluate their programs.

International institutions, such as the World Bank and the United Nations, also require evaluations of their projects (Dasgupta *et al.* 1972; Squire & van der Tak 1975; Nas 1996); Chelimsky & Shadish 1997 in Bisang & Zimmerman 2006). The World Bank requires an impact evaluation of its projects. It provides evaluation guidelines, recognizing that there is no single standard approach to conduct an impact evaluation, and that each evaluation has to consider the project, the country and institutional context and the actors involved. The Bank recognizes that there are different times in project evaluation: (1) evaluations for the Bank have to be timed with mid-term review and closing of the project; (2) evaluations for the government have to be timed with government discussions, i.e., budget, political context. Government participation in the project is considered a key element to the success of a policy. The role of the government is to identify the relevant policy questions, to ensure the integrity of the evaluation, and to incorporate the results in future policy choices (World Bank 2006).

Since the World Bank is an important lending source for developing countries, these developments had numerous impacts on project evaluations in Latin America. In Europe, program evaluations were introduced in the 1970s in Sweden, Germany and the UK. The practice of policy evaluation has expanded to other countries in the 1990s, making it a common practice nowadays (Leeuw 2004 in Bisang & Zimmermann 2006).

2.1.2. Types of evaluation

Policy evaluation methods can be classified in different ways: quantitative and qualitative, social choice and "implementable"[2], rationalist and social. A classification according to the objective of the evaluation criteria has been widely discussed in the literature. These methods range from qualitative methods (Dunn 2004) to quantitative methods (Dasgupta *et al.* 1972; Squire & van der Tak 1975; Ray 1984; Pleskovic & Treviño 1985; Stone 1985; Chowdhury & Kirkpatrick 1994; Zerbe & Dively 1994; Nas 1996), and a combination of both (Slee 2006).

Quantitative methods can be grouped in three categories: Input-Output models (I-O), Computable General Equilibrium models (CGE) and Cost-Benefit analyses (CBA). An I-O model uses a matrix to represent a nation's economy in terms of the linkages between sectors, households and the government (Pleskovic & Treviño 1985; Chowdhury & Kirkpatrick 1994). Multipliers are calculated from the matrix to estimate the change in total economic activity attributable to sector activity. A CGE model simulates a market economy by considering the abstract general equilibrium structure formalized by Arrow and Debreu (Bergman & Henrekson 2003; Wing 2004). A CBA estimates the costs and benefits associated with the new activity or policy. This approach differs from I-O and CGE models since it does not consider the economy as a whole.

Qualitative models include focus groups and in-depth interviews with the populations affected by the policy (Dunn 2004; Slee 2006). They aim to reveal stakeholders´ response to the policy under evaluation (Slee 2006). Most of these methods do not allow immediate quantification, and qualitative statistical methods should be adopted.

[2] The term "implementable" refers to a policy that can be put in practice.

A combination of quantitative and qualitative methods to policy evaluation has been proposed by Slee (2006). The method is called a multidimensional approach and it includes four elements: economic linkages, regional impacts, non-market benefits, and social analysis (Slee *et al.* 2003). The consideration of these elements will allow measuring the spillovers associated with a forest project, such as non-market benefits and local and regional development of the population around the forest.

Mendes classified policy evaluation methods into two general approaches. The first one is used when the policy maker has defined a set of objectives the policy should achieve and evaluates their achievement. The second approach takes performance criteria as given and assesses if the desirable outcomes can be put in practice implemented (Mendes 2000 in Carvalho Mendes 2006). The first group of methods is based on social choice theories, and the second group on implementation theory (Carvalho Mendes 2006). The social choice theories started with the General Possibility Theorem established by Arrow (1951). He proved that any social choice rule that satisfies a basic set of fairness conditions could produce an intransitive social order leading to a non-Pareto Optimal solution (Boardman 2001). The implementation method examines whether the policy targets were achieved, and if they were not, it investigates whether the goals were "implementable". The author proposes three types of implementation constraints: "feasibility, individual rationality, and incentive compatible constraints", and associates these constraints with three facts of policy making: resources availability, decisions decentralization, and imperfect information about the stakeholders (Carvalho Mendes 2006).

Finally, two groups of approaches resulted from the discussion at a symposium on Forest Policy Evaluation held in France in 2004[3]. One group is the rationalist, as the methods included

[3] EFI (European Forest Institute)-ENGREF (French Institute of Forestry, Agricultural and Environmental Engineering)-IUFRO (International Union of Forest Research Organizations) International Symposium. June, 2004.

here use a rationalist framework to evaluate a policy. The theories included the social choice theory, as explained above; the implementation theory, previously mentioned in the classification conducted by Carvalho Mendes; and the systemic theory, which considers the sector as groups of actors interrelated among them and with different institutions. Another group considers the context in which the policy is evaluated, including social and policy considerations rather than using rationalist schemes (Forest Policy and Economics Editorial 2006).

2.2 Cost Benefit Analysis

2.2.1. Social choice

According to the social choice theory, the government intervenes in the economy in response to market failures, which prevent an optimal resource allocation in society. These failures may include imperfect competition, asymmetric information, inability to provide public goods, or externalities. The policies of the government are driven by a goal of reaching income distribution and improving public welfare (Zerbe & Dively 1994; Dunn 2004). The policies will affect prices and then consumer welfare.

A convenient way to measure the change in the social welfare is the consumer surplus. The willingness to pay measured by the compensating and equivalent variations would be the correct way to measure welfare changes. However, in practice, the measures are difficult to obtain since deriving compensated demand curves requires holding utility levels constant. Therefore, demand curves in which income is held constant are used. The welfare measured using these demand curves, called ordinary demand curves are called consumer and producer surplus (Varian 1984; Zerbe & Dively 1994).

Consumer surplus (CS) is approximately the amount one would pay for the good over what one does have to pay. It is the usual measure of welfare change in CBA benefit cost analysis. The CS is represented by the area under the ordinary demand curve, but above the price (Figure 2). Producer surplus (PS) is an analogous concept to consumer surplus. It is the amount that can be taken from the producer or input supplier without diminishing the amount supplied. PS is measured along a supply curve just as CS is measured along a demand curve, so it is the area below the price and above the supply curve.

However, policy questions do not generally concern a single individual only. A central problem of any social welfare or social value theory is the problem of aggregation over individuals to obtain society's welfare (Zerbe & Dively 1994; Boardman 2001). The use of the Pareto Optimality criterion usually allows measuring society's welfare. This criterion is an efficiency norm describing the conditions necessary to achieve optimality in resource allocation. The Pareto Optimality criterion establishes that no one can be made better off without simultaneously making at least one other person worse off (Dunn 2004). The criterion is an efficiency norm criterion and three efficiency conditions are associated with it: production efficiency, exchange efficiency, and allocative efficiency. Production efficiency represents a resource allocation where it is no longer possible to increase the output of one good without reducing the output of another. Exchange efficiency represents a resource allocation where is impossible to make one individual better off without making one other individual worse off. Allocative efficiency is attained when production and exchange efficiency are both attained: the rate at which commodities are substituted in production equals the rate at which commodities are exchanged in consumption. Pareto Optimality criterion distinguishes between optimal and non-

optimal solutions but does not provide a conceptual framework for comparing two solutions that are efficient.

The problem of locating the optimal point on the utility frontier is a problem of social choice. Economists approach to the social choice problem by postulating a social welfare function. A social welfare function is a decision rule for making choices in which the welfare of more than one person or agent is affected. A social welfare function is a function of the utilities of *n* individuals:

$$W = W(U_1, U_2, \ldots, U_n)$$

Where: W = *society's welfare*

U_n = *utility of individual n*

n = *number of individuals in the society*

While the Pareto Optimality indicates an efficient resource allocation, in the real word is difficult to attain. Consequently a more flexible criterion is used: the Potential Pareto improvement also called the Kaldor-Hicks criterion. According to this criterion, those individuals who benefit from reallocation could compensate those individuals who lose (Zerbe & Dively 1994; Boardman 2001).

The value of a resource allocation change can be measured by considering consumer and producer surpluses. Examples of factors affecting welfare include externalities, supply changes, and other market distortions. Social welfare can be affected by a policy, such as new taxation or subsidies. Figure 3 provides an example of how new taxes affect three sectors of the economy: consumers, producers and government. The supply curve shifts backward, and the price paid by the household changes from p_0 to p_d while the price received by the producer is p_s. The loss in CS

equals area A plus area B while PS loses area C plus area D. The revenue received by the government equals area A plus area D. The difference between the revenue received by the government and the households' and producers' loss is called deadweight loss, consisting of area B plus area D.

2.3 Forest Policy

There are several reasons for policy interventions in the forest sector. First, forests provide non-market services such as soil conservation, aesthetic values, recreation, and carbon storage (Chappelle 1971; Ellefson 1988; Dore & Guevara 2000; Clapp 2001; Clark 2004; Richards & Stokes 2004). Second, forest investments are long-term investments. They require the maintenance of a large capital stock, which makes the opportunity cost of capital tied up in growing stock high.

Meijerink (1997 in Enters et al. 2003) proposed that incentives should be applied to public goods only. Where plantations provide environmental services such as soil or watershed protection, prevention of land degradation or carbon sequestration, incentives are appropriate because private net returns are often lower than overall social returns. Enters et al. (2003) proposed incentives to projects that provide employment, especially to new forest industries in countries with competitive advantages, ensuring reliable supplies of strategic timber resources, and alleviating rural poverty. Scherr and Current (1999 in Enters et al 2003) stated that incentives might be particularly justified to accelerate the pace of plantation development in cases where a developing industry requires a minimum supply of raw material. Clapp (1995 in Enters et al 2003) stated that commodity industries such as pulp and paper need economies of scale to be competitive, then a subsidy to start their activities may be necessary. Cubbage et al.

(1993) mentioned that reducing income taxes by providing tax deductions or tax credits for timber growing is a way of favoring timber investments.

On the other hand, some authors claimed that incentives represent a misallocation of public-sector resources and are not needed when the private returns from plantation management exceed those from other land uses (Forestry Law 13723 1968; Haltia & Keipi 1997). Furthermore, in a number of instances government forestry policies have aggravated problems such as deforestation (Repetto & Gillis 1988). The deforestation of Brazilian Amazon, the inefficient use of resources in Philippines, and illegal logging in Indonesia are the most common examples of these negative effects (Repetto 1988; Repetto & Gillis 1988; Berck *et al.* 2003; Bacha 2004).

2.4 Latin American Policy

In Latin America, the use of incentive mechanisms promoting forest investments started in the 1970s and was broadly adopted in the 1980s. Chile, Argentina, Brazil and Uruguay introduced subsidies, tax breaks and tax exonerations to promote the development of forest plantations and wood manufacturing industries, with different results. Colombia, Ecuador and Paraguay took the Chilean model to establish subsidies.

2.4.1. Chile

2.4.1.1 Regulation

The development of the forest sector in Chile began with the Decree Law 701 that created the Forestry National Corporation (CONAF). The objective of the policy was: "…to promote plantations, reforest, rationalize the exploitation and attain the optimum

management of the forest" (Sabag Villalobos 1984). Management plans are required for native forest, forest plantations, afforestation projects, and harvesting operations (FAO 2006). The instruments applied consisted of subsidies and tax exonerations (Sabag Villalobos 1984; Silva 2004; FAO 2006). Currently subsidies are not in force and tax exonerations are the only incentive still available. Policy results were positive. The area of pine and eucalyptus plantations increased substantially (FAO 2006).

Small producers were not included in the incentives schemes established by the Decree Law 701 (Silva 2004). The reestablishment of a democratic government led to several reforms of the forest policy. These reforms included the debate of the Native Forest Bill in 1990, and the reform of the Decree Law 701 between 1994 and 2000 (Silva 1999 in Silva 2004). The Native Forest Bill was one of the first environmental initiatives of the government. The Native Forest Bill aimed to protect native forests that were under pressure from invading pine plantations. Several political issues and opposite interests arose in the debate, with the president and the Agricultural Ministry supporting the Bill, and the Economy Ministry, part of the legislature, and the timber corporations opposing it. The Native Forest Bill is still under deliberation and has not yet been approved. The reform of the Decree Law 701 aimed to redirect the subsidies from large corporations to small producers. Following negotiations, large corporations received an extension of tax exonerations but did not gain access to the subsidies.

2.4.1.2 Forest Resources

Chile's forest area has grown over the past 15 years as a result on increased planting. At the same time, native forest area has been stable. The total forest area reached 16 million hectares (ha) by 2005 (Table 1). Between 1998 and 2004, about 40,000 ha were planted

annually. The country is divided into 13 regions. Native forests are located in Regions IX through XII and forest plantations are concentrated in Regions VII through IX (Lara & Veblen 1993). In 1994 radiata pine covered 75.5% of the total planted area, and eucalyptus 16.9%. By 2004 the share of radiata pine declined to 47% and while that of eucalyptus rose to 40% (Paredes 1999; Southern Hemisphere 2006). The value of forest production increased more than four times between 1984 and 1997. During this period, 74% of the production was exported (Paredes 1999). Wood pulp production reached 3.4 million ton in 2004, as much as 2.5 million were exported. Pulpwood consumption also increased, and there is a concern regarding future pulp wood availability for new projects. Paper exports increased by 78% between 1986 and 2004. Paper exports increased in 2004 compared to 2003 by 31% (Southern Hemisphere 2006).

Lumber production has also increased reaching 8.6 million m^3 in 2004, with 2.4 million m^3 exported. On the other hand, local lumber consumption has also increased due to the growth of the construction sector (Paperloop 2005; Southern Hemisphere 2006).

2.4.1.3 Industry

The Chilean forest industry is one of the most rapidly growing in the world (Clapp 2001; Silva 2004). The pulp industry is highly concentrated. rauco and CMPC Celulosa are the most important companies (Paperloop 2005; Southern Hemisphere 2006). Arauco owns four pulpmills in Chile and one in Argentina (Southern Hemisphere 2006). The solid wood sector is also highly concentrated: nine companies account for 90% of the production. The most important companies are the same as in the pulp sector: Arauco and CMPC Celulosa (Southern Hemisphere 2006).

2.4.2 Brazil

2.4.2.1 Regulation

Between 1967 and 1986, Brazil has provided incentives for establishing forest plantations. The first law was established in 1966 and included tax incentives to plantations (Keugen 2001; Flynn 2005). To be included in this program the owner had to present a plan to the Brazilian Institute for Forestry Development (IBDF), which had to approve it, and then the plantation and maintenance costs were deducted from the income taxes for the first three years of the operation, up to a maximum of 50% of the income tax. During the 1970s the law was revised restricting the tax exonerations to legal entities, and reducing gradually the percentage of tax deduction. In 1987, the percentage was reduced to 10% and restricted to the Northeast of the country (Flynn 2005). A controversial issue was the use of agricultural lands for forestry. In 1976 the regulation established "Priority Regions for Reforestation and/or Forest Industry Districts" for planting. Currently, the federal government has two programs that provide incentives to small and medium sized landowners to plant trees.

Regarding the industry, the Brazilian Government has encouraged the establishment of specific programs to develop the industrial forest sector. The Wood and Furniture Forum is led by the Ministry of Development and Foreign Trade and was established to promote growth in the sector. The BNDES has financed studies which indicate that more plantations are needed in order to provide wood for the new industries. Therefore, the BNDES has been financing forest plantations projects. PROMOVEL is the Brazilian Program for Increasing Furniture Exports. It was created in 1998 by the Brazilian Furniture Association (Flynn 2005).

There are some protective tariffs to the wood products industry. On one hand, taxes on wood imports have been decreasing. On the other hand, imported equipment has high tariffs in order to encourage the use of local machinery (Flynn 2005).

Another law requires that at least 20% of every forest area must be maintained in "natural vegetation"(Flynn 2005).

2.4.2.2 Forest Resources

Today, Brazil has nearly 6 million ha covered with forest plantations, and the total area of natural forest is more than 550 million ha as is shown in Table 2 (Flynn 2005; Paperloop 2005; FAO 2006; Southern Hemisphere 2006). Eucalyptus accounted for 63% of total planted area and pine for 31%. Eucalyputs growth rates differ according to states and companies, ranging from 30 to 50 m^3/ha/year. Annual harvest is estimated in 60-70 million m^3, and it is projected to increase to 106 million m^3. Consumption is divided into pulp mills (50%), charcoal and energy (40%), panels (6%), and lumber (4%) (Flynn 2005).

Pine plantations are located mainly in the state of Parana, 682,000 ha, and were planted between 1967 and 1998 (Southern Hemisphere 2006). The ownership is not very concentrated as 12 companies own 18.4% of the total (Flynn 2005). Rotations are on average 22 years in the South, with a first thinning at 12 years and a second thinning at 17 years. If pines are managed for pulp, rotations are 16 years (Flynn 2005). Pine harvest is divided among sawmills (60%), pulpmills (22%), plywood (10%) and composite wood panels (8%).

2.4.2.3 Industry

Brazil is the 7th largest producer of pulp in the world and the 11th largest producer of paper and paperboard in the world (Flynn 2005; Paperloop 2005). Pulp production has been expanding since the 1990s (Flynn 2005; Paperloop 2005). Aracruz is the most important pulp company with a pulp production capacity of 2.25 million metric tons in 2003. The reminder is divided among five companies (Flynn 2005; Paperloop 2005).

Another growth industry is packaging. The largest packaging producer is Klabin which has a capacity of 150,000 ton/year (Flynn 2005; Paperloop 2005).

2.4.2.4 Exports

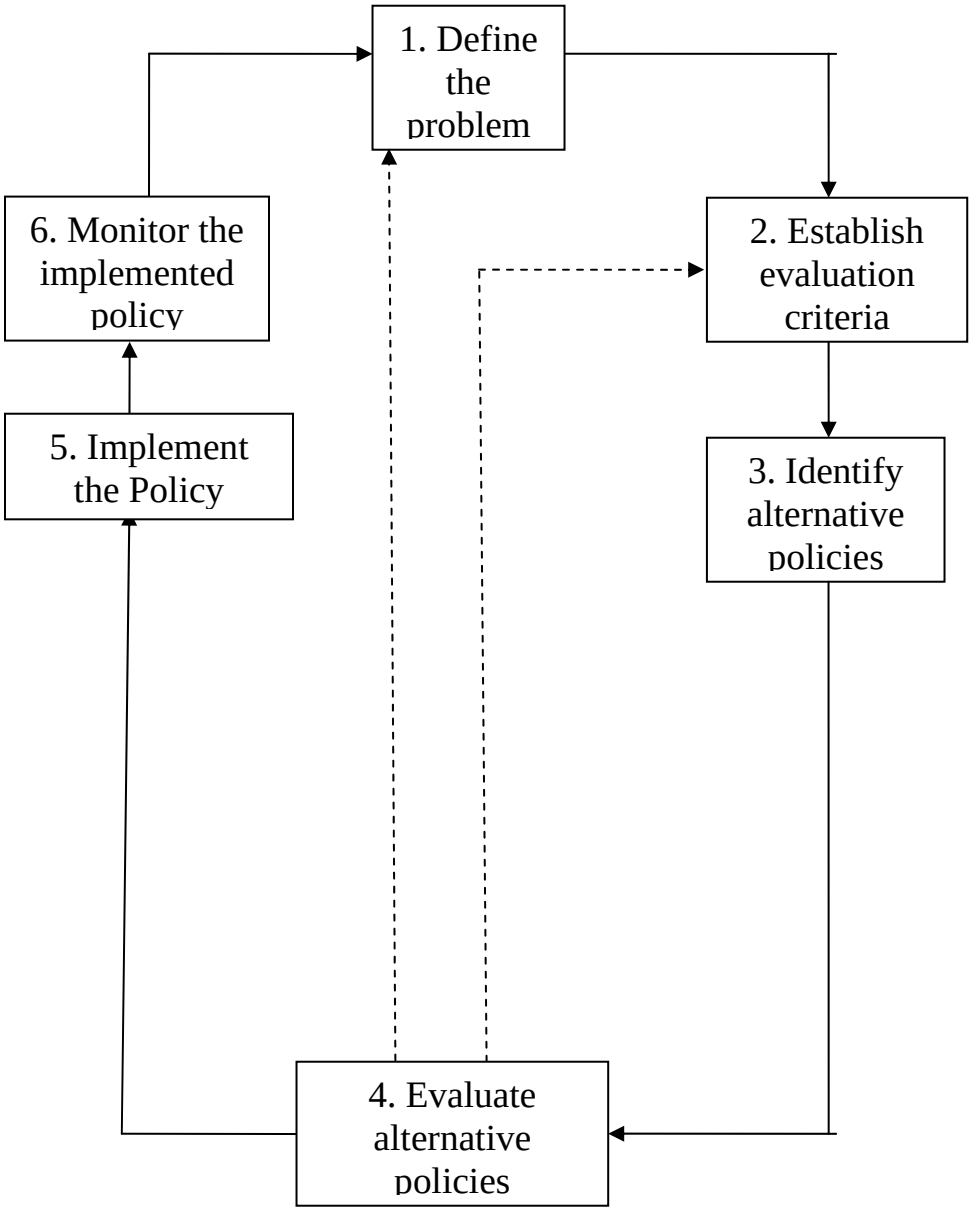
The value of sawn wood exports increased 23% between 2003 and 2004. The growth in the following year was much smaller. The exports increased by 5% only due to the Real devaluation (Southern Hemisphere 2006). The most important export markets were United States and China.

Pulp and paper exports have been increasing reaching 1.187 billion US$ in 2004. The main destinations for pulp were Europe (47%), Asia (29%) and North America (21%); on the other hand, paper went to Latin America, Europe (18%) and North America (16%) (Flynn 2005).

2.5 Summary

The design of a public policy implies the choice of objectives that considers scarce resources and opposite interests. The last objective behind any public policy is to increase the welfare of the society, i.e., to make a group of persons better off without making anyone else worse off. This is known as the Pareto Optimality criteria.

In Latin America, many countries started forest programs with different results. Chile and Brazil can be characterized as the most successful, even though their policies and strategies have been different. Chile has a highly concentrated forest industry while Brazil has less concentrated industry. Both countries rely on exotic species.



Source: Adapted from Patton and Sawicki, 1993.

Figure 1. Basic Policy Analysis Process

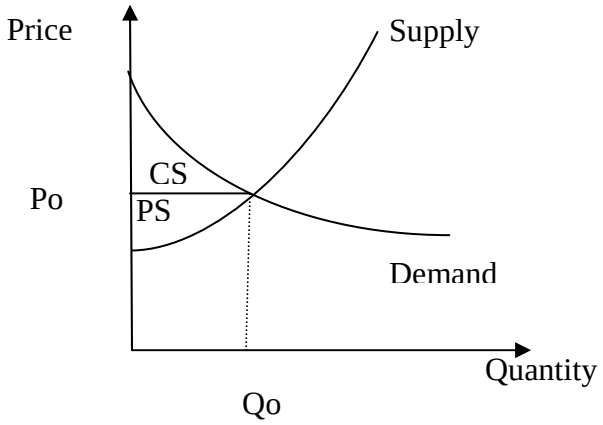


Figure 2. Consumer and Producer Surplus

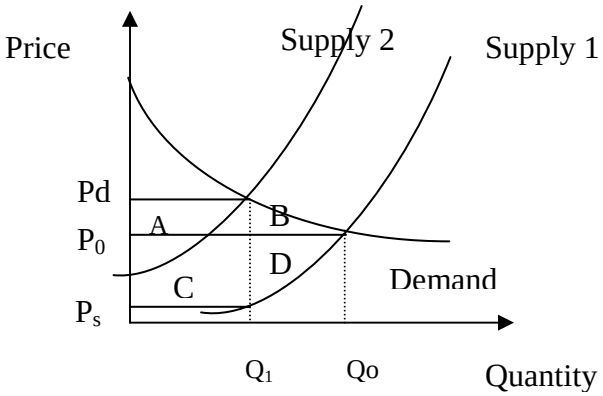


Figure 3. Taxation and Deadweight Loss

Table 1. Forest area in Chile (1,000 ha)

FRA 2005 Categories	1990	2000	2005
Primary	4,152	4,145	4,142
Modified natural	9,344	9,309	9,292
Semi-natural	26	26	26
Sub total	*13,522*	*13,480*	*13,460*
Productive plantation	1,741	2,354	2,661
Protective plantation	0	0	0
Total	15,263	15,834	16,121

Source: FAO, Global Forest Resources Assessment 2005.

Table 2. Forest area in Brazil (1,000 ha)

FRA 2005 Categories	1990	2000	2005
Primary	460,513	433,220	415,890
Modified natural	54,444	54,714	56,424
Semi-natural	-	-	-
Sub total	*514,957*	*487,934*	*472,314*
Productive plantation	5,070	5,279	5,384
Protective plantation	-	-	-
Total	520,027	493,213	477,698

Source: FAO, Global Forest Resources Assessment 2005.

CHAPTER 3

URUGUAY'S FOREST SECTOR

Uruguay is a small South American country located between Argentina and Brazil. It has a Gross Domestic Product (GDP) of 18 billion US$ (Central Bank of Uruguay 2005). The most important sector of the economy is Manufacturing Industries, which accounts for 22.9% of GDP. Another important sector is Agriculture, including livestock, which contributed 8.7% to the GDP (Figure 4). The silviculture sub-sector (forest plantations) has increased its share in the Agricultural GDP between 1990 and 2002 to 13.4% (Table 3).

The Uruguayan Economy has been relatively stable during the last 25 years, except for two financial crises in 1982 and in 2002. In 1982, the exchange rate system collapsed leading to a currency devaluation and a financial crisis. This resulted in a decline in the agricultural sector, which had debt denoted in US$ and was multiplied by the devaluation effect. After a period of high growth in the 1990s, the economy began to contract in 1998, and the 2002 financial crisis reinforced this phenomena. However, in 2003 the GDP increased 1% versus a 10% decline the year before. This reversal can be explained by growing exports and by substituting imports with domestic production. The trade balance in Uruguay was negative between 2000 and 2005 with the exception of 2003. The main export is beef, which accounts for 33% of total exports. Even though in 2005 exports increased by 16.2%, imports increased 24.4%, resulting in a trade deficit of 474 million US$. A one-time special purchase of 243 million US$ of Venezuelan oil was part of the deficit.

The Uruguayan exchange rate regime[4] has changed from pegged exchange rates within horizontal bands in the 1990s to a floating system in 2002, after a 93% devaluation that year. The devaluation has increased the competitiveness of domestic production and exports grew. At the same time, imports declined due to a contraction in consumption (Economic Institute 2003).

3.1 Description of the Uruguayan Forest Sector

3.1.1 Area

Forest area is in Uruguay reaches almost 1.5 million ha, constituting 9% of the country's land base (Agricultural Ministry of Uruguay 2000; Ramos & Cabrera 2001). Forests are classified as either plantations or natural forests. Natural forests cover 740,000 ha, representing 4% of the country's land area (Agricultural Ministry of Uruguay 2000; Ramos & Cabrera 2001). Plantations cover 751,000 ha and their area has grown rapidly from between 1990 and 2005 (Table 4).

The last Agricultural Census, CGA 2000, shows a significant increase in the forest area (Agricultural Ministry of Uruguay 2000). Planted forest area reached 661 thousand ha in 2000. That represented a nearly 4-fold increase from the preceding Census of 1990. According to the Forest Division of the Agricultural Ministry, between 1990 and 2002, 590,000 ha were planted under the incentives of the Forestry Law (Durán 2003).

The law provided fiscal incentives for the development of commercial forests plantations on priority soils, generally marginal agricultural (Figure 5). The CONEAT[5] index measures the productivity of the land by soil type, location, and productivity. The base index is 100; lands

[4] The exchange rate considered here is the price of a dollar in terms of Uruguayan Peso ($U). The US$ is the currency used by the Uruguayan Government to set the exchange rate and the exchange rate regime.

[5] CONEAT stands for the National Commission of Agronomic Study of the Land. This Commission depends on the Renewable Resources Division (RENARE) which depends on the Agricultural and Livestock Ministry (MGAP).

with an index higher than 100 are considered very well for livestock and agriculture; lands with an index lower than 100 are considered poor lands. Ramos and Cabrera built a weighted average CONEAT index for forest lands and estimated that between 1989 and 1999 the index was 69.6 (Ramos & Cabrera 2001) (Table 5).

3.1.2 Species

Plantation incentives were provided for particular tree species. As a consequence, eucalyptus species account for 76% of planted areas greater than 10, and pine for 22% (Figure 6). While pine has been more frequently planted in recent years, eucalyptus still accounts for the majority of the planted area,

3.1.3 Location

Forested areas are geographically concentrated in the north of the country (the provinces of Rivera and Tacuarembó). The remainder is found in the west (the provinces of Paysandú and Río Negro), and in the southwest (the provinces of Lavalleja and Maldonado). Currently, forest area is Cerro Largo also growing. Rivera is the province with the largest forest area (115,000 ha, which represents 13.1% of the total agricultural area of the province). It is followed by Tacuarembó (97,300 ha, 6.6% of the total agricultural area of the province); and Paysandú (93,000 ha, 6.9% of the total area of the province). Nearly a half of the forest planted area is located in those three provinces, Rivera, Tacuarembó and Paysandú (Durán 2003).

3.1.4 Ownership

The saw timber and paper sectors have begun developing rapidly in the 1990s. As the first forest plantations neared their first harvest, international investors have discovered Uruguay's forest sector as an attractive investment opportunity. Traditionally, the sector concentrated on paper and lumber production manufactures. These lumber manufacturers were small local firms (Durán 2004). The Forestry Law has recently attracted new, primarily foreign, investors who focus on plantations development and paper and lumber manufacturing. The forest sector today is characterized by the coexistence of large, vertically integrated firms with many small scale primary producers and a substantial presence of foreign investors. Production and export activities are the domain of a few large firms (Durán 2003; Mendell *et al.* 2007).

Even though there are more than 19,000 farms with at least one forested ha, the forest plantation estate is highly concentrated: 96% of the farms have less than 100 ha planted and they control only 17.3% of the forest area. Most of these small farms use plantations for shelter and shadow for livestock or for other non-commercial purposes. On the other hand, 62.8% of the plantation area is in farms with forest areas greater than 500 ha. Intermediate farms (planted areas between 100 and 500 ha) account for only 9% the total forest planted area (Table 6). According to DIEA assessment, in 2000 there were 64 farms with planted area between 1,000 and 10,000 ha and 9 farms with forest planted areas larger than 10,000 ha (Durán 2003).

3.1.5 Forest Income

The development of plantations and growing production of wood products have transformed the forest sector into an important source of income. According to the Agricultural Census 2000, out of 57,131 farms, 1,015 listed forestry as their main source of income. The

forest sector employs 2,962 workers, from a total of 157,000 employees in the agricultural sector. In addition, a large number of workers serve the forest sector by performing harvesting, pruning, and thinning operations. The Forest Division estimated that in 2000 the sector had approximately 14,000 employees in the forest plantations (Durán 2003).

3.1.6 Wood harvest, manufacturing, and exports

Growing wood harvest fueled a rapid growth in wood exports. The harvest volume increased 27% between 2000 and 2003, rising from 2.9 million to 3.7 million m^3 (cubic meters) (DIEA 2004). Pulpwood production increased from 893,000 to 1.6 million cum, a gain of 83%, and fuel wood production increased from 1.4 to 1.6 million cum, a gain of 13%. Much of the harvest, except fuel wood, is designated for export (Forest Division 2005).

While export growth has been rapid, its share in the Trade Balance remains low. Forest products exports account only for 5% of the country's total exports, and in the period 1989-2004 the share has oscillated between 2 to 7% (Table 7). At the same time, forest products imports account for 3.5% of the total imports (ALADI 2006). It is expected, however, that maturing plantations will increase wood harvest which would promote export-oriented production. The two most important export groups are (1) saw timber (2) paper and cardboard, and pulpwood has been increasing in the last years (Table 8). If paper and cardboard exports are not considered, forest exports account for 4% of the country's total exports.

Since 1990 pulpwood production increased dramatically. About 50% of the production is exported. Saw timber and lumber production also increased. Since domestic consumption of these products has been stable, their export continues to grow. In 2000, about 100 thousand cum of lumber were exported. That accounts for a fifth of the total lumber production. Paper and

cardboard exports also increased, reaching more than 50,000 tons in 1999, or 40% of the total production. That year the total forest exports were less than 100 million US$, 4.4% of the total exports in Uruguay. By 2004, pulpwood exports reached 92.5 million US$, lumber exports 18.1 million US$, and paper and cardboard 31.6 million US$.

During the 1990s pulp logs exports went to Europe: Spain, Norway, Finland and Portugal. Lumber was sold to Italy, USA and Japan (Figures 7 and 8).

3.1.7 Export Prices

Between 1989 and 1999, exports grew in volume but not in value. The Central Bank of Uruguay (BCU) constructs an index for Paper and Cardboard (Series X). The Index is a Paasche Index with base in the previous year on FOB[6] values, and it is available from 1994 to 2004. The index shows that prices increased between 1994 and 1995, but started declining in 1996 (Table 9).

The Forest Division provides export information by value, volume, and item, allowing the estimation of unitary values. This information is available for years from 1980 and 2005, for hardwood and softwood saw timber and pulpwood. The results indicate that hardwood saw timber unit values were more stable than softwood saw timber ones (Table 10). Hardwood prices varied from 27 to 314 US$/$m^3$ in the period[7]; while softwood unit values oscillated from 99 to 115 US$/ m^3. Softwood pulpwood pries were stable at around 40 US$/ m^3 [8].

The Association of Industries of Uruguay (CIU) constructs a Paasche index for the entire sector (saw timber, pulp, paper, cardboard, printing, etc.) based on the National Customs Administration (DNA) data. The index is also calculated for saw timber, but not for pulpwood

[6] Free on Board.
[7] In 1990, the average unit value was 5 US$/cum, a value that probably does not reflect the real price.
[8] There is no information about pulp prices before 1989.

because its share in Uruguay's total exports is low. The weights are not fixed as the index base is the preceding year. Three products are included: pine wood, eucalyptus wood, and other species wood (Table 11). The results from 2000 to 2006 with 2000 as a base year show that prices had decreased until 2002 and after that started growing again.

3.1.8 Imports

Forest products imports increased in the 1990s: paper purchases increased four-fold, representing 60% of the total forest imports in value; lumber represented 18% of the total; remanufactured wood purchases represented 5% of the total. Pulp purchases doubled in value and tripled in volume, reaching more than 10% of the total. Between 1995 and 2005, forest imports[9] were on average US$ 47 million annually (Table 12).

Two thirds of the Uruguayan purchases of paper and cardboard came from the region, mainly from Argentina and Brazil, 15% came from North America, and the rest from Europe. The regions are the source for 70% of pulpwood imports.

3.1.9 Forest Industries

The National Institute of Statistics (INE) collects information for industries using the Uniform International Industrial Classification (CIIU). According to its estimates, based on INE and BCU data, sawmills and pulp and paper industries constituted 1.36% of Uruguay's GDP in 2003 (Table 13). This percentage will be higher after new facilities currently under construction are included. Botnia, which will have completed a pulp and paper mill investment of one billion

[9] Not all the products were considered. Ramos and Cabrera (2001) considered all the products and indicated that between 1989 and 2000, the forest imports averaged 75 million US$ annually.

US$ this year. The mill construction began in the third quarter of 2005. Other companies, such Urupanel and Colonvade in Tacuarembó also completed their investments after 2003.

The CIIU 2 was used until 2002. Then it was replaced the CIIU 3. In CIIU 2, the pulp and paper industry was considered together with newspapers, printing, etc. In CIIU 3, they are separate items, and the wood and wood manufacturing industry includes new items as well. Therefore, the production values of each subgroup cannot be compared for those years. The Association of Industries of Uruguay (CIU) constructs a Production Index (PI) for the industry using the CIIU 3 codes from 1993 to 2006 based on INE data, which was used to convert the values from current US$ to constant 2002 US$ (Table 14).

Pulp and Paper Industry GDP increased 6% between 1998 and 1999, measured in constant US$ of 2002, and then declined (Table 15). In 2002, the INE changed the classification system and the Pulp and Paper sub sector does not include printing; therefore, the results cannot be compared easily. However, after adjusting the data, the results show that the GDP in US$ increased. If only pulp and paper industry is considered, between 2002 and 2003, its GDP increased 30%; sawmills GDP increased by 67%; meanwhile, manufacturing industry GDP decreased. There are no records of sawmills GDP before 2002.

Analyzing the share of forest industries in total manufacturing GDP, only sawmills increased their share significantly between 2002 and 2003 (Table 16). This is consistent with the current situation in the forest sector: the new projects that just have been completed or are about to be completed are not included in the GDP.

The number of sawmills decreased, indicating the industry concentrated. By 2000, the number of sawmills declined to about than 50, down from 113 in 1988. The sawmills operated primarily in Montevideo (45%), San José and Paysandú (20% each) and Rivera and Tacuarembó

(15% of the total) (Ramos & Cabrera 2001). In the 1990s, the production of pulp wood and recycled paper increased, as well as the pulp and cardboard production, to lesser degree, but the employment in those sub sectors was reduced to half (Ramos & Cabrera 2001).

Currently, five firms are key players in the forest sector in Uruguay: Botnia, Colonvade, Fymnsa, Cofusa-Urufor, and Urupanel. Two firms invest heavily in pulp manufacturing: Ence and Stora Enso. Botnia, is constructing a pulp mill in the North of the country, which involves the largest single investment in the country's history, with a value of one billion US$. The mill will be operational the third quarter of 2007. Ence has partnerships with several local firms and had been planning a pulp mill. Due to a dispute with Argentina, Ence has been forced to change the mill's location and that decision is still under consideration. Stora Enso has just arrived in the country and is also planning to build a pulp mill. In the saw timber and plywood sector, the leading firms include Fymnsa and Urufor (domestic) and Weyerhaeuser and Urupanel (foreign). Colonvade is constructing a plywood facility and plans to build five to eight more plants in Tacuarembó, Rivera and Paysandú. Fymnsa, one of the oldest and biggest domestic companies located in Rivera, is constructing a sawmill. Cofusa and Urufor operate in the North of Uruguay and produce high quality eucalyptus grandis timber. Urupanel is a Chilean lumber company located in Tacuarembó.

3.2 Forest Policy

Even though there was a general agreement when the Forestry Law was approved in 1987, controversies soon followed. The Forestry Law in Uruguay was controversial for several reasons including subsidies and regionalization. Regarding subsidies, the main issues were: (1) whether the subsidies were necessary to attract investments, (2) whether to subsidize other,

already established, sectors of the economy and (3) whether the subsidies should be in effect for regions which determined that better alternative uses exist for lands allocated to forest development. Regarding regionalization, the argument focused on the designation of forest priority lands as it was argued that not all lands included were low productivity lands.

3.2.1 Background and Previous Regulation

In the 1950s, the potential to increase forest production in Uruguay was studied. At the same time, the country's soils were classified according to their productivity (CIDE 1963). The classification had five soil groups, and the country was divided into thirteen soils zones for management and conservation (Berreta 2003).

In 1968, the first Forestry Law was approved (Forestry Law 13723 1968), and the forest sector became the only economic sector with a Promotion Policy (Gabriel San Román Policy Director, Forest Division. Personal Communication, July 2006). The objective was to increase the forest area. The instruments used included tax exonerations, tax reinvestments in plantations, and credit extended by the BROU.

The Law did not achieve its objectives for a variety of reasons. The law was incomplete, funds were not allocated for the Forest Fund, and priority zones were not defined. Furthermore the credit extension was not designed according to the long term characteristics of a forest investment (Forestry Law 13723/54-56). Forestry loans were offered by the BROU for a period of only 10 years (Forestry Law 13723/53), and timber rotations range from 15 to 25 years.

3.2.2 Forestry Law 15939: objectives and instruments

The second Forestry Law was approved in 1987 (Forestry Law 15939 1988) by all members of the Parliament, even though some members expressed their concerns about some areas[10].

The parliament passed the law to generate to environmental, economic, and social benefits for the country. The main objectives of the 1987 Forestry Law were to increase planted area and to protect native forests. The specific objectives were to increase forest cover through the introduction of fast-growing species in regions with poor soils, to promote industrial development in non-industrialized regions, and to increase and diversify exports.

The Forestry Law 15939 is the framework for the current forestry policy, but, as the sector has been developing, new regulations have been developed in several decrees and resolutions. Some of these regulations were designed to implement certain parts of the Law (i.e. soils priority zones, tax exonerations, subsidies, Forest Fund); others were developed to consider new factors that emerged during the development of the forest sector (e.g. species productivity); and finally some were developed to modify original resolutions that needed updating (e.g. soils priority zones, subsidies).

The policy instruments used include regionalization, tax exonerations, subsidies, and credit. Regionalization consisted of defining forestry priority zones in the country. Forestlands are defined and zones classified according to soil type in Decree 452/88. Soils classified as priority soils in Forestry Law 15939 and following decrees (Decree 452/88-Article 2; Decree 26/93) are located mainly in the North, Northwest and Northeast of the country. To be classified as the forest priority soil, the site has to be characterized by a low natural fertility but offer good

[10] The Forest Producers Society summarized the history and discussion of the Forestry Law 15939 in an internal report that was obtained during the author's visit to Uruguay, but they date when the report was prepared was not known.

forest growth conditions (Decree 452/88-Article 3). The minimum area to be considered a forest was set at 2,500 square meters (Decree 452/88-Article 1).

The definition of priority zones also included "supplementary soils" that could be planted up to 40% of the total area[11] (Decree 333/90). This decree was revoked in 2005 (Decree 154/05). Currently, forest planting requires an associated management plan, and to plant in accessory soils, an environmental plan (Decree 191/06; Decree 220/06). These changes have only a limited impact on forest investment decisions as they do not affect the management of lands where most forest plantations have been developed [12] (Personal Communication with Forest Companies, July 2006).

Tax exonerations for forestlands and taxes and tariff exonerations for goods and inputs used for forestry activities also were established. Tax exonerations included land tax, which is 1.25% on the land value and will vary according to soil productivity[13]; rural property taxes; the exoneration of the Global Tariff Rate and Value Added Tax (IVA) for the imports[14] by forest companies for 15 years. While the last exoneration expired in 2002; property tax exonerations are still in force. To benefit from the exonerations, the plantations have to be qualified as protective and production forests and they have to be located in forest priority zones.

Law 16002 established a subsidy of up to 30% of the cost of plantation but this percentage was later increased to 50% (Law 16.170, Article 251; Decree 212/97, Article 1). Currently subsidies are not in force. Another change is that forest priority soils and species are under revision, but projects previously approved are not affected.

[11] In Decree 452/98 it was allowed to plant in "supplementary soils" up to 10% of the total area.
[12] Other groups of soils affected are: 2.11a, 2.12, 5.01c, 5.02a, 7, 8 (not all) (Decree 191/06).
[13] The value used to calculate the tax is the CONEAT Index.
[14] Activities are listed in Decree 457/989 and include: fertilizers, chemical products, vehicles, machines, equipment for fire prevention, etc.

Credit is another tool used by the Government to promote forest investments. The Republic of Uruguay Bank (BROU) finances nurseries and different stages of the forest production. It provided financing of up to 80% of the project's value, not considering land value; the credits are in US$, and payment begin up to 10 years later.

The ability to create Joint Stock Corporations with bearer shares was one of the changes introduced by the new Forestry Law. Join Stock corporations with bearer shares were not allowed in the Agricultural Sector, but the Forestry Sector was the exception. Today, they are allowed in the Agricultural Sector as well.

Wood manufacturing industries benefit from other laws as well[15]. Investments Promotion and Protection Law and associated decrees, and Free Trade Zone Companies regulations all help in developing wood processing. Investments Promotion and Protection Law (Law 16906 1998), establishes tax exonerations and tax breaks for investments that are considered as National Interest Projects. To receive the benefits introduced in the Law the project has to be declared by the Government as National Interest Project. The project has to be presented to the Customer Office at the Tourism Ministry. The requirements include presenting a note describing the fiscal incentives requested, an investment project containing a description of its costs and benefits, and an environmental impact study when necessary and a proof of origin of the capital.

Industries can choose to develop a Free Trade Zone. Two international forest companies had adopted this regime: Botnia and Ence[16]. To be considered under this scheme, the company has to present a project to the government describing the economic viability of the project and the benefits it will generate for the country. After obtaining the authorization, the company has to

[15] These laws are in force for all industries, not just for forest industries.

[16] By October 2006, Ence announced a change in the mill construction plans. The mill would be relocated and therefore, the construction is delayed.

pay either a one-time fee or a periodic fee. The benefits include tax exonerations. All the national taxes are exonerated except for social security contributions. In addition, the entrance of goods and the services rendered within the free trade zone is exempt from all taxes. Goods inbound to the zone from Uruguay are considered to be exports and goods outbound from the zone are exempt from all taxes. However, if the goods are moved into Uruguayan territory they are considered imports. The company that operates in a tax free zone is not allowed to have activities in the rest of the country (Tourism Ministry 2006).

3.3 Native Forests

Native species represent 3.7% of the country's land area. They are composed of 140 species. The species distribution varies with geographical location, particularly with soil conditions. Native forests can be into five groups: gallery forests, mountain forests, park forests, ravine forests and palms.

Traditionally, native forest has been used for fuel wood. Fuel wood consumption has been constant at around 35,000 to 40,000 tons annually. The sellers are controlled by the Government and are required to report their stocks every four months.

The native forests also have non-timber uses. The species present in Uruguay can be used for medicine, carbon storage, cosmetics (essential oils), fruits[17], and ornaments (Escudero 2004). The ecotourism has been proposed as an interesting alternative use for native forests and is currently developing in the country.

Some studies have attempted to estimate the returns of managing native woods (Cubbage *et al.* 2006). By considering three different management regimes, the study analyzes different species in the Southern Cone of Latin America and in the Southern United States.

[17] The Agricultural School of the University of Republic in Uruguay has attempted to work in this field.

Natural stand returns in Latin America were much lower than those of plantations. The average natural forest growth rates were estimated at 1 cubic meter per hectare per year (m^3/ha/yr), resulting in a low internal rate of return (IRR). The immediate harvest of native species would be more attractive financially, but is not likely to be sustainable without good management.

The unsustainable use and exploitation of the native forests worldwide is a widespread problem. There are three different approaches to the management of the native forests: exploitation, preservation and conservation. Exploitation refers to the use of the resource, without considering its conservation. Preservation does not allow any resource utilization. Finally the intermediate approach would be the conservation approach, which refers to the regulated use of the forests.

The Uruguayan government has taken the conservation approach, along with the preservation of some specific areas. The harvest of native wood is only allowed in the forests subject to management plans that need to be approved by the Forest Division of the Agricultural Ministry. In addition, the commercialization and transport of the native wood is controlled by the government, as described above.

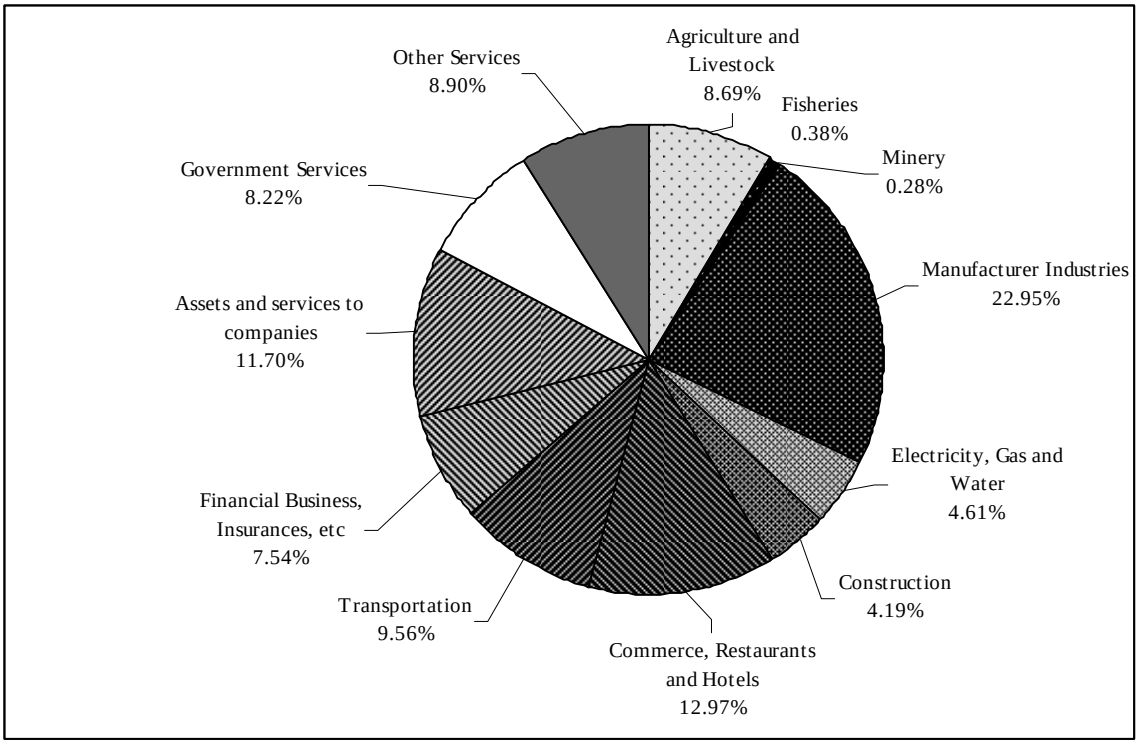
The Uruguayan Government considered the definition proposed by the World Conservation Union (IUCN) to design the native forest policy. They consider that the conservation is positive and involves the preservation, the sustainable management and the improvement of the natural environment. The Uruguayan government as well as some institutions has signed agreements with international organizations to implement projects that protect the native forests, e.g., BIRF Projects UR (3131, 3697), Cooperation Agreement with the European Union (1994-1995).

3.4 Summary

The Forestry Law promoted the rapid development of forest plantations. Between 1989 and 1999 the area planted increased by 491 thousand ha. The annual planting reached its peak in 1998. The plantations are concentrated in the provinces of Rivera, Paysandú, Tacuarembó, Río Negro and Cerro Largo, all located in the North of the country (Forest Division 2004). The Forestry Law attracted new, primarily foreign, firms into the forest sector. These new firms invested in wood growing and lumber and pulp.

The incentives were offered because the forest sector has long-term investments and the returns are not immediate. In addition, if industries are expected to invest in the country, it will be necessary to have a sizeable forest area in order to meet their raw material needs. Even though environmental issues such as the protection of native forest protection were considered, they were not the center of the debate.

Regionalization was another controversial issue related to the new forest policy. It was argued that soils that can be used for livestock would be used for forestry. In such cases agro-forestry systems have been adapted by most of the forest firms.



Source: Central Bank of Uruguay 2007.

Figure 4. Uruguay GDP by sectors (2005)

Table 3. GDP as Percentage of Agricultural GDP

Sub sectors	1990	2002
Agriculture	23.40	21.00
Silviculture	3.80	13.40
Livestock	72.80	65.60
Total	**100.00**	**100.00**

Source: Central Bank of Uruguay.

Table 4. Uruguay Forest Resources (1,000 ha)

FRA 2005 Categories	1990	2000	2005
Primary	591	296	296
Modified natural	465	444	444
Semi-natural	-	-	-
Sub total	*704*	*740*	*740*
Productive plantation	197	655	751
Protective plantation	4	14	15
Total	905	1,409	1,506

Source: FAO, Global Forest Resources Assessment 2005.

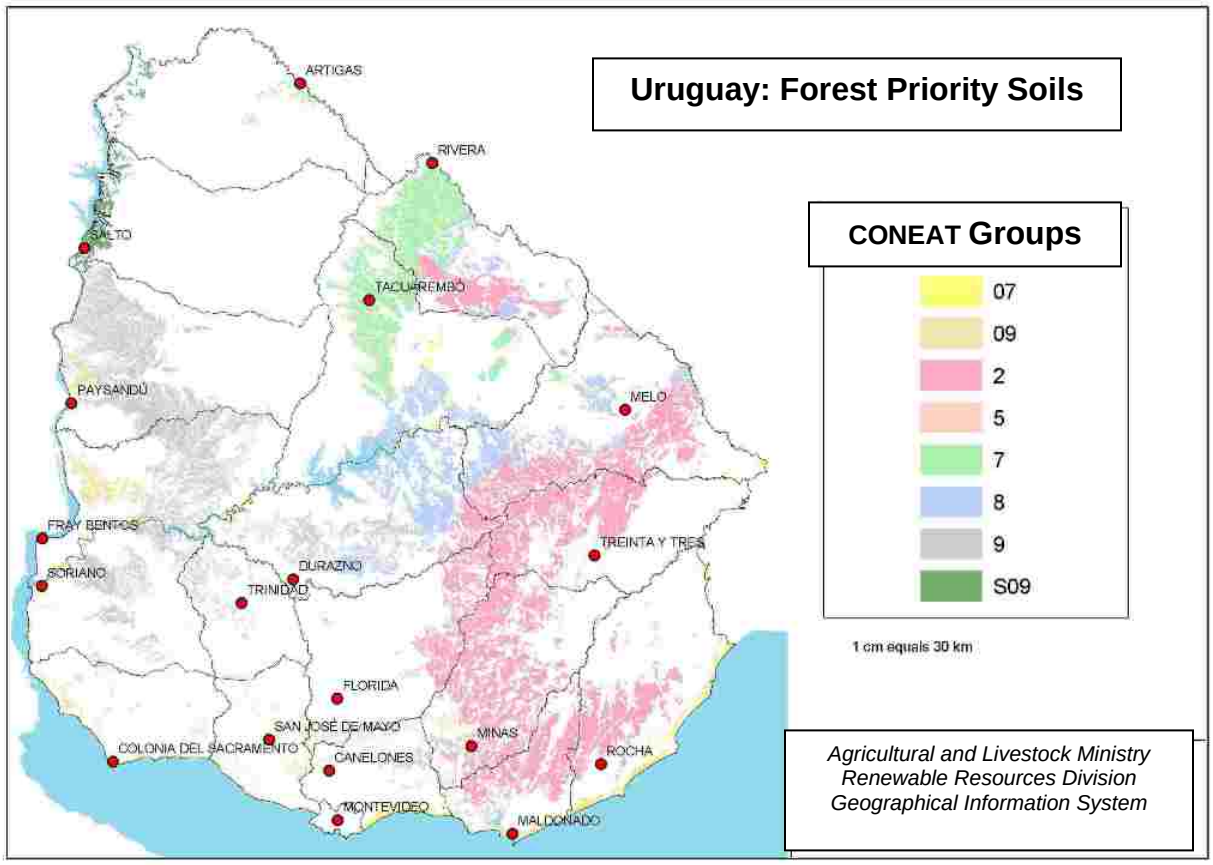
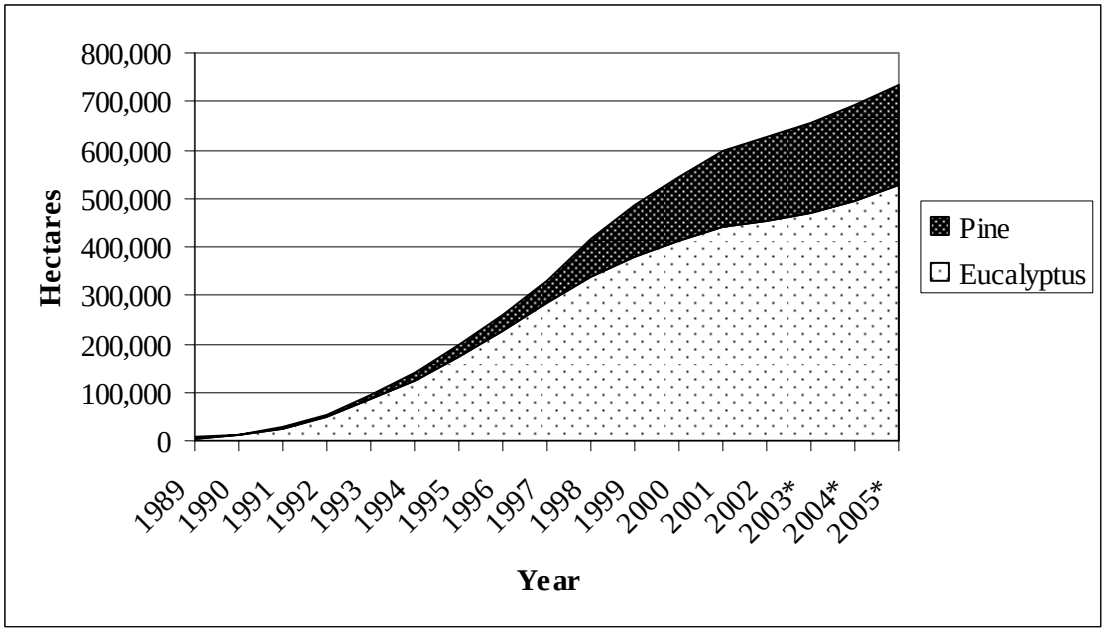


Figure 5. Uruguay Forest Priority Soils

Table 5. CONEAT Index for Forest Lands

Province	Ha	CONEAT Index
Artigas	193	70.5
Canelones	2,753	32.4
Cerro Largo	20,941	65.4
Colonia	1,325	55.3
Durazno	31,951	72.4
Flores	426	69
Florida	23,786	61.2
Lavalleja	42,960	65.6
Maldonado	10,247	65.6
Montevideo	137	4.5
Paysandu	56,348	80.1
Rio Negro	77,668	68.2
Rivera	74,305	69
Rocha	10,316	55.5
Salto	437	41.1
San Jose	2,406	47.2
Soriano	21,784	80.9
Tacuarembo	68,113	71.4
Treinta y Tres	4,823	63.2
Total	**450,917**	**69.6**

Source: Ramos and Cabrera 2001.



(*) For years 2003 and 2004 the official data was not updated, but the total area by 2005 was 751,000 ha, then the area for each species was assigned according to secondary information.
Source: Forest Division

Figure 6. Area Planted by Species (Cumulative)

Table 6. Forest Farms by Area

Plantation area (in ha)	Total	
	Number	%
Total	19,402	100
<3	11,248	58
3-10	5,139	26.5
11-20	1,071	5.5
21-50	832	4.3
51-100	362	1.9
101-500	558	2.9
>500	192	1

Source: Agricultural Census 2000.

Table 7. Uruguay Forest Exports Share in Total Exports

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total Exports	1,599	1,693	1,605	1,703	1,645	1,913	2,106	2,397	2,726	2,771	2,242	2,302	2,061	1,861	2,198	2,922
Forest Exports	101.7	103.1	114	117.4	113.5	120.6	142.6	152.4	172.2	171.4	176.3	84.7	82.9	86.7	94.9	146.2
Share in total	6%	6%	7%	7%	7%	6%	7%	6%	6%	6%	8%	4%	4%	5%	4%	5%
Forest Exports (2)	95	94.7	97.2	101.5	98.9	106.1	127	131.4	139.7	138.7	144.8	48.1	49.9	53.9	63.3	114.6
Share in total	6%	6%	6%	6%	6%	6%	6%	5%	5%	5%	6%	2%	2%	3%	3%	4%

(2) Excludes paper and cardboard

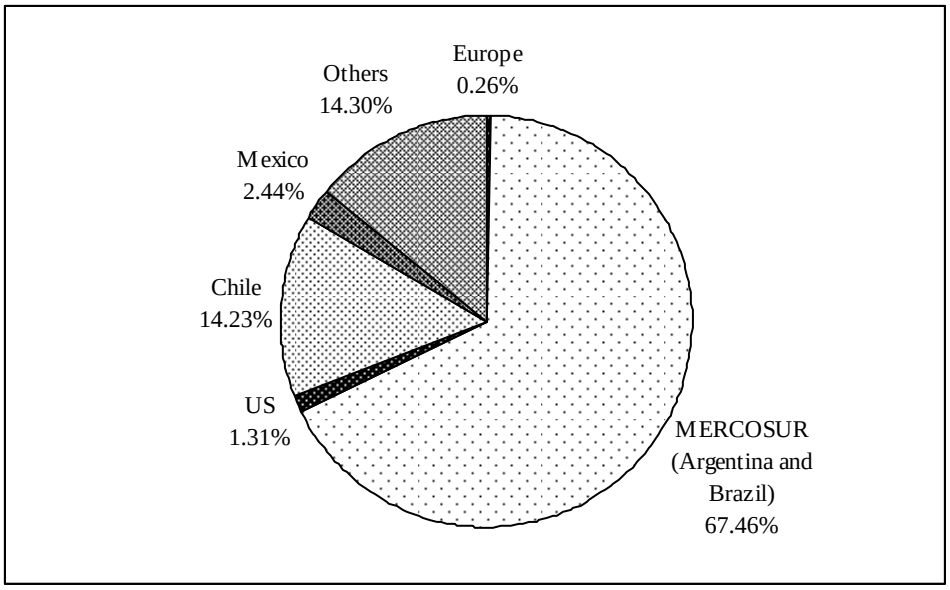
Sources: Forest Division and Central Bank of Uruguay.

Table 8. Exports in Value and Volume

In volume (1,000 m3)																	
Product	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**
Pulpwood	114	83	145	149	88	215	457	510	690	623	702	840	907	1,097	1,369	1,611	1,490
Chips												17	25	12	262	836	1,298
Sawtimber	0	2	2	15	22	28	36	43	64	57	56	72	58	77	96	120	140
Panels												*	*	*	*	*	3
Pulp	3	1	0	1	1	1	2	0	0	*	*	0	1	*	*	*	*
Paper and Cardboard	7	12	22	22	21	20	15	20	32	35	38	39	36	44	43	42	41
In value (million US$)																	
Product	**89**	**90**	**91**	**92**	**93**	**94**	**95**	**96**	**97**	**98**	**99**	**00**	**01**	**02**	**03**	**04**	**05**
Pulpwood	4.5	3.5	5.8	7.3	3.4	7.9	25	27.6	34.8	31.6	35.7	40.3	41.5	43.1	47.5	56.53	55.73
Chips	0	0	0	0	0	0	0	0	0	0	0	0.42	0.67	0.67	10.86	32.69	62.28
Sawtimber	0	0.2	0.3	1.7	2.1	3.8	5.5	7.8	7.9	9.1	10.1	7.8	7	8.8	12.8	18.1	22.7
Panels	0	0	0	0	0	0	0	0	0	0	*	*	*	0.09	0.04	0.01	0.559
Pulp	1.8	1	0.1	0.5	0.4	0.4	1.5	0	0	0	0	0.02	0.71	*	0.03	0.02	*
Paper and Cardboard	6.4	8.4	16.8	15.9	14.6	14.5	15.6	21	32.5	32.7	31.5	36.6	33	32.8	31.6	31.6	30.6

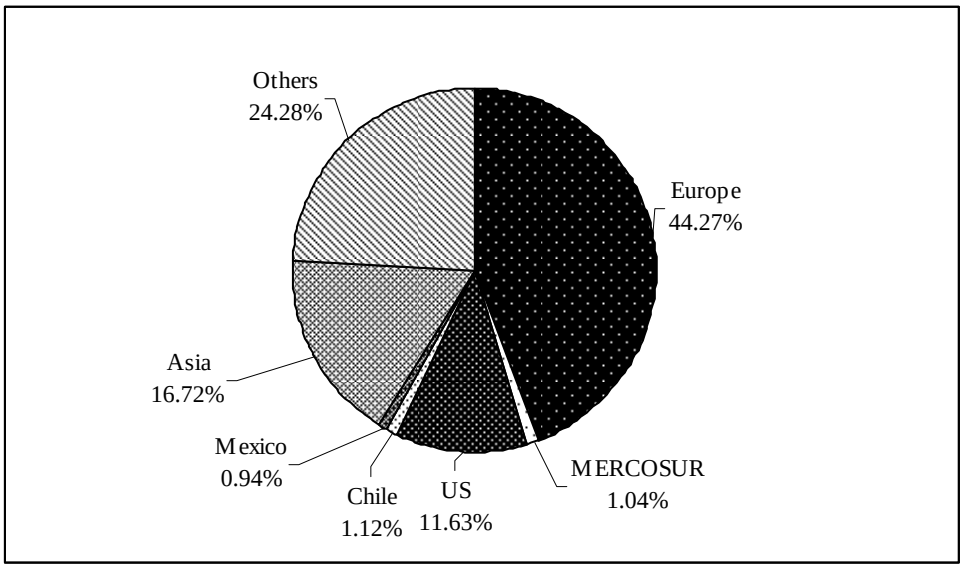
(*) Missing information

Source: Forest Division (Statistics Bulletin 2004 and web site)



Source: ALADI, 2006.

Figure 7. Paper and Cardboard Exports by Region (US$ FOB, 2005)



Note: ALADI classification does not include pulpwood. Source: ALADI, 2006.

Figure 8. Wood and Wood Products Exports by Region (US$ FOB, 2005)

Table 9. Paper and Paper Cardboard Exports Price Index

Year	Price Index
94	104.2
95	128.7
96	85.1
97	90.6
98	95.8
99	89.3
00	103.5
01	99.8
02	83.4
03	97.1
04	103.0

Source: Wood Pastes, Paper and Cardboard (NCM-Section X). Paasche Exports Price Index Base 100=previous year. Central Bank of Uruguay.

Table 10. Wood Export Unit Values (1,000 US$/m3)

	Saw timber			Pulp
Year	**Hardwood**	**Softwood**	**Total**	**Softwood**
1980	-	0.369	0.369	
1981	-	0.410	0.410	-
1982	-	-	-	-
1983	*	0.056	0.063	-
1984	0.086	0.058	0.067	0.032
1985	-	0.150	0.150	-
1986	-	-	-	-
1987	0.100	0.500	0.464	-
1988	0.150	0.231	0.195	-
1989	0.139	0.097	0.119	0.042
1990	0.005	0.099	0.098	0.040
1991	-	0.115	0.115	0.042
1992	0.044	0.120	0.114	0.040
1993	0.140	0.095	0.099	0.046
1994	0.241	0.123	0.132	0.039
1995	0.314	0.139	0.151	0.037
1996	0.027	0.155	0.075	0.055
1997	0.103	0.149	0.121	0.054
1998	0.216	0.129	0.160	0.050
1999	0.049	0.132	0.063	0.049
2000	0.105	0.117	0.108	*0.049*
2001	0.118	0.131	0.121	*0.046*
2002	0.129	0.112	0.114	*0.039*
2003	0.197	0.098	0.133	*0.035*
2004	0.284	0.107	0.151	*0.034*
2005	0.240	0.139	0.162	*0.037*

Source: Based on Forest Division data (Volume and Exports in value).

Table 11. Saw timber Export Price Index

Year	CIU
2000	92.71
2001	93.98
2002	93.15
2003	82.58
2004 (1)	101.59
2005	111.47

(1) The CIU calculates the Index as a Paasche Index with base 100=2004. However, when the index is calculated for year 2004 as a simple average of the monthly indexes, the index is different from 100.
Source: CIU.

Table 12. Uruguay Forest Imports (million US$ FOB)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Wood	0.015	0.048	0	0	0.248	0.118	0.178	0.271	0.011	0.247	0.237	0.226	0.183	0.051	0.116	0.281	0.554
Saw timber	4.936	4.999	5.926	5.597	6.641	9.173	9.552	7.3	14.15	15.2	12.9	9.3	8.985	4.2	3.478	6.589	8.074
Panels	0.667	0.612	1.36	1.784	2.276	3.228	3.764	4.354	5.942	6.642	5.9	4.963	4.281	2.459	2.701	3.571	5.149
Paper and Cardboard	12.01	13.45	19.65	26.28	30.1	36.29	48.96	46.77	41.31	47.41	44.78	50.8	61.24	30.9	20.84	13.35	45.47

Source: Forest Division 2006.

Table 13. GDP Forest Industries as Percentage of Total GDP (2003)

	2003
GDP Industry/GDP Total	18.57%
GDP SW/GDP Industry	1.44%
GDP P&P/GDP Industry	5.90%
GDP SW/GDP Total	0.27%
GDP P&P/GDP Total	1.10%
GDP SW and P&P/GDP Total	**1.36%**

SW=sawmills, P&P= pulp and paper industries
Source: Own estimations based on INE and BCU data.

Table 14. CIIU Production Index, base 100=2002

Year	Sawmills (1)	Pulp and Paper (2)
1993	nd	69
1994	nd	75
1995	nd	59
1996	nd	84
1997	nd	94
1998	nd	98
1999	nd	101
2000	nd	100
2001	nd	96
2002	100	100
2003	201	103
2004	120	111
2005	111	109
Jan-Aug 05	103	104
Jan-Aug 06	134	112

Source: CIU based on INE data.

Table 15. GDP Forest Industries and Manufacturing Industry (constant million 2002 US$)

	1998	1999	2000	2001	2002	2003
Pulp and Paper	101.3	108.3	104.8	99.2	106.3(*)	122.1(*)
Sawmills	-	-	-	-	18.8	58.0
Industry	**2,146.7**	**1,802.4**	**1,780.3**	**1,715.7**	**1,921.9**	**1,887.7**

(*) In 2002, INE changed the classification system from to CIIU 2 to CIIU 3. These results were estimated adding the information for pulp and paper and printing press (sub sectors 21 and 22 according to CIIU 3 classification) in order to compare the results.
Source: INE.

Table 16. Sawmills and Pulp and Paper Industries Share in Industry Product and Industry Wages

	1998	1999	2000	2001	2002	2003
GNP						
Pulp and Paper	6.12%	7.28%	6.86%	5.98%	4.97%	4.47%
Sawmills	-	-	-	-	0.82%	1.01%
Slaughter Houses	42.26%	42.96%	41.74%	42.68%	43.97%	45.54%
Wool, cotton and leather	12.21%	11.45%	11.42%	11.26%	14.06%	13.82%
GDP						
Pulp and Paper	6.58%	7.44%	7.50%	7.13%	5.53%	5.90%
Sawmills	-	-	-	-	0.98%	1.44%
Slaughter Houses	35.36%	37.91%	37.91%	38.45%	38.59%	39.29%
Wool, cotton and leather	10.16%	9.54%	9.53%	8.73%	9.63%	11.68%
Salaries						
Pulp and Paper	10.06%	11.04%	10.10%	9.82%	9.44%	8.42%
Sawmills	-	-	-	-	1.11%	1.09%
Slaughter Houses	38.07%	39.07%	39.81%	40.76%	42.54%	42.63%
Wool, cotton and leather	14.66%	13.72%	13.09%	12.04%	11.88%	13.15%

Source: Own estimates based on INE data.

CHAPTER 4

METHODS, RESULTS, AND DISCUSSION

The objective of the research was to evaluate the impact of the new forest sector on the Uruguayan economy by considering the costs and benefits of the policy that started with the Forestry Law 15939 in 1987. Different approaches to policy evaluation were discussed in Chapter 2. Considering the aim of the study and data availability, a CBA was chosen for this research. The analytical process included the following steps: (1) identifying the costs, benefits and investments associated with the policy; (2) quantifying them; and (3) evaluating the overall impact of the policy on the national economy.

Different studies that attempted to measure the economic impact of the forest sector in Uruguay comparing the economy with and without the forest sector (Vázquez Platero 1996; Ramos & Cabrera 2001). They considered plantations as well as industrial activities, and both concluded that the impact will be positive. The limitations for the sector would be related with high costs in US$, especially fuel, and a low exchange rate which leads to a competitiveness loss.

Vázquez Platero (1996) evaluated the forest policy estimating Fiscal Balance, employment, and costs (including plantations and sawmills), and compared the forestry activity with livestock. He uses market prices and includes subsidies and taxes. Investments were not considered and plantations from 1989 to 1994 were included. The results showed a Net Present Value (NPV) for the forest sector equals to 26 million US$, using a 10% discount rate. The internal rate of return (IRR) was 29.8%. Ramos and Cabrera (2001) using the same approach, evaluate the forest policy considering the plantations between 1989 and 1999. They estimated a

NPV equals to 730 million US$, and an IRR equals to 38.7%. The total subsidies accrued between 1989 and 1999 were 29 million US$ which gives an average subsidy of 181 US$/ha.

The Forest Division estimates the cost of the policy at 149 million US$ (Forest Division 2006). This analysis conducted by Forest Division considered tax exoneration and subsidies to plantations. It is estimated that 2.86 jobs were created by 1,000 ha planted.

No studies that consider direct and indirect impacts of the forest sector in Uruguay have been done, however a study for BOTNIA, a Finnish Company that is building a pulp mill in Uruguay, estimated the impact of the new mill on the Uruguayan Economy using an I-O model (Metsa-Botnia 2004). The study used elements from C-B analysis and I-O models to describe two scenarios: one assessing the Uruguayan Economy without the mill project and the other assessing the Uruguayan Economy with the project. The study determined the main variables of the economy as well as the activities more related with the forest sector from 2004 to 2016. Direct and indirect impacts were measured. Direct impacts referred to "…the effects of the pulp mill investment and production on output and employment in those sectors, which are directly connected to the investment and production process". The study estimated that the new pulp mill will increase the GDP by 1.4% by year 2016, and it will increase employment in 2200 new jobs. However, the impact on labor fluctuates according to which stage of the construction/ operation of the mill was considered. Although the trade balance is positive for the period considered, imports will increase at the beginning due to the mill construction. Indirect impacts referred to the impacts induced by increasing the activity in the forest sector that leads to increase consumption, income and employment. In addition, development impacts were summarized grouping them into: population and sociology, forest sector, regional economy and national

economy. The study located the effects on three different state economies involved: Río Negro, Soriano and Paysandú.

4.1. Methods: CBA

While CBA is generally similar to Cost-Effectiveness Analysis (CEA), there are several differences (Little & Mirrlees 1974; Nas 1996). First, taxes and subsidies are not included in the CBA because they are transfers between agents within the economy. Second, some benefits or costs resulting from the project's operation do not appear as inputs or outputs in the ordinary accounts. Third, the discount rate used to evaluate the project is usually different from the market interest rate which might be used by a private firm.

CBA is a very comprehensive procedure as it considers all potential gains and losses from a policy and it is particularly designed for the evaluation of public projects. The project outcome is always evaluated in CBA on the basis of public interest. Prices in CBA are corrected for market distortions. Costs and benefits are measured in terms of social utility gains and losses rather than cash or revenue flows, and external costs and benefits are invariably included in the evaluation (Nas 1996). CBA may be used to recommend policy actions, in which case it is applied prospectively (ex ante). It may also be used to evaluate policy performance. This approach is applied retrospectively (ex post) in this study.

4.1.1 Shadow Prices

Shadow prices are defined as the increase in welfare resulting from any marginal change in the availability of commodities of factors of production (Squire & van der Tak 1975). "A shadow price is a measure of the welfare effects of marginal changes in the supply or demand

of good or services" (Londero & Cervini 2003). As it was discussed in the previous chapter, CBA is based in welfare economics as is shadow prices theory (Londero & Cervini 2003). An important assumption in applied welfare economics is the use of economic shadow prices to appraise investments (Harou 1987). The analytical method uses a partial equilibrium approach: it is assumed that all prices other than that of the good being studied remain unchanged. Individual markets are studied in isolation, as if they were independent from other markets, reflecting the expectation that a price change in one market does not have significant repercussions in other markets (Londero & Cervini 2003). In this study this assumption is not too restrictive as forestry accounts only for small part of the national economy.

One approach to estimate shadow prices is the efficiency analysis, in which equal weights are assigned to the marginal income changes, not considering differences among income levels. Another approach assigns the same valuation in welfare function to all that have the same income level. The most important authors in this group include UNIDO (1972), Little and Mirrlees (1974), and Squire and van der Tak (1975) (Londero & Cervini 2003). Little and Mirrlees (1974) proposed the "accounting prices" to conduct social cost-benefit analysis (Little & Mirrlees 1974). The UNIDO (1972) approach distinguishes between "weights" which are political value judgments, and the shadow prices derived from these judgments and technical information (Marglin 1977). UNIDO Guidelines propose a "bottom-up" procedure in which the weights are generated by the formulation and evaluation procedure itself (Dasgupta *et al.* 1972). Squire and van der Tak (1975) proposed the use of distribution weights, which may be derived from an explicitly specified welfare function. The choice of a numeraire (unit of account) is basic to the determination of weights, insofar as the numeraire determines the absolute level of weights (Squire & van der Tak 1975). However, the conclusions would not change if the numeraire

changes (Londero & Cervini 2003). In LMST, the value of public investment in border[18] prices is expressed in relation to the value of consumption in border prices. In the Squire van der Tak system the value of public investment in border prices is expressed in relation to the value of consumption in domestic prices (Ray 1984).

The technique of shadow prices consists of several steps. First, goods or services are classified in several ways according to how additional demand is met. According to Londero and Cervini, goods or services can be classified considering how additional demand is met: fixed supply goods, where it is met from withdrawals from other uses; produced goods, when it is met by additional production; and socially traded goods; when it is met by additional imports or reduced exports (Londero & Cervini 2003). According to Squire and van der Tak goods and services can be classified considering whether they are tradable or not tradable: goods imported or exported at the margin with infinite elasticity, goods imported or exported at the margin with less than infinite elasticity, goods not currently traded but ought to be traded, and goods not currently traded and ought not to be traded (Squire & van der Tak 1975). Second, several techniques can be used to estimate the shadow prices: input-output matrices (Londero & Cervini 2003), linear programming (Harou 1987), and welfare functions (Squire & van der Tak 1975).

Shadow pricing of forestry projects was proposed in the 50s (Duerr and Vaux 1953) but started to be applied in the 70s (Watt 1973, FAO 1979, Harou 1981). The methodology has been developed for industrial investments (OECD 1968, UNIDO 1972, Squire and Van Der Tak 1976, UNIDO 1979) and agricultural projects (Gittinger 1983 in Harou 1987). In forestry projects,

[18] Border prices are the prices of imports or exports of a commodity. Import prices usually are calculated as CIF prices (it is the price paid by the buyer, which includes: Cost, Insurance and Freight) and export prices are calculated as FOB prices (Free on Board) refers to the price received by the seller, who pays the transportation from the port of origin to the country.

most outputs can be expressed in shadow prices. On the other hand, major input such as land, labor, and machinery may or may not be considered for shadow pricing. Whether or not it is actually worth shadow pricing a particular input depends on the magnitude of the estimated difference between its market price and its economic value[19] (Gregersen & Contreras 1979; Harou 1987).

There are some difficulties in estimating the shadow price of land by measuring the compensating variation of those affected by the change in the demand (supply) of land. First, the market price of land is determined by the present value of the associated rent. When moving to forestry from alternative uses it is necessary to estimate the effects of the change and to compute their future values. Second, the use of land could have significant external effects that could or could not impact other markets. These difficulties may be further related to different land qualities, different land locations, and the existence of taxes. Therefore, simplified approaches are used to estimate the shadow price of land (Londero & Cervini 2003). The appropriate measure of value for land is the highest net return that actually has been obtained from the land in the absence of the project (Gregersen & Contreras 1979; Londero & Cervini 2003).

The objective in valuing labor is to arrive at a measure of the benefits foregone by employing labor in the project rather than in its next best alternative use. If labor is hired away from other productive activity and there is little unemployment in the project region, the value of labor in the other activity, or the market wage, provides an acceptable measure of opportunity cost for the economic analysis (Dasgupta *et al.* 1972; Little & Mirrlees 1974; Marglin 1977; Gregersen & Contreras 1979; Londero & Cervini 2003).

The shadow price ratio (SPR) for labor is the ratio of its efficiency cost to its market cost: the reduction in production per unit of withdrawn value, multiplied by the amount of labor

[19] In the text, the economic value is referred sometimes as “efficiency price” that is defined in the next pages.

withdrawn (Londero & Cervini 2003). The difference between the efficiency salary and the market salary depends on the characteristic of the labor market. This topic has been extensively discussed in the literature (Dasgupta *et al.* 1972; Little & Mirrlees 1974; Squire & van der Tak 1975; Marglin 1977; Gregersen & Contreras 1979; Ray 1984; Harou 1987; Londero & Cervini 2003). Labor markets can be classified in different ways. According to Londero and Cervini (2003), (1) labor can be withdrawn from the production of traded goods; (2) dual urban markets can exist where there is a group of workers protected by labor legislation and/or represented by unions; and (3) rural urban migration can be caused by the new activity.

The efficiency price of foreign exchange, like any other efficiency price, is defined as the sum of the compensating variations attributable to a unit change in the demand or supply of foreign exchange. Its SPR would be the ratio of that shadow price to the market price, the prevailing exchange rate (Londero & Cervini 2003).

4.1.2 Discount Rate

Discounting is based on the idea that a given amount of resources available for use in the future is worth less than the same amount of resources available today. Through investments, one can transform resources that are currently available for use into a greater amount of resources in the future (Boardman 2001). The selection of the most appropriate rate of discount is related to the weights that the society should apply to consumption that occurs in future periods relative to the same amount of consumption in the current period. These weights represent how much of the current consumption the society is willing to give up now in order to obtain a given increase in future consumption.

The choice of the social rate of return is based on the preferences of individuals in the society. In order to compare the costs and benefits associated with the policy they have to be weighted (Dasgupta *et al.* 1972). The weights (w_j) are related to the discount rate (*i*) as follows:

$$w_j = \frac{1}{(1+i)^n}$$

where:

n= number of periods,

i= discount rate

These weights can be determined if the consumers' preferences are known and markets do not have imperfections. In addition, there should not be any distortions such are taxes, risk, and transaction costs[20] (Dasgupta *et al.* 1972; Boardman *et al.* 1997). An approach to measure transaction costs for Uruguay can be found in the report present by the World Bank where 175 countries are measured according several indicators that measure "…business regulation and the protection of property rights and their effect on businesses" (World Bank 2006) in order to establish the average period of time that takes starting a business in a country. Uruguay ranked 70 in 2005[21] and 64 in 2006. While the country has similar indicators to the region[22] in some cases in other they are similar to OECD countries.

[20] Transactions costs are defined as the costs incurred in the exchange process as transaction fees, gather information, move products (Chavas & Bouamra Mechemache 2006)

[21] A complete report of the ranking can be found at: www.doingbusiness.org

[22] Uruguay is included in Latin America and Caribbean.

Regarding risk, the "country risk"[23] is measured in Uruguay using an indicator called Uruguay Bond Index (UBI) that measures the spread between the returns on Uruguayan bonds and USA bonds. The UBI was 3,100 basis points during the 2002 and financial crisis, and it is 167 points today, reaching the lowest value in the last six years. According to Adamodar (Hagler 2007) Uruguay pays a 5.25% of risk premium while in the region Chile pays 1.05%, Brazil 3.75%, and Argentina 6.75%.

Taxes in Uruguay are the main source of income for the Government. In the last two decades the taxes went from 62.5% of the Government income in 1990 to 71.3% in 2002; and taxes went from 17.8% of the GDP in 1990 to 22.1% in 2002. Compared with other countries, the share of taxes in the GDP is lower than developed countries but higher than the average in Latin America; compared with the region, Uruguay is between Argentina and Brazil (Lorenzo *et al.* 2005).

The discount rate used in this project was 6%, as this is the social interest rate that is being used in the country to evaluate local development projects.

4.1.3 "Before and After" Approach versus "With and Without" Approach to CBA.

The "With and Without" approach to analyze the effects of a policy is not the same as comparing the situation "Before and After" its implementation.

The "Before and After" analysis compares the economy before the project is established with the economy after the project is established. The "Before and After" approach would not give information about the changes that may occur without the policy because it does not describes the same economy (Boardman 2001).

[23] The country risk is defined as an index that reflects the risk that a country has for foreign investments.

The “With and Without” analysis consists of estimating the net marginal benefit induced by the new policy (Harou 1987). In this project, the “With and Without” approach will be used. The “With” situation is defined as the situation where the Forestry Policy has been established in 1989; the “Without” situation is defined as the situation where the Forestry Policy has not been established. The “With” situation describes what happened in the economy after the Forestry Law. Therefore, plantations from 1989 onward were considered and, according to the management regimes, forest industries were considered from the first year when wood harvest was processed into manufactured wood products. The “Without” situation describes what would have happened to the economy if the Forestry Policy had not been established. It was assumed that if the lands were not used for forestry, they would have been used for livestock. Therefore, slaughter houses, tanning leather and wool industries would have been developed.

4.1.4 Sensitivity Analysis

Uncertainty about the magnitude of the results is always present as there is uncertainty about the values we assign to the costs and benefits associated to the policy evaluated. Sensitivity analysis acknowledges this uncertainty and allows analysts to identify how sensitive the results are to the assumptions made. The analysis also helps to identify the key variables that affect the policy results.

Three approaches can be taken in order to conduct a sensitivity analysis: partial sensitivity analysis, worst and best case analysis, and Monte Carlo simulations. Partial sensitivity analysis consists of estimating how net benefits change as one variable is changed and the others remain constant. Worst and best case analysis consists of changing some assumptions in order to identify the assumptions or a combination of assumptions that would change the analysis’

results. Monte Carlo sensitivity analysis consists of assigning probability distribution functions to some key assumptions and evaluating how changes of these assumptions would affect the net results (Boardman 2001).

In this study, a partial sensitivity analysis will be conducted in order to identify the variables that most affect the results obtained.

4.1.5 Terminal Value

Forestry investments are usually long-term investments; therefore, some corporations have unlimited planning horizons and anticipate managing their forests forever. To evaluate an asset that produces cash flows over an infinite time frame, it is necessary to have a procedure for calculating the present value of an infinite series of cash flows (Clutter *et al.* 1983). There are several indicators to evaluate forest investments, some based on yield criteria, and others on economic criteria (Clutter *et al.* 1983; Newman 1988; Perman *et al.* 2003). Those based on yield criteria are maximum single-rotation physical yield; maximum single-rotation annual yield, also called Mean Annual Increment (MAI); and Maximum Sustainable Yield (MSY). Those based on economic criteria are maximization of discounted net revenues from a single rotation; maximization of the discount net revenues from an infinite series of like rotations, also called soils expectation value (SEV) or bare land value (BLV); maximization of annual net revenues, also called forest rent; and internal rate of return (Clutter *et al.* 1983; Newman 1988; Perman *et al.* 2003).

However, the discussion of the optimum rotation length for a forest stand has not been a simple issue[24] (Newman 1988). Faustman's Formula (1849) is the first rule used to evaluate the optimal rotation age, and was based in the maximization of discounted net revenues (Perman *et*

[24] A very good discussion on the literature referring to Optimal Forest Rotation can be found in Newman (1988).

al. 2003). Even though it is important, the formula contains simplified assumptions that have been changed in the following years, allowing the development of a great number of theories and practices (Newman 1988). Newman discusses six criteria for an optimal rotation age: Maximum Gross Yield, Maximum Sustained Yield, Present Net Worth, Soil Rent, Forest Rent, and Internal Rate of Return (Newman 1988).

In this study, BLV criterion was used to estimate the terminal value of the plantations' investments and the land value in order to compare it with land market prices. BLV, associated with a given rotation age, is the present value of the net returns from all the rotations in the continuing series. This is the present value of all cash flows produced by an infinite series of rotations using a rotation age of *t* years (Clutter *et al.* 1983).

Cash flows for continuing series of plantations for each alternative were calculated, and the present value of each alternative was maximized. The maximum present value is accomplished with the rotation age with maximum BLV, and this rotation age is called the optimum economic rotation (Clutter *et al.* 1983). BLV was used because it estimates the net present value of the land in infinite rotations and it is a good approach of the opportunity cost of land.

4.2. Data and Assumptions

Costs, investments and benefits[25] were estimated from primary and secondary information. Primary information was obtained from a survey conducted in Uruguay in July 2006[26]. Secondary information was obtained from the Forest Division (DF), the Agricultural Planning and Policy Office (OPYPA), the Agricultural Statistics Division (DIEA), the Forest

[25] The tables with the assumptions for the period of analysis are presented in Appendix III.
[26] The questionnaire and the Survey's results are presented in Appendices I and II.

Producers Society (SPF), the National Institute of Statistics (INE), the Central Bank of Uruguay (BCU), the Association of Industries of Uruguay (CIU), the Agricultural and Livestock Plan Office (IPA), and the National Colonization Institute (INC). In addition, estimates on plantations and sawmills data were taken from two previous studies: Vázquez Platero (1996) and Ramos and Cabrera (2001). Taxes estimates were obtained from Ramos and Cabrera (2001). Growth rates and management plans were compared with those obtained from the survey and with SPF information.

Market prices were converted to shadow prices according to two studies: Fernández Gaeta (1995) and Pereyra (2004). Both studies considered the income as numeraire and defined the SPR as:

$spr_i = sp_i/p_i$

where:

spr_i *=shadow price ratio of the good i,*

sp_i *= shadow price of good i,*

p_i *= market price of good i*

From 1989 to 2001, Fernández Gaeta (Fernandez Gaeta 1995) estimates for 1995 were used. From 2001 to 2005, Pereyra estimates from 2004 (Pereyra 2004) were used because the major change in the economy occurred in 2002 after the devaluation of the Uruguayan currency and Pereyra estimates reflected those changes. The first study provided estimates of all the shadow prices of the economy except for imports; while the second provided estimates for only a few items related to infrastructure projects.

Labor SPR has been less than one in the period 1989-2005. Estimates for 1995 showed that the SPR for skilled labor was 0.98 and for non-skilled and semi-skilled labor was 0.8, meaning that the market wage for skilled labor was similar to the opportunity cost of it. On the other hand, the market wage for non-skilled and semi-skilled labor was higher than its opportunity costs. Labor SPR estimates for 2004 showed that the SPR for skilled labor had not changed significantly, but the SPR for non-skilled and semi-skilled labor had dropped to 0.6 (Table 17). These results reflect the increase in the unemployment rate which went from 7% in 1989 to 12% in 2005 (Table 18). The unemployment rate estimates includes only cities with more than 5,000 habitants, therefore the rural unemployment was not included. However, the analysis of the provinces where plantations were established, indicate that the unemployment has decreased. Therefore the question: What does the rest of the economy ultimately lose when a person joins the project? becomes crucial for the analysis of the situation in Uruguay where two opposite phenomena occur. On one hand, a high level of unemployment in the cities and lower in rural areas, and a high demand for semi-skilled labor in the new industries that in some cases has been difficult to meet. The states of Río Negro and Tacuarembó are examples of the changes in the opportunity cost of semi-skilled and skilled labor. In Río Negro, Botnia is constructing a pulp mill and the province state did not have enough labor available to meet the needs. In Tacuarembó, Colonvade[27] and Urupanel[28] are building plywood facilities and the demand semi-skilled and skilled labor has also been growing and attracting labor from other states. In those cases, the companies started training programs and they are encouraging technical teaching institutes to adapt their programs to the new industries requirements.

[27] Colonvade is a company with partnership between Weyerhaeuser and Global Partners with facilities located in Tacuarembó and Rivera.
[28] Urupanel is a Chilean company with facilities located in Tacuarembó.

Therefore, despite the high level of unemployment in the Uruguayan economy, the opportunity cost of labor in the forest sector is not zero because some resources are being withdrawn from other sectors.

One of the most important effects of the new Forestry Law was the increase in land prices. As the demand for land increased, prices rose. Average prices presented by the DIEA which calculates the price in US$/ha as an average of the transactions in the period, do not reflect the prices of the transactions accurately because data from INC shows that land prices are higher than those reported by DIEA. The INC shows that, during the first semester of 2006, the average price land was 1354.30 US$/ha; if this average is standardized according to productivity indexes, it was 1465.06 US$/ha CONEAT 100 (Colonization National Institute 2006). In 1995, Fernández Gaeta estimated that the SPR for land was 1.19, meaning that the market prices under value the land. Fernández Gaeta estimated the land price considering the net present value of the most important outputs for year 1992, when the agricultural and livestock sector had a different structure. Based on the CGA information, he assumed that the total area was distributed as follows: 76.9% livestock, 7.7% dairy production, 3.9% rice and 11.5% other cereals production. The sector structure was different from today's structure, where the forest sector has small participation.

To fill this lack of information, BLV for land were estimated. The BLV were divided into three activities: land designated for eucalyptus plantations, land designated for pine plantations, and land designated for livestock. As it was discussed in Chapter 3, land designated for forestry has a site productivity index of 69 in average; therefore the BLV was estimated for these sites.

The results show that the market prices are lower than shadow prices estimated (Table 19). The SPR showed that for forestlands designated for eucalyptus it is 1.20, for forestlands designated for pine is 1.42 and for lands designated for livestock is 1.25. These results show the BLV in 2005, but a complete series could not be estimated. As the changes have been important in the period of analysis, 1989-2005, the opportunity cost of the land might have been changing. Therefore for the CBA, market prices were used and a sensitivity analysis was conducted.

Exports and imports values were corrected by the foreign exchange SPR (SPRf). Considering the 1993 Uruguay's trade structure, the 1993 Trade Commercial Balance and the equilibrium and observed exchange rate, Fernández Gaeta estimated a SPRf of 1.31. Pereyra, using the same approach but including 2003 data, estimated SPRf of 1.01 (Pereyra 2004).

*SPRf = (Eq. ER/Obs. ER) * [(Imports*(1+Taxes and Tariffs) +*

Exports (1+Subsidies)]/(Imports +Exports)

where:

Eq. ER=Equilibrium Exchange Rate,

Obs. ER= Observed Exchange Rate

The exchange rate he used was 30 Uruguayan Pesos per US$ (U/US), and currently the ER is 25 U/US, then the shadow price does not reflect the current currency value but it is the most updated version of shadow prices estimation.

The analysis covered the period from 1989 through 2005, in order to consider the plantations that were established as a result of the Forestry Law 15939.

Two indicators were calculated to determine the value of the project for the society: NPV, using a 6% discount rate, and IRR. Both were calculated at year 1989.

4.2.1 Production

4.2.1.1. Forest Management Plans

Several forest management plans have been designed in the past decades. Vázquez Platero (1996) assumed a management plan consisting of two prunings, four thinnings and final harvest for pine for saw timber; two prunings, two thinnings and final harvest for eucalyptus for sawtimber; and a final at year eight for eucalyptus for pulpwood (Vázquez Platero 1996).

Ramos and Cabrera (2001) proposed six different models and six different management plans according to wood destination and regions. Eucalyptus management plans included one thinning and the final harvest if the wood was grown for pulp, or two thinnings and the final harvest if the wood was grown for saw timber. Pine plantations management plans included two or three thinnings, and a final harvest at age 22 or 24. Pine plantations were grown for saw timber (saw logs, plywood logs, sawn wood).In the survey conducted in Uruguay, rotation ages varied according to the final product of the company. Therefore, in Pine grown for saw timber was managed on rotations 22 to 25 year long. On the other hand, information on rotation ages for eucalyptus differed among plantations: plantations grown for saw timber had rotation ages from 15 to 20 years, and plantations grown for pulpwood had rotation ages around 10 years.

This study assumed that 70% of the eucalyptus plantation area was grown for pulp and 30% for saw timber. The rotation age for pulp was 9 years and for saw timber 18 years with two intermediate thinnings, at 9 and 13. Both thinnings produced pulpwood. The assumptions are presented in Table 21 and volume estimations are based on Methol's model (Methol 2003). For

pine it was assumed that 100% of the plantations are grown for saw timber. The rotation age was 22 years with three intermediate thinnings, at years 4, 12 and 18, and two prunings. The assumptions are shown in Table 21 and were based on Ramos and Cabrera model for Pine in the North[29] (Ramos & Cabrera 2001).

4.2.1.2. Growth rates

Growth rates have been adjusted after first plantations were established. Vázquez Platero (1996), according to producers, estimated growth rates ranging from 22 to 36 cubic cu m/yr/ha on average[30] for eucalyptus and 17 to 26 m^3/yr/ha for pine according to the location.

Ramos and Cabrera (2001) estimated different growth rates by location, products and species. For eucalyptus plantations grown for saw timber, MAI varies from 28 to 32 m^3/yr/ha, and for pulp from 18 to 23 m^3/year. For pine plantations MAI can be from 19 to 24 m^3/yr/ha. According to the survey conducted in Uruguay, growth rates vary from 20 m^3/yr/ha for Pine to 20 to 25 m^3/yr/ha for eucalyptus with an average of 22 m^3/yr/ha.

In this research the following growth rates were assumed: 24 m^3/yr/ha for Pine, and 30 m^3/yr/ha for eucalyptus.

4.2.2 Inputs

4.2.2.1. Production Costs

4.2.2.1.1. Plantations

Plantation costs vary with management plans and species. Management plans have been changing since expertise was gained in the field. Before the Forestry Law 15939 was established,

[29] In Ramos and Cabrera study, these assumptions correspond to Model 2.

[30] This is the Mean Annual Increment (MAI) which designs the average production per year.

plantations were oriented towards fuel wood or saw timber production for local companies, with some exceptions.

Plantation costs were based on Ramos and Cabrera estimates (Ramos & Cabrera 2001). They include fencing, soil preparation, ant control, fertilization, plants, plantation, and other minor costs. Each item includes the labor required for the activity, and only imported items were included. On average, labor costs are 16% of plantations costs meanwhile imports account for 10%. Shadow prices were assigned according to the share of each component in total costs; taxes were not considered (Table 22).

4.2.2.1.2. Pruning and Thinning

The most important component in these activities is labor. Labor used varies according to the management plan: pruning and thinning ages.

In this study, it was assumed that eucalyptus plantations grown for pulp are not pruned or thinned; eucalyptus plantations growth for saw timber are thinned at year 9; and pine plantations growth for saw timber are pruned at years 4, 6 and 8 and thinned at years 4, 12 and 18. It was assumed a cost of 60 US$/ha for pruning and 8 US$/ha for thinning (Table 23).

4.2.2.1.3. Harvesting

For pulp, labor requirements were estimated in 0.289 daily wages/ m^3 for pulp and 0.222 daily wages/ m^3 for saw timber according to Ramos and Cabrera based on SPF information (Ramos & Cabrera 2001). The costs structure for final harvest is as follows: 55% labor, 30% fuel, and the other costs are 15% of the total cost. These costs were corrected using shadow prices, which where assigned according to the weight of each item in the total cost.

4.2.2.1.4. Industry

For the case with project, sawmills were included in the analysis. Costs in thousand US$/ m^3 of wood processed were obtained from Ramos and Cabrera based on INE data, from 1999 the coefficients were considered constant. Wood manufacturing costs, included wood, were estimated at 119 US$/ m^3 of wood processed in 1989 and in 67 US$/ m^3 from 1999. Several factors could explain this drop: a decrease in equipment maintenance after 1993 and the disappearance of the cost of fuel wood in the last three years. On the other hand, salary costs remained stable in US$ despite increasing 70 to 80% in $U. Wood processed was obtained from the eucalyptus and pine models described above.

For the case without the project, slaughter houses, wool and leather industries were considered. The productivity indexes for these industries were considered from Ramos and Cabrera between 1989 and 1999, from IPA between 2000 and 2005, and thereafter assumed constant until 2010. These costs were corrected using the same criteria as in the previous item (Table 24).

4.2.2.1.5. Transportation

Transportation costs were based on figures provided by Ramos and Cabrera (2001) by region, species and product. Costs were estimated by tons and divided into pulp and saw timber products. Harvested wood could be destined for either the mill or the seaport. Transportation costs included costs from the plantation to the mill and from the mill to the final destination (Table 25). Wood designated for final consumption either in the local markets or abroad, had other transportation costs associated. Then, transportation costs were first calculated for the distance between the plantation and the mills. Costs from the mill to the final destination were assigned to the industry.

For the case without the project, the livestock that would have been transported if forestland were used for livestock production was estimated.

4.2.2.1.6. Export Costs

Export costs include labor costs for activities in the port, and these costs were based on Ramos and Cabrera estimates. They assumed that 0.022 daily wages/day/m^3 was needed to prepare wood for export from the port.

4.2.3 Investments

4.2.3.1. Plantations

Investments in plantations were calculated as the total area declared in the Forest Division multiplied by the land price of the same year. Land price series were taken from DIEA and a sensitivity analysis was conducted to address the differences between market and shadow prices (Table 26).

4.2.3.2. Industry

Investments in the industry were based on the survey data, and only sawmills were considered because information regarding pulp mill investments was not available. According to the survey, 85% of the investments in equipment in the industry are imported, and the companies have tax exonerations for imports to the industry. Therefore, it was assumed that 85% of the investments were imported and that the information did not include taxes.

4.2.4 Outputs

Wood exports are the output considered in the analysis as they represent income generated in the country. For the case with project, total wood exports were estimated according to the level of production, and the value was estimated considering average stumpage prices obtained from the Forest Division. In the model, the wood can be used to produce either pulp or saw timber. As of 2006, there were not pulp mills in the country; therefore, it was assumed that until that year all wood for pulp was exported.

For the situation without project, exports from alternative activities were estimated based on production levels and producers prices, as most of the production is destined for exports (Ramos & Cabrera 2001). To estimate the percentage of the production exported each year, CIU estimations and IPA information were used. Between 1988 and 1998, CIU estimated that leather and wool were sub-sectors that exported more than 50% of their production, while slaughter houses exported from 11% to 50% of their production. The slaughter houses accounted for most of the total value of the alternative products considered here, it was assumed that between 1989 and 2000 50% of the total production was exported. In 2001, the foot-and-mouth disease caused beef exports to drop until 2002. Based on IPA data, for 2001 it was assumed that 40% of the production was exported as the outbreak began in October of that year; for 2002 and 2003 it was assumed that 30% of the production was exported; and for 2004 and 2005 it was assumed that 60% of the production. From 1999 to 2005, leather and wool industries decreased their exports and slaughter houses increased them, becoming one of the most important sectors in the total exports of the country.

4.3. Results

The results show that the forest sector compared with an alternative production, livestock, had a net positive impact on the Uruguayan economy in the period 1989-2005. The NPV for the forest sector compared with livestock in year 1989 equals 630.2 million US$, using a 6% discount rate. The IRR for the forest sector was 36.4% (Table 27). Since the project's products are mostly exported, all economic project's outputs are included. On the other hand, only inputs including imported items and labor are included. In addition, SPRs are lower than one for inputs and equal or higher to one for outputs. Therefore the results are more positive than evaluating the policy at market prices.

The alternative industries costs savings were high. The livestock production is an annual activity, and therefore costs associated with the industry will occur every year. On the other hand, forestry is a periodic activity and industry costs will start when the first wood harvested is processed. In the model, forest industries started to operate 9 years after the plantations were established; as a result, there is a 9-year period where there no forestry industry costs.

Sensitivity analyses were conducted on wood prices, yields, transportation costs, land prices and thinning, administration and harvesting costs. The results are presented as variations of NPV and IRR in percentage. Wood markets are a key factor for the analysis as its results are sensitive to changes in wood prices. Results are more sensitive to changes in pulpwood prices than in saw timber prices (Table 28). These results can be explained by the fact that pulpwood accounts for most of wood output. Between 1989 and 2005 a total of 72.2 million of cum of pulpwood were produced versus 22.7 million of cum of sawn wood.

Since the prices considered were FOB Montevideo, freight costs to final destinations were not included. According to the industries' survey, the oceanic freight costs increased 60%

between 2002 and 2006. It is expected that wood consumption would continue to rise, but the real price of products will increase slightly. The biggest effect would be on trade rather than on production, with a shift on trade toward processed products (Prestemon *et al.* 2003). This increasing demand represents an opportunity to Uruguayan products; however, an analysis of price trends and markets would be important to obtain benefits.

The results are very sensitive to changes in yields: if both plantations yields decreased 20%, the IRR would decrease more than 7% and the NPV would decrease nearly 100%. A reduction in eucalyptus yields has more impact on NPV and IRR than a reduction in pine yields. This result can be explained by the different areas covered by pine and eucalyptus. Approximately 75% of the area is covered with eucalyptus and the rest by pine. With most land owned by private investors, the investors' management decisions are the key factor influencing the provision of forest benefits to the society. The idea that private forest management is less socially responsible and characterized by lower environmental standards has proved to be not always true; forest certification and private management plans analysis are two elements that support this outcome (Siry *et al.* 2005).

Transportation costs at the beginning of the project represent a saving in costs because there is no wood transported. However, after wood processing begins, these costs will be included. A decrease or increase in transportation costs rangin from 10 to 20%, change the IRR less than 1% point, meanwhile the NPV will increase or decrease by 3% when the costs vary by 20% (Table 31). This result does not conform with the private investors' view that transportation is an important factor in their production operations.

Results were very sensitive to changes in land prices, a drop of 20% in land prices, will result in a 21% increase in the IRR and a 9.5% in the NPV. On the other hand, a 20% increase

will lower the IRR by 8% and the NPV by 11% (Table 32). The IRR is not very sensitive to changes in management costs: a change of 10% in thinning, harvesting and management costs changes the IRR by less than 1% (Table 33). Results show that land prices are still lower than shadow prices. If the demand for land was driven by timber prices, an analysis of the products and markets where Uruguay plans to export would be necessary. Even though the land price in Uruguay has increased in the last thirty years, historically, it has been lower than the land prices in Argentina and Brazil. Considering the same quality land, average prices per hectare in Argentina and Brazil have been higher than the Uruguay's average land price between 1994 and 2003 (Sáder Neffa 2004). Current land prices in Uruguay are similar to land prices in Brazil and in Argentina. Lower land price can be considered as another factor attracting foreign investors to the Uruguayan forest sector.

Forestry generally provides more jobs than the livestock on the same land base. Considering the primary production costs in both alternatives, forestry costs are higher. Labour accounts for much of the costs; therefore, the forest activity has a positive impact on employment. Results show that, on average, labor costs in US$/ha in forest plantations were four times higher than labor costs in livestock activities. If pruning, thinning, management, administration, and harvesting costs are added, labor costs are twenty times higher than those in livestock activities. These results are consistent with those estimated by the Forest Division and Ramos and Cabrera (Ramos & Cabrera 2001; San Roman 2005). The Forest Division estimated that the employment generated in the forest sector is higher than the employment generated in the livestock sector. First, they considered only the permanent employees in plantations and the results were that 2 to 9 jobs were created per 1,000 ha. Second, they DIEA adjusted these results considering the labor hired by third parties, and they estimated that the sector generates

7 jobs/ 1,000 ha. Third, based on CGA 2000 results, DF estimated that the forest sector generated 7.98 jobs/1,000 ha, that is, four times the employment generated in the livestock sector (DIEA estimates that the livestock activity generates 1.96 to 2.65 jobs/1,000 ha). The Forest Division estimates salaries in plantations at 130% of the minimum national wage. In addition, salaries paid in the forest sector are higher than those paid in the livestock sector.

Finally non-market benefits were not included in the evaluation as this assessment exceeded the objectives of this research. Other benefits associated with the forests are carbon storage, recreational, bird watching, hiking, and wildlife. In addition, forests decrease erosion, diminish urban migration, and promote industrial development. These impacts are difficult to quantify but they will increase the social net return of the policy.

One underlying objective of forest management is maintaining a variety and valuable supply of forest products while at the same time ensuring that production and harvesting are sustainable in the long run and do not compromise the consumption of generations.

Uruguay has also attempted to evaluate the alternative use of forests[31]. The country ratified the Kyoto Protocol in 2001, and has been promoting participation in the Clean Development Mechanism (CDM) for forestry and agricultural projects. The Environmental

[31] Some of the activities and publications regarding CS developed by the Uruguayan Government include:

- Host Country approval for CDM projects in Uruguay Applications on sustainability Tool Assessment. August 2003.
- Research to support the appliance to CDM for the Kyoto Protocol for Uruguay. May 2002. MVOTMA.
- Meeting Climate Change: CDM application in Uruguay. Montevideo, 24- 25 April 2003.
- National Capacity Proposal No 15.

Ministry (MVOTMA) is in charge of the research and activities related to the evaluation of CDM projects [32].

In addition, the Agricultural and Livestock Ministry (MGAP) established an office to analyze the possibilities of producing alternative energy from biomass (Methol 2004; Souto & Methol 2005). The Agricultural Projects of Climate Change Unit (UPACC) was established in February 2001and started their activities in 2004[33]. The Forest Division integrates the UPCC along with other Divisions.

Currently the Forest Division is analyzing the feasibility of horse and cattle breeding along with forest activities (Seminar: Opinions on the Forest Policy – Forest Division Director Andrés Berterreche- July 20 2006). This alternative has been part of a strategy of the new government to combine the two most important activities in the country. Most of the companies have been developing agroforestry projects which minimize fire risk because animal grazing reduces fuel loads in forests (COFUSA 2006).

The most important forest companies have programs to preserve native flora and fauna in their forests. Ence has two conservation areas: M'Bopicuá and Santo Domingo (Ence 2006). M'Bopicuá Conservation Area is located on the banks of the Uruguay River in Río Negro, covering 150 ha. It comprises "…the breeding station, the Nature Trail for appreciating native flora and an area of special historic interest. The aim is to preserve species of native flora and fauna, reproduce certain species that are in danger of extinction and then re-introduce them back into their natural habitat and contribute to environmental education in schools in the area". The Santo Domingo conservation area of 7,000 ha is located in Paysandú. Since 1996 plans have

[32] www.cambioclimatico.gub.uy

[33] Law 17296.

been developed for preserving palm trees, wetlands and native fauna. This is the first developed wetland restoration project in the country. Native species threatened with extinction (coati and caiman) have been reintroduced to this area. A project for improving the numbers of the natural population of caimans is also being developed.

Table 17. Shadow Prices Relations for Uruguay

Category	1995	2004
Non-skilled and semi-skilled labor	0.8	0.6
Qualified labor	0.8	1
Foreign Exchange	1.31	1.01
Land	1.19	-
Ground transportation	0.77	0.77
Investments	0.98	0.77

Sources: Fernández Gaeta (1995), Pereyra (2004).

Table 18. Unemployment Rate in Uruguay

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Total (Urban)	8	9	9	9	8	9	10	12	11	10	11	14	15	17	17	13	12
Montevideo	*9*	*9*	*9*	*9*	*8*	*9*	*11*	*12*	*12*	*10*	*12*	*14*	*16*	*17*	*17*	*13*	*12*
Provinces	*7*	*8*	*9*	*9*	*8*	*9*	*10*	*11*	*11*	*10*	*11*	*13*	*15*	*17*	*17*	*13*	*13*
Artigas	19	12	14	14	15	20	13	16	15	13	13	17	20	15	17	13	15
Canelones	9	9	8	9	9	10	9	13	14	12	12	14	15	19	21	16	14
Cerro Largo	**7**	**7**	**9**	**8**	**7**	**7**	**8**	**10**	**12**	**10**	**12**	**11**	**12**	**14**	**10**	**5**	**9**
Colonia	5	6	10	12	8	8	8	9	11	8	14	16	20	20	18	12	10
Durazno	**9**	**8**	**8**	**3**	**5**	**6**	**11**	**10**	**13**	**8**	**17**	**22**	**24**	**25**	**22**	**14**	**13**
Flores	8	5	10	5	6	4	10	8	15	14	19	20	16	18	16	14	17
Florida	**9**	**10**	**10**	**9**	**6**	**8**	**10**	**10**	**15**	**11**	**11**	**15**	**21**	**23**	**22**	**19**	**16**
Lavalleja	9	10	11	11	8	9	7	9	9	9	7	11	13	17	16	10	16
Maldonado	4	8	8	9	7	9	12	13	13	8	11	17	20	24	23	20	18
Paysandú	**7**	**7**	**8**	**10**	**7**	**8**	**9**	**12**	**9**	**9**	**9**	**11**	**13**	**13**	**19**	**16**	**13**
Río Negro	**13**	**11**	**17**	**9**	**11**	**12**	**16**	**26**	**13**	**13**	**12**	**6**	**9**	**6**	**7**	**4**	**8**
Rivera	**6**	**6**	**11**	**11**	**10**	**16**	**13**	**11**	**7**	**6**	**3**	**8**	**6**	**6**	**3**	**4**	**4**
Rocha	9	7	7	8	7	9	13	10	12	8	10	12	16	18	18	13	14
Salto	5	9	5	5	5	4	3	2	1	1	4	2	6	8	7	6	12
San José	4	2	6	6	7	8	8	9	6	10	9	10	12	14	12	10	13
Soriano	6	7	10	10	10	6	10	12	11	15	14	18	19	21	18	17	12
Tacuarembó	**8**	**8**	**9**	**9**	**9**	**10**	**11**	**11**	**12**	**10**	**8**	**15**	**14**	**17**	**13**	**11**	**8**
Treinta y Tres	5	5	13	11	14	13	17	14	15	13	14	13	17	17	25	15	18

Note: The provinces marked in bold are the provinces with higher forest area.

Source: National Institute of Statistics (2006).

Table 19. Uruguay BLV (2005)

Market Prices	**US$/ha**
Pine	1,028
Eucalyptus	1,493
Livestock	420
Shadow Prices	**US$/ha**
Pine	1,460
Eucalyptus	1,785
Livestock	523

Source: Own estimates.

Table 20. Eucalyptus Growth, Yields and Management Assumptions

Pulp (70% area)			
Growth rate (m3/ha/year)	30		
Rotation age (years)	9		
Initial Density (trees/ha)	1,000		
Final Density (trees/ha)	800		
Extraction (m3/ha)	250		
Saw timber (30% area)			
Growth rate (m3/ha/year)	30		
Rotation age (years)	18		
Extraction (m3/ha)	m3/ha	Product	Year
1st Thinning	50	Pulp	9
2nd Thinning	140	Pulp	13
Final Harvest	340	Saw timber	18

Source: Own estimates based on Methol (2001)

Table 21. Pine Growth, Yields and Management Assumptions

Saw timber					
Growth rate (m3/ha/year)	24				
Rotation age (years)	22				
Initial Density (trees/ha)	1,000	-			
1st Thinning Density	1,000	600			
2nd Thinning Density	600	400			
3rd Thinning Density	400	200			
Final Density (trees/ha)	200	0			
Extraction	m3/ha	Year	Saw timber	Fuel wood	No Value
1st Thinning	11	4	0%	0%	100%
2nd Thinning	93	12	50%	50%	0%
3rd Thinning	188	18	70%	30%	0%
Final Harvest	255	22	85%	15%	0%

Source: Ramos and Cabrera (2001)

Table 22. Plantation Costs Structure

Items	Share of Total Costs	Taxes	%
Fences	**9%**		
Posts	47%	Exonerated	
Wire	30%	Exonerated	
Labor	24%	BPS	11.5%
Soil Preparation	**16%**		
Fuel	56%	IMESI	34%
Lubricants	8%	IMESI	26%
Machinery	25%	Exonerated	
Labor	11%	BPS	12%
Ants control	**3%**		
Inputs	55%	IVA	17%
Labor	45%	BPS	12%
Fertilization	**6%**		
Inputs	61%	Exonerated	
Labor	39%	BPS	12%
Plants	**40%**	IVA pending	
Plantation			
Labor	7%	BPS	12%
Reposition	**9%**		
Plants	85%	IVA pending	
Labor	15%	BPS	12%
Miscellaneous	**9%**	IVA Basic	17%

Source: Adapted from Ramos and Cabrera (2001)

Table 23. Forest Production Costs (2005)

Export Costs	
Total Labor Costs/volume of wood exported (1,000 US$/1,000 m^3)	0.38
Pruning (1,000 US$/ha)	0.060
Thinning (1,000 US$/ha)	0.008
Administration and Management	
Ants Control (1,000 US$/ha)	0.007
Year 1	
Wage days/ha	1.25
1 day wage (1,000 US$)	0.015
Years 1 and 2	
Paths	
Daily wages/ha	0.3
Daily wage (1,000 US$)	0.015
Annual	
Administration	
Daily wages/ha	3

Harvest		
	Pulp	**Sawn wood**
Daily wages (# daily wages/m3)	0.289	0.222
Salaries US$ (130% minimum national wage)		
1 day salary (1,000 US$)	0.015385	
Cost Structure		
Labor	55%	
Fuel	30%	
Rest	15%	
Total Costs	100%	

Source: Own estimations based on Ramos and Cabrera (2001).

Table 24. Industrial Costs Structure (2005)

	Beef	Wool	Leather	Wood
Total Costs	**100%**	**99%**	**100%**	**100%**
Inputs	65%	44%	42%	77%
Production Costs	35%	54%	58%	23%

Imports and Labor as percentage of total costs

	Imports	Labor
Wood	8%	35%
Leather	3%	15%
Slaughter Houses	4%	12%
Wool	3%	15%

Sources: Own estimates based on Ramos and Cabrera (2001) and INE.

Table 25. Transportation Costs Coefficients

Wood Transportation

Coefficients	
Pulpwood transportation/Pulpwood extracted	0.90
Sawn wood transportation/Sawn wood extracted	0.80
Total Costs US$/ tons	9
Saw timber transported/Saw timber	0.45

Livestock Transportation

Transportation Costs (1,000 US$/ha)	0.0009
1989	
Livestock production (kg/ha)	43
Total Area	6575
Livestock production total (tons)	285
Livestock production (ton/ha)	0.043
# trips (total tons/13 tons)	22
Transportation fees (US$/km-1 trip=13 tons)	1.15
US$/km/ton	0.08
Km/trip	250

Source: Own estimations based on Ramos and Cabrera (2001).

Table 26. Forest Land Prices vs. Livestock Land Prices

Year	US$/ha			
	Average	**Forest**	**Livestock**	**Difference**
1999	530	617	486	132
2000	473	624	415	209
2001	421	565	349	217
2002	362	460	283	177
2003	434	584	385	199
2004	689	871	599	271
2005	807	1015	692	323

Source: DIEA based on INC

Table 27. Cost Benefit Analysis Results

	89	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05
INPUTS	0.3	0.3	1.0	1.5	2.4	2.6	3.3	3.0	3.7	13.2	13.0	24.5	42.6	55.9	69.4	100.6	116.6
Production Costs	0.3	0.3	1.0	1.6	2.4	2.7	3.5	3.2	4.0	8.9	8.2	12.6	19.7	10.2	22.1	41.3	59.3
Plantations	0.1	0.1	0.2	0.4	0.6	0.6	0.7	0.4	0.7	0.5	-0.2	-1.2	-1.4	-3.2	-1.9	-2.1	-2.7
Nurseries	0.2	0.2	0.6	1.0	2.0	2.2	2.7	2.7	3.2	3.4	1.9	2.2	1.9	0.5	0.8	1.6	2.6
Pruning and Thinning	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.3	0.4	0.5	0.8	1.9	2.2	2.7	2.9
Management and Adm	0.2	0.3	1.0	1.4	2.1	2.7	3.6	3.7	4.4	5.3	5.0	4.3	3.4	0.7	1.1	2.4	5.8
Harvesting	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.5	10.6	18.7	12.3	22.0	39.8	55.0
Industry	0.0	0.0	-0.1	-0.2	-0.4	-0.6	-0.8	-1.0	-1.2	-1.5	-1.5	-1.6	-1.8	-1.5	-1.3	-1.5	-1.6
Transportation	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.2	-0.2	-0.3	4.1	4.6	11.5	22.1	43.7	45.3	56.7	54.8
Export Costs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.4	0.8	1.9	2.0	2.6	2.5
INVESTMENTS	0.0	0.9	2.0	3.1	5.1	5.4	20.8	7.1	8.9	16.6	12.5	16.2	14.9	5.2	16.1	20.9	55.7
Plantations	0.0	0.9	2.0	3.1	5.1	5.4	7.1	7.1	8.9	16.6	12.5	16.2	14.9	5.2	5.5	10.3	13.8
Industry	0.0	0.0	0.0	0.0	0.0	0.0	13.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.6	10.6	41.9
OUTPUTS	-0.2	-0.2	-0.4	-0.6	-1.0	-1.0	-1.8	-1.8	-2.4	23.4	31.1	60.6	114.7	187.4	214.5	274.8	297.1
Exports	-0.2	-0.2	-0.4	-0.6	-1.0	-1.0	-1.8	-1.8	-2.4	23.4	31.1	60.6	114.7	187.4	214.5	274.8	297.1
Terminal Value																	1164.5
CASH FLOW	-0.4	-1.4	-3.4	-5.2	-8.4	-8.9	-26.0	-11.9	-15.0	-6.3	5.6	19.9	57.2	126.3	129.0	153.3	1289.3

IRR	**36.4%**
NPV (6%) mill US$ 1989	**630.2**

Table 28. Sensitivity Analysis: Wood Prices

IRR

Saw timber \ Pulpwood	-20%	-10%	0%	10%	20%
-10%	33.38%	34.81%	36.17%	37.46%	38.69%
0%	33.63%	35.05%	**36.39%**	37.67%	38.89%
10%	33.88%	35.28%	36.61%	37.88%	39.09%
20%	34.13%	35.52%	36.83%	38.09%	39.28%

Saw timber \ Pulpwood	-20%	-10%	0%	10%	20%
-10%	-3.01%	-1.58%	-0.22%	1.07%	2.30%
0%	-2.76%	-1.34%	0.00%	1.28%	2.50%
10%	-2.51%	-1.11%	0.22%	1.49%	2.70%
20%	-2.26%	-0.87%	0.44%	1.70%	2.89%

NPV

Saw timber \ Pulpwood	-20%	-10%	0%	10%	20%
-10%	564,972	579,189	*621,762*	664,334	706,907
0%	545,061	587,663	**630,206**	*672,778*	*715,350*
10%	553,505	596,077	*638,649*	681,222	723,794
20%	561,948	604,521	*647,093*	689,666	732,238

Saw timber \ Pulpwood	-20%	-10%	0%	10%	20%
-10%	-11.55%	-8.81%	-1.36%	5.14%	10.85%
0%	-15.62%	-7.24%	0.00%	6.33%	11.90%
10%	-13.86%	-5.73%	1.32%	7.49%	12.93%
20%	-12.15%	-4.25%	2.61%	8.62%	13.93%

Table 29. Sensitivity Analysis: Yields

IRR

Eucalyptus \ Pine	-20%	-10%	0%	10%	20%
-20%	29.02%	29.70%	30.35%	30.97%	31.57%
-10%	32.67%	33.19%	33.70%	34.19%	34.66%
0%	35.55%	35.98%	**36.39%**	36.80%	37.19%
10%	37.94%	38.30%	38.66%	39.00%	39.34%
20%	40.00%	40.31%	40.62%	40.92%	41.21%

Eucalyptus \ Pine	-20%	-10%	0%	10%	20%
-20%	-7.37%	-6.69%	-6.04%	-5.42%	-4.82%
-10%	-3.72%	-3.20%	-2.69%	-2.20%	-1.73%
0%	-0.84%	-0.41%	0.00%	0.41%	0.80%
10%	1.55%	1.91%	2.27%	2.61%	2.95%
20%	3.61%	3.92%	4.23%	4.53%	4.82%

NPV

Eucalyptus \ Pine	-20%	-10%	0%	10%	20%
-20%	321,701	343,506	365,312	387,117	408,922
-10%	454,148	475,953	497,759	519,564	541,369
0%	586,595	608,400	**630,206**	652,011	673,816
10%	719,042	740,847	762,653	784,458	806,264
20%	851,489	873,294	895,100	916,905	938,711

Eucalyptus \ Pine	-20%	-10%	0%	10%	20%
-20%	-95.90%	-83.46%	-72.51%	-62.79%	-54.11%
-10%	-38.77%	-32.41%	-26.61%	-21.30%	-16.41%
0%	-7.43%	-3.58%	0.00%	3.34%	6.47%
10%	12.35%	14.93%	17.37%	19.66%	21.84%
20%	25.99%	27.84%	29.59%	31.27%	32.86%

Table 30. Sensitivity Analysis: Transportation Costs

IRR

Livestock \ Wood	-20%	-10%	0%	10%	20%
-20%	36.96%	36.66%	36.35%	36.05%	35.73%
-10%	36.98%	36.68%	36.37%	36.07%	35.75%
0%	37.00%	36.70%	**36.39%**	36.09%	35.77%
10%	37.02%	36.72%	36.41%	36.11%	35.80%
20%	37.04%	36.74%	36.43%	36.13%	35.82%

Livestock \ Wood	-20%	-10%	0%	10%	20%
-20%	0.26%	-0.04%	-0.35%	-0.65%	-0.97%
-10%	0.28%	-0.02%	-0.33%	-0.63%	-0.95%
0%	0.30%	0.00%	-0.31%	-0.61%	-0.93%
10%	0.32%	0.02%	-0.29%	-0.59%	-0.90%
20%	0.34%	0.04%	-0.27%	-0.57%	-0.88%

NPV

Livestock \ Wood	-20%	-10%	0%	10%	20%
-20%	650,415	640,078	629,740	619,403	609,066
-10%	650,647	640,310	629,973	619,636	609,299
0%	650,880	640,543	**630,206**	619,868	609,531
10%	651,113	640,775	630,438	620,101	609,764
20%	651,345	641,008	630,671	620,334	609,996

Livestock \ Wood	-20%	-10%	0%	10%	20%
-20%	3.11%	1.54%	-0.07%	-1.74%	-3.47%
-10%	3.14%	1.58%	-0.04%	-1.71%	-3.43%
0%	3.18%	1.61%	0.00%	-1.67%	-3.39%
10%	3.21%	1.65%	0.04%	-1.63%	-3.35%
20%	3.25%	1.69%	0.07%	-1.59%	-3.31%

Table 31. Sensitivity Analysis: Land Price

	Land Price -20%	-10%	0%	10%	20%	50%
IRR	57.50%	43.38%	**36.39%**	31.71%	28.18%	20.94%
NPV	698,946	664,576	**630,206**	595,835	561,465	458,354

	Land Price -20%	-10%	0%	10%	20%	50%
IRR	21.11%	6.99%	0.00%	-4.68%	-8.21%	-15.45%
NPV	9.83%	5.17%	0.00%	-5.77%	-12.24%	-37.49%

Table 32. Sensitivity Analysis: Harvesting, Thinning and Management Costs

	Land Price -20%	-10%	0%	10%	20%	50%
IRR	57.50%	43.38%	**36.39%**	31.71%	28.18%	20.94%
NPV	698,946	664,576	**630,206**	595,835	561,465	458,354

	Land Price -20%	-10%	0%	10%	20%	50%
IRR	21.11%	6.99%	0.00%	-4.68%	-8.21%	-15.45%
NPV	9.83%	5.17%	0.00%	-5.77%	-12.24%	-37.49%

CHAPTER 5

CONCLUSIONS

The forest policy in Uruguay was developed to promote economic growth and generate environmental benefits. The government considered it as a tool to transform marginal agricultural lands, offering good forest growth conditions, into a thriving, globally competitive forest sector. The government thought that effective policies will help in developing a higher-value land use while promoting economic development, creating employment, attracting foreign investment, and increasing exports. While the development of the forest policy benefited from broad support in the legislature, it still was controversial. Subsidies proved to be particularly contentious. The main issues were: (1) whether the subsidies were necessary to attract investments, (2) whether to subsidize other, already established, sectors of the economy, and (3) whether the subsidies should be in effect for regions which determined that better alternative uses exist for lands allocated to forest development.

This study evaluated the forest policy in Uruguay nearly twenty years after it was developed. It used a CBA approach that has not been used before. While some studies had tried to evaluate the impact of the new forest sector on Uruguay's economy, they had focused on fiscal impacts and individual projects, not on the sector as a whole. This study compares the new forest sector with alternative activities that would have been developed if the project would have not been implemented. Livestock was assumed to be the alternative land use, corresponding closely to what has been observed on the ground. The CBA model had to make an extensive use of secondary information and own estimates. Linkages with other sectors of the economy, excluding direct transportation costs, were not considered due to data limitations. The current area of forest priority soils is 3 million ha; forests are already planted on 750 thousand ha. This

indicates that the forest planted area can still grow substantially, followed by further growth of wood manufacturing industries.

The results indicate a positive net impact of the newly developed forest sector on the Uruguayan economy when compared with agriculture and livestock. The NPV for the forest sector equals 630.2 million US$, using a 6% discount rate. The IRR for the forest sector development is 36.4%. These results are somewhat sensitive to changes in wood prices and growth rates and harvest yields. This indicates that market conditions and forest management operations are important variables in the evaluation of impacts that the sector has on the country's economy.

Forest policy in Uruguay has been successful in several ways. It has increased exports, which improved the balance of payments. It has found more productive uses for poor quality lands while attracting foreign investment, generating income and employment, and providing environmental benefits. Still, some aspects of the forest policy are a subject of a heated debate.

One of the most contentious issues is the increased competition for land. The development of the forest sector has brought about higher land prices. It has been harder and more expensive to purchase land, rising dissent in some circles of the society. There are only limited investment opportunities in Uruguay, and land has traditionally been considered as an important low risk investment. Current land prices are on par with prices in neighboring Brazil and Argentina. In the past, they had been lower. While not mentioned by forest investors, the lower land prices were one of the factors that attracted foreign investment. In addition, some farmers complained about the necessity of moving livestock to new areas once traditional pastures were converted to forestry. Since this process has been gradual, the cost is not expected to be high.

Other contentious issue regarding the forest policy was the use of subsidies to support the development of forest plantations and wood manufacturing industries. It has been shown that the even though subsidies the subsidy were important to attract investments, they were not the key factor. The discussion of whether to subsidize other sectors of the economy can be addressed with the positive net results obtained from evaluating the cost and benefits of the forest activity compared with an alternative production.

One may ask: Why the impacts of the forest policy in Uruguay have been uniformly positive? After all, there are numerous examples of countries that tried and failed in developing their forest sectors in an efficient and sustainable way (Repetto 1988; Repetto & Gillis 1988). Certainly, Uruguay has growth conditions suitable for forestry. Factors that may have decided the successes of the policy include a stable economic policy and investment polices that truly encourage foreign capital to invest to the country.

Throughout the course of this research project, several opportunities for further research have been identified. First, an extension of this CBA analysis should be conducted in a few years time. This is because large wood manufacturing facilities, including two paper mills, are nearing completion and will start operating in the next few years. Their massive, value-added products targeting global wood and paper markets will have a major impact on the country's economy and the evaluation of the forest policy.

Second, it would be worthwhile to estimate shadow prices for the forest sector, in particular for land and labor. Shadow prices for land in forestry uses have not been developed in Uruguay as suggested in the forest research literature. Labor treatment has been long a controversial issue. Unemployment is high in Uruguay, and large numbers of workers migrate in search for employment opportunities. While employment generation has not been a major

policy's objective, it has been an important argument in debating and defending it. A comprehensive assessment of labor issues would certainly help in informing this and future policy debates.

Third, the use of a more comprehensive evaluation method may also cast more information on the policy's impacts. Three approaches are generally used to evaluate forest policies. They include the Computable General Equilibrium (CGE), Input-Output (I-O) and Cost-Benefit Analysis (CBA), which was used in this study. CGE requires estimation of macroeconomic equations which was beyond the scope of this project. The second approach requires an updated I-O matrix. The rationale for a more comprehensive approach is that in a small country such as Uruguay, the forest sector, once large mills become operable, will have a substantial impact on the country's economy.

Finally, further research should incorporate non-market variables. They include a range of environmental services that are provided by forest plantations. Environmental values are increasingly important in policy debates, and Uruguay is no exception. While the plantations have been criticized on environmental grounds, they appear to put less stress on the environment than agriculture and livestock. These impacts too need to be evaluated to inform policy debates and permit rational land use decision-making.

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APPENDIX I

SURVEY RESULTS

THE ECONOMIC IMPACT OF THE FOREST SECTOR IN URUGUAY: SURVEY RESULTS

A survey to institutions and companies in the forest sector was conducted in July 2006 in Uruguay. The institutions selected were the Forest Producers Society (SPF), the Economic Institute of the Social Sciences Faculty of the Republic of Uruguay University, the Forest Division and the Agricultural Planning and Policy Office (OPYPA) of the Agricultural Ministry. Selected companies included were Botnia, Eufores, Colonvade, Fymnsa and Cofusa.

The Forest Producers Society (SPF) is a private association that represents the forest business sector in Uruguay. It is made up of technicians, producers, and companies, both local and foreign. Its objective is to promote a sustainable forest sector in Uruguay by promoting forest plantations and contributing to the conservation of the natural forests in the country (Forest Producers Society 2006).

The Economic Institute of the Social Sciences Faculty of the Republic of Uruguay University is a research institute which research areas include: econometric, industrial organization, business, microeconomics, macroeconomics, finance and labor economic.

The Forest Division of the Agricultural Ministry is in charge of the Forest Policy (Forestry Law 15939 1988). The main activities are to promote the forest activity, to design and to analyze management plans for public and private lands, to assist the institutions on the forest management and to coordinate activities related with the forestry.

OPYPA of the Agricultural Ministry is the office in charge of advising the government in the design, execution and control of the agricultural policies.

The companies were selected for the following reasons: first, they include both local and foreign companies; second, all together they own 30% of the plantations and the rest is fragmented; third, they produce a spectrum of products (two, wood for pulp; two, saw timber; one, plywood); fourth, each of the companies is in a different stage of development; fifth, they have different types of organization according to capital, species and timber management. Some of the companies have different names for their plantation's firm and for their manufacturing firm; furthermore, some companies have different names from the name they use in their country of origin (Table 33).

Botnia is constructing a pulp mill in the North of the country, which involves the largest single investment in the country's history: a one billion US$ investment. It consumes 3.5 million cum of pulpwood when operating at full capacity (Metsa-Botnia 2004). Its main product is bleached eucalyptus Kraft pulp, and their estimated production capacity will be one million tons per year. Its capital originates from Finland and was used to purchase the Uruguayan company, FOSA, which owned the forest plantations. The company is located in Río Negro and Paysandú.

Colonvade is a branch of the US company Weyerhaeuser. It is constructing a plywood facility and plans to construct five to eight more plants in Tacuarembó, Rivera and Paysandú. Its total investment is between $500 and $800 million, depending on the number of plants it will construct. It has already made a $270 million investment in 131,000 hectares of land for plantations, of which 85,000 were already planted. Its first commercial thinning was planned for the current year, and it expected to obtain 16,000 m^3 wood. By 2012 it expects to extract 2.5 million m^3 per year, from which it would obtain 900,000 m^3 in products to export. The main products are: plywood, saw timber, MDF (medium density board) and LVL (laminated veneer lumber) (El Espectador Radio 2005).

Ence, a Spanish company that has partnerships with several local companies, was planning to construct a pulp mill by the end of the current year. Eufores is the local branch of the company. At M'Bopicuá Logistic Terminal, Ence invested $622 million in a chip plant with a production capacity of 500,000 cum per year. Maserlit, an Uruguayan sawmill that Ence controls, produces 35,000 cum per year of kiln dried wood to produce Eucalyptus Grandis lumber. By the time of the interview, Ence estimated that by the year 2008 they will be operating at full capacity. However, these days it has been subsequently announced the relocation of the mill and the information of when they are going to begin the construction is not known.

Fymnsa, which produces saw logs, is one of the oldest and biggest local companies and is building a sawmill in Rivera (northern Uruguay). It is producing 18,000 tons of chips per year and it has 13,000 ha of plantations.

Cofusa and Urufor are two forestry companies that belong to the same economic group. They are located in the North of Uruguay and produce high quality Eucalyptus Grandis timber. Cofusa owns 25,000 haof plantations and Urufor owns a sawmill.

The survey for institutions had semi structured questions on topics which differed according to the institution. SPF was asked about regulation, their studies on forest sector impact and policy evaluation and limitations for the sector's development; the Economic Institute of Social Sciences Faculty was asked about macroeconomic data availability to use in the research; Forest Division was asked about the Forest Policy history and the current regulation in force as well as about their future actions; and OPYPA was asked about the situation of the forest sector in Uruguay and its possible impacts in the economy.

The survey for companies had open and structured questions. The companies had to fill out two different forms: one for its plantation activities and the other for its industrial activities, as some companies has separate corporations for each activity.

Each plantation company was asked about location, origin of the capital, production (forest area, harvest, and rotation age), costs and investments, labor, certification programs and future plans. Each industry was asked questions dealing with location, origin of the capital, production (products, markets, sales, and plants' capacity), investment and costs, labor, regulation, certification programs and future plans. Each company was also asked for the reasons it started its activities in Uruguay.

Institutions interviewed evaluated the impact of the forest sector in Uruguay as positive. There is an agreement that the sector is just starting its development and it is going to grow fast in the next years when plantations start to be harvested. Opinions on regulation differed: the SPF said that regulation is good, and people in the Forest Division said that current regulation needs to be adjusted. Institutions are weaker than at the beginning of the forest sector development.

The SPF had evaluated the impact of the new forest sector using cost benefit analysis. Two private consultants compared the Uruguayan economy with and without the forest sector (Vázquez Platero 1996; Ramos & Cabrera 2001). They considered plantations as well as industrial activities, and both concluded that the impact will be positive. The limitations for the sector would be related with high costs in US dollars, specially fuel, and a low exchange rate[34] which leads to a competitiveness loss.

The Forest Division described the origin and objectives of the current Forest Policy in force. Regarding the institution itself, two factors have a negative impact on their activities: first, an

[34] Currently the exchange rate is 24 $U/ 1 US$.

increasing number of technicians are going to the private sector, and second, more resources are going to the Environmental Ministry to evaluate forest projects.

The companies are located in the North and Northwest of the country, and one is expanding their activities to the Northeast. The companies' capital is originated in different countries: Spain, Finland, USA and Uruguay. All the companies together have a forest area that represents 30% of the country's forest area. They have more than 50% of their land planted; meanwhile this ratio for the country is only 4.3%. These results show that the companies will buy new land to increase the plantations area (Table 34).

Even though Eucalyptus is the most important specie planted, Pine is increasing its participation reaching 77,265 hectares in 2004 (Table 35). Eucalyptus is mostly managed for pulp with the exception of one company that is managing it for hardwood. Pine is managed for saw timber and plywood.

Rotation ages vary from 22 to 25 for Pine according to the final product, and 10 to 20 years for Eucalyptus. On average, this represents 23 years for Pine and 15 years for Eucalyptus (Table 36).

Investments vary from each company according to their stage of development. By 2008, four companies' total investments[35] will be approximately 1,900 million US$[36]. This amount includes investments that the companies have been done in land and investments they planned to do in industries. There are important differences in amount, as one company is planning to invest 1 billion US $ in its pulp mill. The most important investments are from the foreign companies.

[35] One company did not give information about its total investments, and another did not give information before 2005.

[36] These days, one of the companies announced that an 800million US $ investment planned will be delayed. If this investment were not considered, the total amount would be 1.100 billion US $.

All the companies are involved in Certification Programs: four of them have Forest Stewardship Council (FSC) certification and one has International Organization for Standardization 14001 (ISO 14001) certification.

The regulation is good, but labor regulation is needed. Plantation workers are regulated under agricultural laws without considering the specific characteristics of the forest sector, such are safety issues. The general opinion is that the sector started developing because of the Forestry Law 15939 and subsidies were an important part of the incentives' package.

All the companies have plans to grow in the future, either to increase the area planted, to export, to build new mills or to increase their current capacity. Two companies are already building their second sawmill.

The companies mentioned several reasons for starting their activities in Uruguay. All of them mentioned soils and growth rates as key elements to go to the country. They also pointed put that a good economy's performance, economy's stability and a good regulation in the Forest Sector were factors that contribute to this decision.

Labor's skills were a problem at the beginning, but the problem was quickly solved by training the labor in the skills needed. Training programs were offered by companies to their labor force and most of the companies said that Uruguayan workers are open to learn.

Table 33. Companies classified according to the origin of the capital

Uruguayan Entity		International Firm in Control	Origin of (Foreign) Capital
Manufacturing	Forest Plantations		
Botnia	Fosa	Oy Metsa Botnia	Finland
Eufores	Eufores	Ence	Spain
Colonvade	Colonvade	Weyerhaeuser	United States
Fymnsa	Fymnsa	-	Uruguay
Urufor	Cofusa	-	Uruguay

Table 34. Area by companies

	Planted Area (ha)	**Land Area (ha)**	**Planted/ Land Area**
Total 5 Companies	220,893	391,000	56.49%
Total Uruguay	714,000	16,666,670	4.30%
% Total (5 Companies/Uruguay)	30.94%		

Table 35. Area by species (in ha)

Euc. Grandis	**Pinus Taeda**	**Euc. Globulus**	**Pinus Patula**	**Pinus Elliotti**	**Total Area**
38,120	77,265	105,000	129	379	220,893

Table 36. Rotation ages and Growth rates

Estimations	**Pine**	**Eucalyptus**
Rotation Age	23 years	15 years
Growth Rates	20 m3/year	22 m3/year

APPENDIX II

SURVEY FORMS

The Impact of the Forest Sector on the Uruguayan Economy

Master of Science Thesis Research

Warnell School of Forestry and Natural Resources

University of Georgia

Survey - Plantations

July, 2006

I. General Information

1. Company Name: _____
2. Contact Information:

   Address/ Phone Number/E-mail address:

   _____

   _____

   _____
3. Name and Position of the Person who answer the survey:

   _____

   _____
4. **Type of business organization**: Domestic ⬭ Foreign ⬭

   Sole Proprietorship ⬭ Domestic Partnership ⬭ Corporation ⬭
5. **Origin of foreign capital** (if applicable): _____

II. Production

6. Area of Forest Land:

Species	Total Land Area	Planted Area	Location
Total			

7. **Harvest:**

Product	Tons
Saw timber	
Chip and Saw	
Pulpwood	

8. Rotation: which is the average rotation by specie or by product?

_____

_____

III. Investments and Costs

9. **Investments**: Which are the estimated investments per year?

Category	Amount (in dollars)	Year	Imported (%)

10. **Total costs**

Year	Amount
2000	
2001	
2002	
2003	
2004	
2005	

11. Costs as percentage of the total:

Concept	Amount (in dollars)	Year
Raw material (timber)		
Transportation		
Services, maintenance and repair		
Equipment		
Wages		
Insurance		
Supplies		
Contractual Services		
Fuels		
Utilities (Water, Electricity, Phone)		
Taxes		
Other administrative expenses		
Others (describe)		

IV. Employment

12. Indicate number of employees by part of the company.

_____

_____

_____

_____

_____

V. Environmental, certification and other programs

13. Does the company have environmental programs? If yes, please describe them briefly.

_____

_____

_____

_____

14. Does the company participate in any certification programs? If yes, in which ones?

_____

_____

_____

_____

15. In which other programs does the company participate?

_____

_____

_____

_____

_____

VI. Future Plans

16. What are the company's plans for the following years?

17. Which are the most important limitations that, in your opinion, the company would face in the following years? E.g.: transport, financing, labor, markets.

18. Which are the growth rates expected by species?

19. How much production is expected for the next years?

The Impact of the Forest Sector on the Uruguayan Economy

Master of Science Thesis Research

Warnell School of Forestry and Natural Resources

University of Georgia

Survey Industry

July 2006

I. General Information

1. Company Name: _____
2. Contact Information:

   Address/ Phone Number/E-mail address:

   _____

   _____

   _____
3. Name and Position of the Person who answer the survey:

   _____

   _____
4. **Type of business organization**: Domestic ⬭ Foreign ⬭

   Sole Proprietorship ⬭ Domestic Partnership ⬭ Corporation ⬭
5. **Origin of foreign capital** (if applicable): _____

II. Production

6. **Products:**

Product	Destination (markets)	% of the total sales
Fuel wood		
Chips		
Plywood		
Boards		
Pulp		
Paper		
Others (specify)		

7. **Total Sales of Forest Products**: indicate the approximate amount of sales per year.

Year	Amount
2000	
2001	
2002	
2003	
2004	
2005	

8. Does the company buy wood (timber) from other companies? Yes ⬭ No ⬭ . If yes, fill in the following table:

Seller	% of total timber consumed	Specie(s)
Farmer(s)		
Other companies		
(1) _____		
(2) _____		
(3) _____		
(4) _____		
(5) _____		

9. **Mill capacity**. Indicate current and expected annual capacity of your mill(s) in cum.

Plant	Year	Capacity	Product	Location

III. Investments and Costs

10. **Investments**: Which are the estimated investments per year?

Concept	Amount (in dollars)	Year	Imported (%)

11. **Total costs:** how much are the total costs per year?

Year	Amount
2000	
2001	
2002	
2003	
2004	
2005	

12. Costs as percentage of the total:

Concept	Amount (in dollars)	Year
Raw material (timber)		
Transportation		
Services, maintenance and repair		
Equipment		
Wages		
Insurance		
Supplies		
Contractual Services		
Fuels		
Utilities (Water, Electricity, Phone)		
Taxes		
Other administrative expenses		
Others (describe)		

IV. Employment

13. Indicate number of employees by part of the company. If the company has more than one plant, please use different tables.

Plant: _____

	Years						
Concept							
Construction							
Operation							

Plant: _____

	Years						
Concept							
Construction							
Operation							

Plant: _____

	Years						
Concept							
Construction							
Operation							

Plant: _____

	Years						
Concept							
Construction							
Operation							

14. Which external services do you hire?

_____

_____

_____

_____

_____

V. Regulation

15. Why did the company choose Uruguay to run the business?

16. If the subsidies and tax exonerations were not established, would you have chosen the country to invest?

17. How do you evaluate the regulation in the Forest Sector in Uruguay?

18. Do you consider the Law No. 16906 (National Interest Investments) an important incentive to invest in the country?

19. Which elements (or regulation) will be necessary to improve the developing of the sector in the next years?

_____

_____

_____

_____

VI. Environmental, certification and other programs

20. Does the company have programs to monitor environmental effects? If yes, which kind of programs?

_____

_____

_____

_____

21. Does the company participate in any certification programs? If yes, in which one(s)?

_____

_____

_____

_____

22. Does the company participate in Chain of Custody certification programs?

_____

_____

_____

_____

23. In which other programs the company participates?

VII. Future Plans

24. What are the company's plans for the following years? E.g.: increase capacity, buy new land, and explore new markets.

25. Which are the most important limitations that, in your opinion, the company would face in the following years? E.g.: transport, financing, wood supply, labor, markets.

26. What are the perspectives you see on the development of the forest sector in Uruguay?

APPENDIX III

CBA TABLES

Table 37. Total Extraction Eucalyptus (1,000 m^3)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Effective Area (in ha)	3,817	4,208	10,070	16,473	25,707	26,736	35,651	34,671	41,683	38,274	28,865	22,778	19,988	8,807	8,620	19,808	17,873
Pulp										668	736	1,762	2,883	4,499	4,679	6,239	6,067
Saw timber																	
Pulp																	
1st Thinning										57	63	151	247	386	401	535	520
2nd Thinning														1,080	1,123	1,497	1,456
Saw timber																	
Total Pulp	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**725**	**799**	**1,913**	**3,130**	**5,964**	**6,203**	**8,271**	**8,044**
Total Saw timber	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Table 38. Total Extraction Pine (1,000 m^3)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Effective Area (in ha)	602	914	1,172	1,352	3,359	4,005	5,231	6,465	9,514	20,885	22,104	17,719	16,306	11,955	9,975	6,788	11,915
Total Extraction																	
No Value																	
1st Thinning					7	10	13	15	37	45	58	72	106	233	246	198	182
2nd Thin													-	-	-	-	-
3rd Thin.													-	-	-	-	-
Harvest																	
Fuel wood																	
1st Thinning					-	-	-	-	-	-	-	-	-	-	-	-	-
2nd Thin.													442	970	1,027	823	758
3rd Thin.																	
Harvest																	
Saw timber																	
1st Thinning					-	-	-	-	-	-	-	-	-	-	-	-	-
2nd Thin.													442	970	1,027	823	758
3rd Thin.																	
Harvest																	
Total Pulp	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total SW	0	0	0	0	0	0	0	0	0	0	0	0	442	970	1,027	823	758
Total Fuel wood	0	0	0	0	0	0	0	0	0	0	0	0	442	970	1,027	823	758
Total No Value	-	-	-	-	7	10	13	15	37	45	58	72	106	233	246	198	182

Table 39. Basic Assumptions

Forest Area (in 1,000 ha)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Annual 1989-1999	7	8	16	26	42	44	59	59	73	85	73	58	52	30	27	38	43
Cumulative	7	14	31	56	98	143	201	260	333	418	491	549	601	631	657	695	738

With Project Production-Model (1,000 m3/ha)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
TOTAL	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**725**	**799**	**1,913**	**3,572**	**6,934**	**7,230**	**9,094**	**8,801**
Pulpwood	0	0	0	0	0	0	0	0	0	725	799	1,913	3,130	5,964	6,203	8,271	8,044
Sawn wood	0	0	0	0	0	0	0	0	0	0	0	0	442	970	1,027	823	758
Saw timber	0	0	0	0	0	0	0	0	0	0	0	0	199	437	462	370	341

Prices (1,000 US$/m3)

Saw timber price	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.084	0.112	0.112	0.112	0.112
Pulpwood prices	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.028	0.032	0.025	0.023	0.023	0.026	0.028	0.032

Table 40. Investments in Land (million US$)

Plantations	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
With																	
Market Land Price (1,000 US$/ha)	0.361	0.528	0.580	0.637	0.658	0.716	0.749	0.760	0.734	0.796	0.630	0.650	0.590	0.460	0.593	0.871	1.871
SPR land	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1	1	1	1
Investments Land million US$/ha																	
Market Prices	2.37	4.02	9.48	16.37	27.62	31.73	43.85	44.74	53.70	67.49	46.00	37.71	30.65	13.66	15.77	33.09	43.21
Shadow Prices	2.82	4.79	11.28	19.48	32.86	37.75	52.18	53.24	63.91	80.31	54.73	44.87	36.48	13.66	15.77	33.09	43.21
Without																	
Market Land Price (1,000 US$/ha)																	
Livestock	0.361	0.426	0.478	0.535	0.556	0.614	0.647	0.658	0.632	0.632	0.486	0.415	0.349	0.283	0.385	0.599	0.599
SPR land																	
Land	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.19	1.00	1.00	1.00	1.00
Investments Land million US$/ha																	
Market Prices	2.37	3.25	7.81	13.75	23.35	27.22	37.89	38.75	46.26	53.58	35.47	24.08	18.11	8.41	10.23	22.77	29.44
Shadow Prices	2.82	3.86	9.30	16.37	27.78	32.39	45.09	46.12	55.05	63.76	42.20	28.65	21.55	8.41	10.23	22.77	29.44
Incremental																	
Market Prices	**0.00**	**0.78**	**1.66**	**2.61**	**4.27**	**4.51**	**5.96**	**5.99**	**7.44**	**13.91**	**10.53**	**13.63**	**12.55**	**5.25**	**5.54**	**10.31**	**13.77**
Shadow Prices	**0.00**	**0.92**	**1.98**	**3.11**	**5.08**	**5.36**	**7.09**	**7.13**	**8.86**	**16.55**	**12.53**	**16.22**	**14.93**	**5.25**	**5.54**	**10.31**	**13.77**

Table 41. Industry Investments (million US$)

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Investments (with Project)	0	0	0	0	0	0	10.50	0	0	0	0	0	0	0	10.50	10.50	41.50
Saw timber							10.50								10.50	10.50	41.50
Pulp																	
Investments (without Project)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental Investments market prices	0	0	0	0	0	0	10.50	0	0	0	0	0	0	0	10.50	10.50	41.50
Incremental Investments shadow Prices	**0**	**0**	**0**	**0**	**0**	**0**	**13.76**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**10.61**	**10.61**	**41.92**

Table 42. Exports

	1989	1990	1991	1992	1993	1994	1995	1996	1997
With									
Cumulative area (1,000 ha)	6.58	14.2	30.55	56.25	98.24	142.57	201.14	260.04	333.23
Forest Area (1,000 ha)	6.58	7.62	16.35	25.71	41.99	44.33	58.57	58.9	73.2
Total Exports	0	0	0	0	0	0	0	0	0
Saw timber	0	0	0	0	0	0	0	0	0
Pulpwood	0	0	0	0	0	0	0	0	0
Without									
Total Exports (million US $)	0.13	0.13	0.27	0.44	0.75	0.75	1.4	1.36	1.84
Alternative Productions (total production)	0.22	0.22	0.46	0.74	1.24	1.25	2.33	2.26	2.83
Alt. Prod. (exports)	0.13	0.13	0.27	0.44	0.75	0.75	1.4	1.36	1.84
Incremental market prices (million US$)	**-0.13**	**-0.13**	**-0.27**	**-0.44**	**-0.75**	**-0.75**	**-1.4**	**-1.36**	**-1.84**
Incremental shadow prices (million US$)	**-0.17**	**-0.17**	**-0.36**	**-0.58**	**-0.98**	**-0.99**	**-1.83**	**-1.78**	**-2.41**

Table 42 (cont) Exports

	1998	1999	2000	2001	2002	2003	2004	2005
With								
Cumulative area (1,000 ha)	418.01	491.02	549.03	600.99	630.72	657.31	695.31	737.86
Forest Area (1,000 ha)	84.78	73.01	58.01	51.96	29.73	26.59	37.99	42.55
Total Exports	20.31	25.58	47.83	88.64	185.9	212.84	272.93	295.44
Saw timber	0	0	0	16.65	48.73	51.57	41.34	38.05
Pulpwood	20.31	25.58	47.83	71.99	137.17	161.27	231.59	257.4
Without								
Total Exports (million US $)	2.43	1.81	1.55	1.08	0.35	0.47	0.85	1.28
Alternative Productions (total production)	3.74	2.79	2.38	1.66	0.54	0.72	1.22	1.83
Alt. Prod. (exports)	2.43	1.81	1.55	1.08	0.35	0.47	0.85	1.28
Incremental market prices (million US$)	**17.88**	**23.77**	**46.28**	**87.56**	**185.55**	**212.38**	**272.08**	**294.16**
Incremental shadow prices (million US$)	**23.42**	**31.14**	**60.63**	**114.7**	**187.41**	**214.5**	**274.8**	**297.1**

Table 43. Transportation Costs (million US$)

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
With																	
Transportation (in 1,000 tons)																	
Pulpwood	0	0	0	0	0	0	0	0	0	653	720	1722	2817	5368	5582	7444	7239
Sawn wood	0	0	0	0	0	0	0	0	0	0	0	0	354	776	822	659	606
Saw timber	0	0	0	0	0	0	0	0	0	0	0	0	90	196	208	167	153
Total Volume	0	0	0	0	0	0	0	0	0	653	720	1722	3260	6340	6612	8269	7999
Total Wood Transportation Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.87	6.48	15.50	29.34	57.06	59.51	74.42	71.99
Total Livestock Transportation Costs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Transp. Costs																	
Market Prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.87	6.48	15.50	29.34	57.06	59.51	74.42	71.99
Shadow Prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.52	4.99	11.93	22.59	43.94	45.82	57.31	55.43
Without																	
Livestock not transported (million US$)	0.01	0.01	0.03	0.05	0.08	0.13	0.21	0.28	0.42	0.51	0.54	0.61	0.67	0.27	0.73	0.77	0.82
Total Costs in shadow prices	0.00	0.01	0.02	0.04	0.06	0.10	0.16	0.22	0.33	0.40	0.42	0.47	0.51	0.21	0.56	0.59	0.63
Incremental																	
Market prices	**-0.01**	**-0.01**	**-0.03**	**-0.05**	**-0.08**	**-0.13**	**-0.21**	**-0.28**	**-0.42**	**5.36**	**5.93**	**14.89**	**28.67**	**56.79**	**58.78**	**73.65**	**71.17**
Shadow prices	**0.00**	**-0.01**	**-0.02**	**-0.04**	**-0.06**	**-0.10**	**-0.16**	**-0.22**	**-0.33**	**4.13**	**4.57**	**11.46**	**22.08**	**43.73**	**45.26**	**56.71**	**54.80**

Table 44. Livestock Transportation Costs

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Without									
Livestock production (kg/ha)	43	43	45	45	45	45	45	45	50
Total Area	6,575	14,199	30,545	56,251	98,242	142,572	201,140	260,037	333,232
Livestock production total (tons)	285	616	1,381	2,543	4,441	6,444	9,092	11,754	16,696
Livestock production (ton/ha)	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05	0.05
# trips (total tons/13 tons)	22	47	106	196	342	496	699	904	1,284
Transportation fees (US$/km-1 trip=13 tons)	1.15	1.30	1.24	1.11	1.07	1.14	1.31	1.40	1.47
US$/km/ton	0.08	0.09	0.09	0.08	0.07	0.08	0.09	0.10	0.10
Km/trip	250	250	250	250	250	250	250	250	250
Transportation Costs (million US$)	**0.02**	**0.05**	**0.11**	**0.20**	**0.34**	**0.50**	**0.70**	**0.90**	**1.28**

	1998	1999	2000	2001	2002	2003	2004	2005
Without								
Livestock production (kg/ha)	52	51	51	51	20	51	51	51
Total Area	418,009	491,017	549,030	600,986	630,716	657,311	695,305	737,860
Livestock production total (tons)	21,817	25,003	27,957	30,602	12,614	33,470	35,405	37,572
Livestock production (ton/ha)	0.05	0.05	0.05	0.05	0.02	0.05	0.05	0.05
# trips (total tons/13 tons)	1,678	1,923	2,151	2,354	970	2,575	2,723	2,890
Transportation fees (US$/km-1 trip=13 tons)	1.36	1.26	1.26	1.26	1.26	1.26	1.26	1.26
US$/km/ton	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Km/trip	250	250	250	250	250	250	250	250
Transportation Costs (million US$)	**1.68**	**1.92**	**2.15**	**2.35**	**0.97**	**2.57**	**2.72**	**2.89**

Table 45. Industry Costs

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Production Costs (imports) 1,000 US$/ha									
Slaughter Houses	0.00025	0.00027	0.00028	0.00029	0.00030	0.00031	0.00037	0.00034	0.00038
Wool	0.00012	0.00012	0.00012	0.00012	0.00012	0.00013	0.00013	0.00013	0.00011
Leather	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00006
Wood (1,000 US$/$m^3$)	0.00225	0.00209	0.00210	0.00146	0.00148	0.00133	0.00130	0.00127	0.00127
Labor									
Slaughter Houses	0.0013	0.0014	0.0015	0.0015	0.0015	0.0016	0.0019	0.0017	0.0020
Wool	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.004	0.003
Leather	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002
Wood (1,000 US$/$m^3$)	0.02639	0.02451	0.02468	0.01713	0.01736	0.01556	0.01529	0.01489	0.01489
In market prices									
	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
With Project	0	0	0	0	0	0	0	0	0
Labor									
Alternative Productions	0	0	0	0	0	0	0	0	0
Saw timber	0	0	0	0	0	0	0	0	0
Production Costs (imports)									
Alternative Productions	0	0	0	0	0	0	0	0	0
Saw timber	0	0	0	0	0	0	0	0	0
Without Project	29	62	141	261	457	705	1017	1300	1536
Labor									
Alternative Productions	26	56	127	235	410	634	906	1164	1350
Production Costs (imports)									
Alternative Productions	3	6	14	26	46	71	111	136	186

Table 45 (cont) Industry Costs Production and Labor

Shadow Prices									
	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
With Project	0	0	0	0	0	0	0	0	0
Labor									
Saw timber	0	0	0	0	0	0	0	0	0
Without Project	23	50	113	209	365	564	813	1040	1229
Labor									
Alternative Productions	21	45	102	188	328	507	725	931	1080
Production Costs (imports)									
Alternative Productions	2	5	11	21	37	57	89	109	149
Incremental in SPR (million US$)	**-0.02**	**-0.05**	**-0.11**	**-0.21**	**-0.37**	**-0.56**	**-0.81**	**-1.04**	**-1.23**

DATA

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Production (kg/ha)									
Beef	35	35	36	36	36	36	36	36	41
Lamb	8	8	9	9	9	9	9	9	6
Wool	4	4	5	5	5	5	5	5	4
Leather	4	4	4	4	4	4	4	4	5
Total Costs Alternative Industries (1,000 US$/kg)									
Beef	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Lamb	0.000	0.000	0.000	0.001	0.001	0.001	0.001	0.001	0.001
Wool	0.002	0.001	0.002	0.002	0.002	0.003	0.003	0.003	0.003
Leather	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Total Costs Sawmills (1,000 US$/ m^3)									
Wood	0.119	0.111	0.112	0.078	0.079	0.070	0.069	0.067	0.067

Table 45 (cont) Industry Costs Production and Labor

	1998	1999	2000	2001	2002	2003	2004	2005
Production Costs (imports) 1,000 US$/ha								
Slaughter Houses	0.00043	0.00037	0.00037	0.00037	0.00017	0.00029	0.00037	0.00037
Wool	0.00011	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008	0.00008
Leather	0.00007	0.00007	0.00007	0.00007	0.00001	0.00003	0.00007	0.00007
Wood (1,000 US$/$m^3$)	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127	0.00127
Labor								
Slaughter Houses	0.0023	0.0020	0.0020	0.0020	0.0009	0.0016	0.0020	0.0020
Wool	0.003	0.003	0.003	0.003	0.003	0.003	0.003	0.003
Leather	0.0002	0.0002	0.0002	0.0002	0.0000	0.0001	0.0002	0.0002
Wood (1,000 US$/$m^3$)	0.01489	0.01489	0.01489	0.01489	0.01489	0.01489	0.01489	0.01489
In market prices								
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
With Project	0	0	0	0	0	0	0	0
Labor								
Alternative Productions	0	0	0	0	0	0	0	0
Saw timber	0	0	0	0	1	1	0	0
Production Costs (imports)								
Alternative Productions	0	0	0	0	0	0	0	0
Saw timber	0	0	0	3	7	7	6	5
Without Project	1859	1814	2028	2220	1926	2211	2568	2726
Labor								
Alternative Productions	1608	1558	1742	1906	1758	1945	2206	2341
Production Costs (imports)								
Alternative Productions	252	256	287	314	168	266	363	385

Table 45 (cont) Industry Costs Production and Labor

Shadow Prices								
	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
With Project	0	0	0	3	6	7	5	5
Saw timber	0	0	0	3	6	7	5	5
Without Project	1487	1451	1622	1776	1541	1327	1541	1635
Labor								
Alternative Productions	1286	1246	1393	1525	1407	1167	1323	1404
Production Costs (imports)								
Alternative Productions	201	205	229	251	134	160	218	231
Incremental in shadow prices(million US$)	**-1.49**	**-1.45**	**-1.62**	**-1.77**	**-1.53**	**-1.32**	**-1.54**	**-1.63**

DATA

	1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Production (kg/ha)								
Beef	43	44	44	44	20	34	44	44
Lamb	7	5	5	5	2	5	5	5
Wool	4	3	3	3	3	3	3	3
Leather	5	5	5	5	1	2	5	5

Total Costs Alternative Industries (1,000 US$/kg)

Beef	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Lamb	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Wool	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Leather	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001

Total Costs Sawmills (1,000 US$/ m^3)

Wood	0.067	0.067	0.067	0.067	0.067	0.067	0.067	0.067

Table 46. Production Costs

Market Prices

	1989	1990	1991	1992	1993	1994	1995	1996	1997
With Project									
Plantation Costs	**0.027**	**0.026**	**0.033**	**0.042**	**0.042**	**0.049**	**0.05**	**0.053**	**0.056**
Labor	0.011	0.011	0.013	0.017	0.017	0.019	0.02	0.021	0.022
Import	0.016	0.016	0.02	0.025	0.025	0.029	0.03	0.032	0.034
Area	6,575	7,624	16,346	25,706	41,991	44,330	58,568	58,897	73,195
Effective Area	4,931	5,718	12,260	19,280	31,493	33,248	43,926	44,173	54,896
Plantation Costs (mill. US$)	0.133	0.151	0.399	0.81	1.317	1.614	2.182	2.361	3.094
Without Project									
Alternative Productions									
Area (in ha)	6,575	14,199	30,545	56,251	98,242	142,572	201,140	260,037	333,232
Labor	0.003	0.003	0.004	0.004	0.004	0.005	0.005	0.005	0.005
Import	0.001	0.001	0.002	0.001	0.001	0.002	0.002	0.002	0.002
Prod Costs	**0.03**	**0.06**	**0.16**	**0.28**	**0.52**	**0.92**	**1.36**	**1.83**	**2.28**
Incremental (mill. US$)	0.1	0.09	0.23	0.53	0.8	0.69	0.82	0.53	0.82

Shadow Prices

With Project

Plantation Costs	0.021	0.021	0.026	0.034	0.033	0.039	0.04	0.043	0.045
Labor	0.009	0.008	0.01	0.013	0.013	0.015	0.016	0.017	0.018
Import	0.013	0.013	0.016	0.02	0.02	0.023	0.024	0.026	0.027
Area	6,575	7,624	16,346	25,706	41,991	44,330	58,568	58,897	73,195
Effective Area	4,931	5,718	12,260	19,280	31,493	33,248	43,926	44,173	54,896
Total Plantation Costs	0.11	0.12	0.32	0.65	1.05	1.29	1.75	1.89	2.48
Production Costs With (million US$)	0.11	0.12	0.32	0.65	1.05	1.29	1.75	1.89	2.48
Without Project									
Prod Costs (1,000 US$/ha)	0	0	0	0	0	0.01	0.01	0.01	0.01
Labor	0.003	0.003	0.003	0.003	0.003	0.004	0.004	0.004	0.004
Import	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002
Area (in ha)	6,575	14,199	30,545	56,251	98,242	142,572	201,140	260,037	333,232
Total Prod. Costs (mill. US$)	0.02	0.05	0.13	0.22	0.42	0.74	1.09	1.46	1.82
Incremental (mill. US$)	**0.08**	**0.07**	**0.19**	**0.42**	**0.64**	**0.55**	**0.66**	**0.43**	**0.65**

Table 46 (Cont) Production Costs

Market Prices

	1998	1999	2000	2001	2002	2003	2004	2005
With Project								
Plantation Costs	**0.056**	**0.056**	**0.051**	**0.051**	**0.037**	**0.045**	**0.037**	**0.037**
Labor	0.022	0.022	0.02	0.02	0.015	0.018	0.015	0.015
Import	0.034	0.034	0.031	0.031	0.022	0.027	0.022	0.022
Area	84,777	73,008	58,013	51,956	29,730	26,595	37,995	42,555
Effective Area	63,583	54,756	43,510	38,967	22,298	19,946	28,496	31,916
Plantation Costs (mill. US$)	3.591	3.047	2.224	1.979	0.831	0.895	1.052	1.178
Without Project								
Alternative Productions								
Area (in ha)	418,009	491,017	549,030	600,986	630,716	657,311	695,305	737,860
Labor	0.005	0.005	0.005	0.004	0.006	0.004	0.005	0.006
Import	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
Prod Costs	**2.94**	**3.33**	**3.69**	**3.76**	**4.79**	**4**	**4.6**	**5.67**
Incremental (mill. US$)	0.65	-0.28	-1.47	-1.78	-3.96	-3.11	-3.55	-4.49
With Project								
Plantation Costs	0.045	0.045	0.041	0.041	0.03	0.027	0.022	0.022
Labor	0.018	0.018	0.016	0.016	0.012	0.011	0.009	0.009
Import	0.027	0.027	0.025	0.024	0.018	0.016	0.013	0.013
Area	84,777	73,008	58,013	51,956	29,730	26,595	37,995	42,555
Effective Area	63,583	54,756	43,510	38,967	22,298	19,946	28,496	31,916
Total Plantation Costs	2.87	2.44	1.78	1.58	0.67	0.54	0.63	0.71
Production Costs With (million US$)	2.87	2.44	1.78	1.58	0.67	0.54	0.63	0.71
Without Project								
Prod Costs (1,000 US$/ha)	0.006	0.005	0.005	0.005	0.006	0.004	0.004	0.005
Labor	0.004	0.004	0.004	0.003	0.004	0.002	0.003	0.003
Import	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001
Area (in ha)	418,009	491,017	549,030	600,986	630,716	657,311	695,305	737,860
Total Prod. Costs (mill. US$)	2.35	2.66	2.95	3.01	3.83	2.4	2.76	3.4
Incremental (mill. US$)	**0.52**	**-0.22**	**-1.17**	**-1.43**	**-3.17**	**-1.86**	**-2.13**	**-2.7**

Table 47. Labor Costs Exports (million US$)

With

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Wood Exported (1,000 m3)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.73	0.80	1.91	3.33	6.40	6.66	8.64	8.38
Total Costs market prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.30	0.73	1.26	2.43	2.53	3.28	3.19
Total Costs shadow prices	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.18	0.44	0.76	1.95	2.03	2.63	2.55

Table 48. Pruning and Thinning Costs (million US$)

With

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Pruning (million US$)	**0.00**	**0.00**	**0.00**	**0.00**	**0.02**	**0.03**	**0.10**	**0.13**	**0.38**	**0.46**	**0.72**	**0.87**	**1.34**	**2.32**	**2.72**	**3.33**	**3.54**
1,000 US$/ha	0.00	0.00	0.00	0.00	0.04	0.04	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Total (1,000 US$)																	
First	*0.00*	*0.00*	*0.00*	*0.00*	*22*	*34*	*65*	*75*	*248*	*296*	*386*	*477*	*703*	*1542*	*1632*	*1308*	*1204*
Second	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*33*	*51*	*87*	*100*	*248*	*296*	*386*	*477*	*703*	*1542*	*1632*
Third	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*0.00*	*44*	*67*	*87*	*100*	*248*	*296*	*386*	*477*	*703*
Thinning (million US$)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.03**	**0.03**	**0.03**	**0.03**
Total Costs market prices (million US$)	0.00	0.00	0.00	0.00	0.02	0.03	0.10	0.13	0.38	0.46	0.72	0.87	1.35	2.34	2.75	3.36	3.57
Total Costs shadow prices (million US$)	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.02**	**0.06**	**0.08**	**0.23**	**0.28**	**0.43**	**0.52**	**0.81**	**1.88**	**2.20**	**2.69**	**2.85**

Table 49. Administration and Management Costs (million US$)

Administration and Management Costs

With																	
	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Management	0.00	0.09	0.19	0.32	0.57	0.92	1.18	1.41	1.61	1.82	2.15	2.11	1.71	1.05	0.61	0.69	1.19
Ants Control	0.00	0.03	0.04	0.08	0.12	0.20	0.22	0.29	0.29	0.36	0.41	0.34	0.26	0.11	0.11	0.14	0.28
Paths	0.00	0.02	0.02	0.05	0.08	0.13	0.14	0.19	0.19	0.24	0.27	0.23	0.17	0.07	0.07	0.09	0.19
Administration	0.21	0.24	0.53	0.84	1.37	1.45	1.93	1.94	2.42	2.79	2.36	1.84	1.60	0.42	0.65	1.34	2.14
Total Costs market prices	0.21	0.26	0.99	1.38	2.18	2.74	3.64	3.81	4.49	5.37	5.08	4.35	3.49	0.72	1.07	2.42	5.78
Total Costs shadow prices	0.20	0.25	0.97	1.35	2.14	2.69	3.57	3.73	4.40	5.26	4.98	4.26	3.42	0.72	1.07	2.42	5.78

Table 50. Harvesting Costs

With

	1989	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Labor	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.06	3.21	7.55	13.35	10.08	18.00	32.60	44.99
Pulp	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.06	3.21	7.55	11.94	8.65	15.40	29.60	41.06
Sawn wood	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.41	1.43	2.60	3.00	3.94
Fuel	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.67	1.75	4.12	7.28	5.50	9.82	17.78	24.54
Rest	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.88	2.06	3.64	2.75	4.91	8.89	12.27
Total Costs market prices (million US$)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**5.57**	**5.84**	**13.72**	**24.26**	**18.33**	**32.73**	**59.27**	**81.81**
Total Costs shadow prices (million US$)	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**4.30**	**4.50**	**10.58**	**18.72**	**12.31**	**21.99**	**39.83**	**54.97**

Table 51. Nursery Costs

	1989	1990	1991	1992	1993	1994	1995	1996	1997
Labor	87%	94%	94%	94%	94%	94%	94%	94%	94%
Imports	13%	6%	6%	6%	6%	6%	6%	6%	6%
Area planted (ha)	4,419	5,121	11,241	17,825	29,065	30,741	40,882	41,136	51,197
Costs (1,000 US$/ha)	0.043	0.048	0.061	0.067	0.08	0.081	0.077	0.077	0.072
Average Costs (1,000 US$/ha)	**0.065**								
Total Costs market prices (mill.US$)	**0.19**	**0.25**	**0.69**	**1.2**	**2.32**	**2.49**	**3.16**	**3.15**	**3.71**
Total Costs shadow prices (mill. US$)	**0.16**	**0.21**	**0.59**	**1.03**	**2**	**2.15**	**2.73**	**2.73**	**3.21**

	1998	1999	2000	2001	2002	2003	2004	2005
Labor	94%	94%	94%	94%	94%	94%	94%	94%
Imports	6%	6%	6%	6%	6%	6%	6%	6%
Area planted (ha)	59,159	50,969	40,497	36,294	20,763	18,595	26,596	29,788
Costs (1,000 US$/ha)	0.067	0.043	0.063	0.061	0.028	0.048	0.069	0.099
Average Costs (1,000 US$/ha)								
Total Costs market prices (mill.US$)	**3.94**	**2.19**	**2.54**	**2.2**	**0.58**	**0.9**	**1.85**	**2.95**
Total Costs shadow prices (mill. US$)	**3.41**	**1.89**	**2.2**	**1.9**	**0.51**	**0.78**	**1.6**	**2.55**