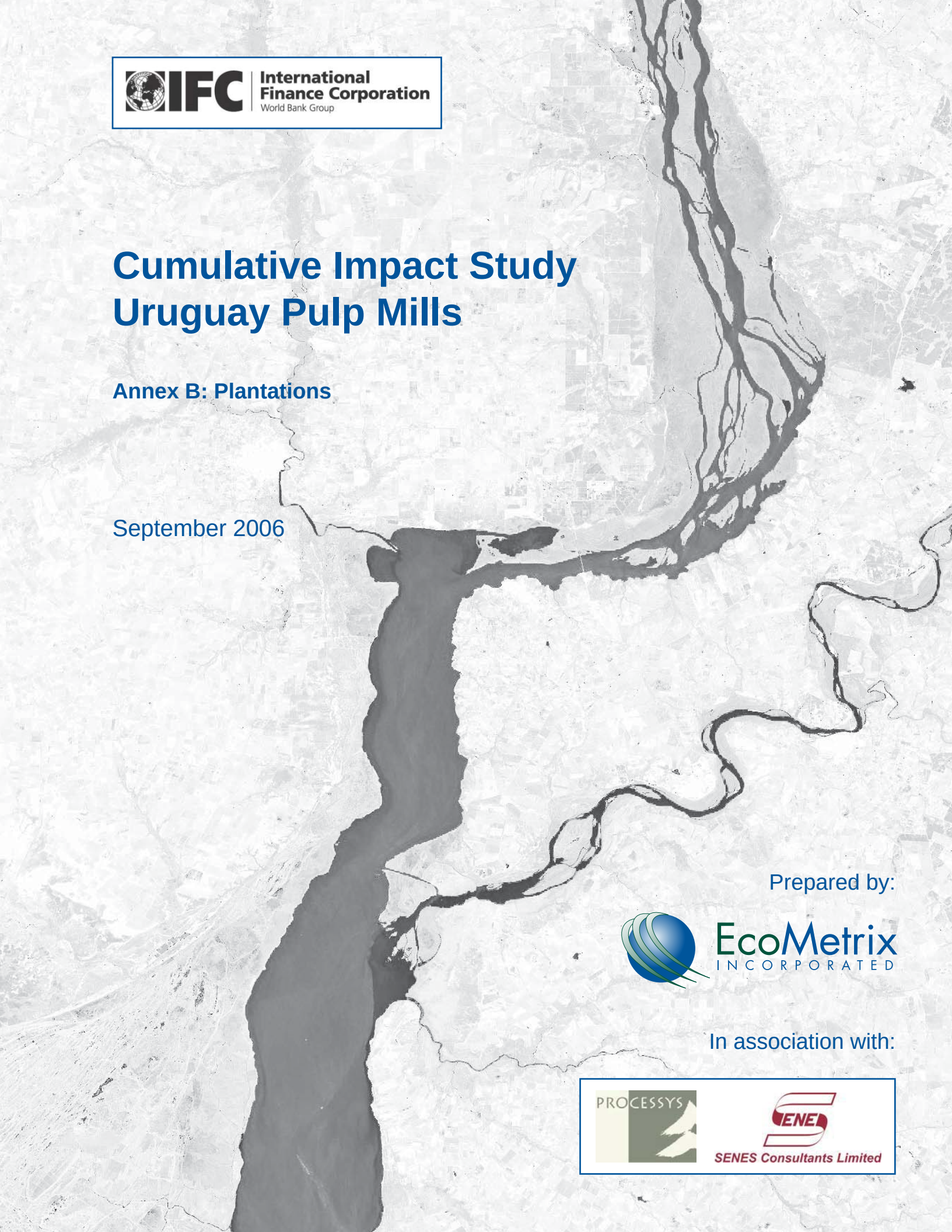

IFC International Finance Corporation World Bank Group

Cumulative Impact Study Uruguay Pulp Mills

Annex B: Plantations

September 2006

Prepared by:

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In association with:

PROCESSYS

SENES Consultants Limited

ANNEX B

Plantations

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B1.0 INTRODUCTION

The International Finance Corporation of the World Bank Group (IFC) is currently assessing two pulp mill projects in Uruguay for financing. The proponents of the mills are Botnia of Finland and ENCE of Spain.

To complete the assessment of the combined environmental and social impacts of the two proposed mills, IFC commissioned a Cumulative Impact Study (CIS) of the construction and operations of the two pulp mills and their respective raw material sourcing. The following report forms a portion of this CIS and specifically addresses the raw material sourcing.

This report is a revised version of the draft CIS which was originally prepared by Pacific Consultants International and Malcolm Pirnie Incorporated and issued by IFC in December 2005. The revisions are in response to the recommendations of independent experts, the published Terms of Reference, original research, stakeholder commentary and other project related documentation. This annex was updated for EcoMetrix Incorporated (EcoMetrix) by Daryl W. Cowell with support by Pieter W. Prange.

An economical and sustainable wood supply must be ensured to guarantee the financial viability of the mill operations. The relatively high cost of transportation dictates that the wood will need to be sourced from within 150 km or so of the mill locations. In this regard, the wood supply for both mills will be derived from existing eucalyptus plantations located within western and central Uruguay. Although some additional plantation areas will be developed in these areas over the next three years, they will not be essential for the sustainable wood supply to the mills.

The conversion of land to new forestry plantations consisting of exotic species and the on-going operation of existing plantations raises numerous environmental and social issues which must be addressed as part of the development and operation of the proposed pulp mills. Of particular concern are the social implications relating to employment dynamics of plantations relative to other land uses. Environmental issues relate principally to surface and groundwater effects, soil compaction and erosion, nutrient cycling and loss of nutrients, and changes in biodiversity.

B2.0 FOREST PLANTATIONS AND WOOD SUPPLY

B2.1 Forest Plantations in Uruguay

In Uruguay, the Forestry Act of Law 15.939 of December 15, 1987 (under the administration of the Ministerio de Ganaderia, Agricultura y Pesca, and executed by the Dirección Forestal) encouraged forestry plantations by providing tax benefits and financial subsidies covering a portion of the tree plantation establishment costs.[1] This program has been extremely successful in attracting new plantation establishment in Uruguay, including investments by domestic institutions and by overseas companies from Spain, Finland, Canada, and the United States. The incentive program is still in place, but the financial subsidies are being phased out (as of January 2004) and will end by 2007.

Establishment of eucalyptus plantations peaked in Uruguay in 1997 at close to 60,000 hectares, but fell to an annual rate of less than 10,000 hectares per year by 2003 (Figure B2.1-1). Pine plantation establishment has also fallen to a relatively low rate. This decline has been attributed to several factors, including higher prices for land, the economic crisis in Uruguay and Argentina in the early years of this decade, and declining prices for wood and wood products. Even with the lower rate of new plantation establishment, however, it is clear that a significant mass of tree plantations has been established through this program, and the country is only recently beginning to develop the industry to process the available wood. The two proposed pulp mills can be seen as the logical extension of a program begun in the late 1980s with the intention of attracting industrial development to Uruguay. The first phase, developing the plantations, has been largely and successfully completed; the second phase, industrial development based on wood processing, is only now beginning.

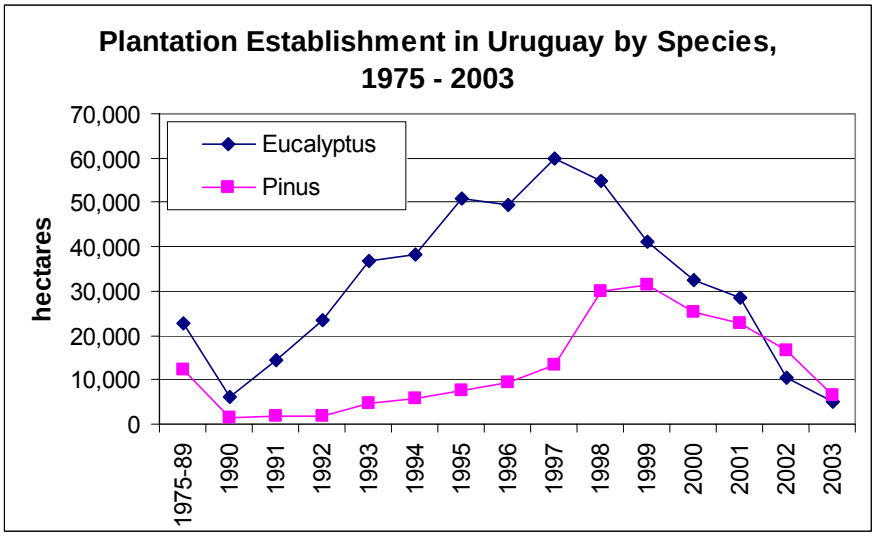
There are a total of 17.3 million hectares of land in Uruguay, of which 3.57 million ha have been categorized as “Forest Priority Soils” by the Dirección Forestal. It is important to note that in order to qualify for the tree plantation subsidy and the tax benefits, only lands which have been categorized as “Forest Priority Soils” can be planted. In addition, all planting plans must be approved by the Dirección Forestal.

From 1975 through 2003, a total of 670,042 hectares of tree plantations were developed in Uruguay[2]. These were dominantly eucalyptus and pine with minor areas of poplar, and willow. These plantations are most heavily concentrated in the north part of the country in the Departments of Rivera and Tacuarembó (Figure B2.1-2), the “Litoral” Region in the west of the country along the Rio Uruguay (Departments of Paysandú, Rio Negro, and

[1] In Forest Management Certification Report, SGS Qualifor (July 31, 2003) p.40, (http://www.qualifor.sgs.com/) it is stated that : “The parliamentary discussion during the process of approval of the law Forestry Act of 1988 shows that the aim of the legislators was to use the lands that were degraded by bad agricultural practices. This is encapsulated in Title 1 Article 5 of the Forestry Law 15.939. The decree 452/988 and the decree 296/994 prescribe the areas and soil groups where forestry plantations should be established (Art.2nd).”

[2] Boletin Estadistico, Año 4-No.3, Deciembre 2004, Dirección General Forestal (http://www.mgap.gub.uy/forestal/dgf.htm).

Figure B2.1-1: Plantation Establishment in Uruguay



Source: Dirección Forestal

Figure B2.1-2: Map of Uruguay showing Location of Proposed Mills (Fray Bentos in the Department of Río Negro) and associated departments.

(from: http://www.lib.utexas.edu/maps/americas/uruguay_pol_95.jpg)

Soriano), and in the central and southeast parts of the country (Durazno, Florida, Lavelleja and Cerro Largo). In addition, there are about 100,000 hectares of plantations across the Rio Uruguay in Argentina's Entre Rios, Missiones and southwest Corrientes Provinces that could supplement wood to the planned pulp mill projects in Uruguay, if required.

In the Littoral Region[3] of western Uruguay, the Boletin Estadistico of the Dirección Forestal reported that a total of 172,649 hectares of eucalyptus had been planted between 1975 and the end of 2003.[4] This amounts to only about one-quarter of the lands classified as "Forest Available Soils" and potentially available for plantation development in the Littoral (Table B2.1-1).

A private survey using the most recent satellite imagery and survey of Departmental ownership records in 2004 and 2005 identified a total of 140,000 hectares of commercial plantations; approximately 80% of the gross estimate noted above. The difference between the two sources is primarily due to lack of updating after harvest, and a much less rigorous definition of "net planted, commercially viable hectares", by the Dirección Forestal. It must be pointed out that "net area" of tree plantations occupy approximately 65% of a specific "gross" area. The loss of up to 35% of the "gross" area is due to lost plantable areas needed for internal roads and firelanes, areas which are not viable due to unsuitable soils, native forest areas preservation, other conservation areas and wetlands, streams and lakes among others. Based on these numbers only 2.2% of the entire Littoral Region is directly planted to eucalyptus.

[3] The term "Litoral Region" refers here to the departments of Paysandú, Rio Negro, and Soriano.
[4] Boletin Estadistico, Año 4-N°3, Deciembre 2004, Direcció General Forestal (December 2004). (http://www.mgap.gub.uy/forestal/dgf.htm)

Table B2.1-1: Area of "Forest Priority Soils" by Forest Region in Uruguay[5]

Region	Department	Area (ha)
Central-North	Rivera	244,492
	Tacuarembó	316,413
	Durazno	272,149
		833,054
Littoral Rio Uruguay	Paysandú	343,470
	Rio Negro	248,807
	Soriano	121,369
		683,706
South-East	Lavalleja	154,675
	Maldonado	84,840
		239,515
Total Area of Forest Priority Soils		1,756,275

Plantations are also found in other departments located within the "Pulp Mill Area of Influence" (PMAI)[6] including Rivera and Tacuarembó in the North Region and Durazno and Florida in the Center-East Region. As of the end of 2003 the reported area of eucalyptus plantations (all species) in these departments was 43,890 ha, 43,285 ha, 33,264 ha and 31,746 ha, respectively, for a total of 152,185 ha.[7] Although not all of these plantations will be within the 150 km distance noted above, most of those within Tacuarembó, Durazno, and Florida are within this distance.

[5] Departamento de Desarrollo Regional y Medio Ambiente, Secretaría Ejecutiva para Asuntos Económicios y Sociales, Secretaría General de la Organización de los Estados Americanos, y Dirección Forestal Ministerio de Ganaderia, Agricultura y Pesca – Uruguay. Uruguay – Proyecto Regional de Alternativas para la Inversion Forestal. Washington, D.C., USA, 1994 (http://www.oas.org/usde/publications/Unit/oea20s/ch04.htm)

[6] The PMAI is defined as the area of economic wood supply for the ENCE mill and includes portions of the north and center-east regions in Uruguay as well as parts of northern Argentina. Wood Resources International. "Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M'Bopicuá, Uruguay". Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.

[7] Boletin Estadistico, Año 4-No.3, Deciembre 2004, Dirección General Forestal (http://www.mgap.gub.uy/forestal/dgf.htm).

B2.2 Wood Supply Requirements and Sourcing

The Orion Pulp Mill is owned by Botnia S.A. will be supplied by its subsidiary Forestal Oriental (FOSA), its parter, Tile Forestal and third party suppliers. The Celulosas de M'Bopicuá (CMB) mill is owned by ENCE S.A. and will be supplied by its subsidiary EUFORES along with third party contractors.

The Wood Resources International report[8] provides details regarding the wood supply requirements for the two mills. Wood consumption will be lower in the first two to three years of production with Botnia requiring 1.1 million m^3 of wood in the first year. Consumption will then rise to 3.37 million m^3 in the second year as both mills come on-line; 4.52 million m^3 in the third year, and 5.3 million m^3 in years four through eight. Beyond that, the continued supply requirements level off at about 5.2 million m^3. These wood supply volumes can be converted to plantation area needed to grow the required supply. The precise volume will depend in part on the actual species mix utilized. For example, if ENCE utilizes a higher percentage of E.globulus than currently planned, then their total wood consumption will be lower than cited here.

Assuming an average conservative growth rate of 25 m^3/ha/year, and an 8 year growing cycle, each hectare will yield approximately 200 m^3 at harvest[9]. Actual growth rates will vary by species and ownership. For example, FOSA claims growth rates between 33 and 40 m^3/ha/yr on their *E. grandis* and *E. dunnii* plantations, while EUFORES claims a slightly lower rate for their *E. globulus* plantations. The required wood production can then be approximated by dividing the wood volume by 200. Hence, the required wood supply in the start-up year will need to be sourced from 5,500 ha of plantations (1.1 million m^3/200m^3). Following through to year eight, a total of 177,450 ha of net plantation area will be required to meet the demand of the two mills. With a sustained demand for 5.2 million m^3/year beginning in year nine, this number will rise to 208,000 ha of plantations based on an eight-year rotation.

If all of the plantations occurring within the Uruguayan portion of the PMAI were available to these mills, and using a net plantation area, then the total potentially available existing plantation area (as of the end of 2003) is approximately 260,000 ha (net area of 140,000 in the Littoral and 120,000 for the North and Center-East). Clearly not all of these plantations will be supplying the mills, however these numbers also underestimate the total plantation area developed and planted since 2003.

The Wood Resources International report noted that as of 2005 there was a large volume of eucalyptus "available for harvest". This is mature timber on plantations waiting to be

[8] Wood Resources International. "Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M'Bopicuá, Uruguay". Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.

[9] This is a conservative number as the Wood Resources International report indicated a 9 year rotation may be more appropriate and, hence, there would be a greater volume per rotation, however, on a year-to-year basis the actual supply would depend on the tree age structure mix in available plantations.

harvested which, including export available wood, they calculated to be 12.1 million m^3 within the PMAI in Uruguay. They also noted that their model showed a decrease in the "available for harvest" supply to 1.5 million m^3 in 2012 suggesting a shortfall during the middle period of the first 8 years of operation. However, since not all of this will be utilized immediately, the supply will be smoothed out over time to meet the expected demand at the pulp mills.[10] Even so, their model scenario assumed that a 400,000 to 450,000 m^3/yr of *E. grandis* will be imported from Argentina. This wood is shown to be readily available but may be less economical due to tariffs (see below).

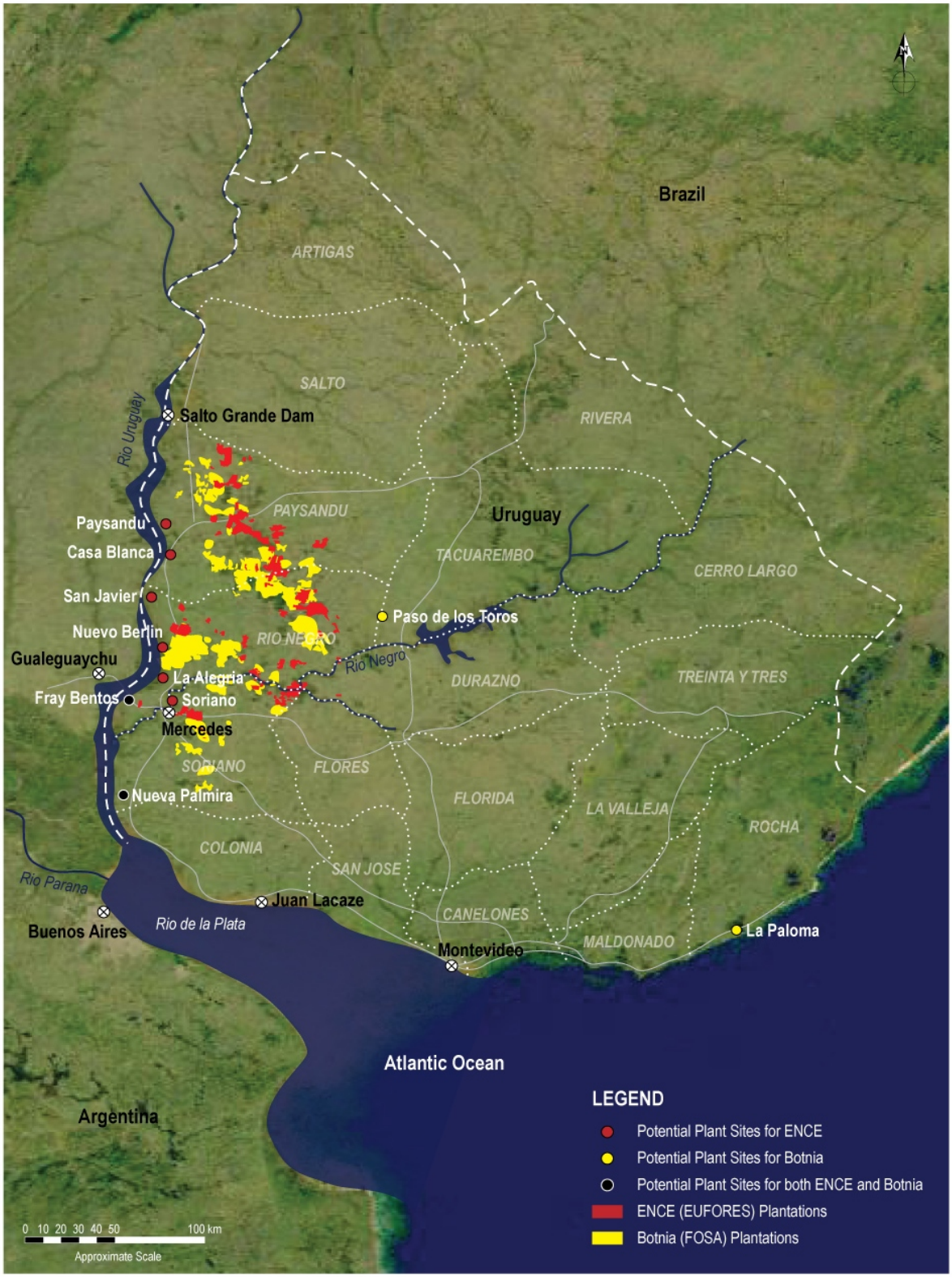
As of mid-June 2006, the combined plantation land holdings of FOSA and EUFORES within the Littoral Region amounted to 258,304 ha (Figure B2.2-1). Of this, 160,980 ha consisted of planted and plantable land of which 122,277 ha were planted.[11] This amounts to just over 70% of the required supply for the mills during the first 8 years of operation (174,450 ha). If all the plantable areas are planted prior to start-up, then the direct planted holdings of the two companies will provide 77.4% of the needed sustained supply beyond year eight (208,000 ha). The additional plantings on the companies' lands would amount to an area of 37,980 ha.

As of September, 2006 all of the noted shortfall in supply, for the first 8 years as well as for the ongoing sustained operations, is expected to be secured.[12] This includes a combination of company-owned plantations and third party suppliers. Wood for the CMB mill will be obtained completely from existing plantations located within the Littoral (net 136,144 ha) as well as from the departments of Tacuarembó, Durazno, and Florida (net 86,930 ha) in the PMAI. All of these plantations have been planted as of December 2005. The total potential supply amounts to 223,074 ha, above the estimated sustained requirement of 208,000 ha. Although some of this wood will not be available immediately, the youngest plantings will be harvestable within 4 years or less of start-up given a start-up date of 2008 or later. The companies anticipate that another 30,000 to 40,000 ha/yr will be planted within the PMAI in the next 3 years. Some of this wood may be available to cover short-term shortfalls, especially the smaller diameter wood, however most will be utilized principally for saw logs and export.

It should be pointed out that, although the required area of existing plantations appears to be sufficient to meet the demands of both mills, not all of the supply has been contractually secured. The Botnia mill, for example has formally secured sufficient wood through the end of 2009 but will experience shortfalls of 300,000 to 600,000 m^3/yr between 2010 and 2012 and about 300,000 m^3/yr between 2014 and 2015. Although not currently contracted,

[10] Wood Resources International. "Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M'Bopicuá, Uruguay". Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.
[11] Data provided to Pieter Prange by the companies in August 2006.
[12] Personal communications from Enrique Puricelli, Assistant to the Director General, CMB, and Eric Drummer, FOSA to Daryl Cowell, September 15 and 20, 2006, respectively.

Figure B2.2-1: Plantation Land Holdings of Botnia and ENCE in Western Uruguay



Botnia expects to meet this shortfall with wood from private growers. ENCE is conducting discussions with private contactors as well, but will not formally secure the additional wood until mill financing arrangements are completed.

The combined land area of the Littoral Region[13] and the three other departments in the PMAI within which the wood is sourced amounts to 6,970,200 ha.[14] The area of secured and required plantations occupy a total of 3.2% of this land area. Excess existing supply and future expansion of plantation areas beyond those needed to supply the mills would be related to the need for saw logs, export, and/or conversion into an energy source for other industrial sectors such as grain driers, milk conversion plants, citrus processing plants, beer breweries, leather processing plants and others who are in need of a sustainable supply of firewood. The recently escalating cost of petroleum products could in the future result in the formation of joint-ventures with existing reforestation companies to increase the supply of wood, and this may serve both purposes (i.e. pulpwood and wood for energy using the same eucalyptus species already in place).

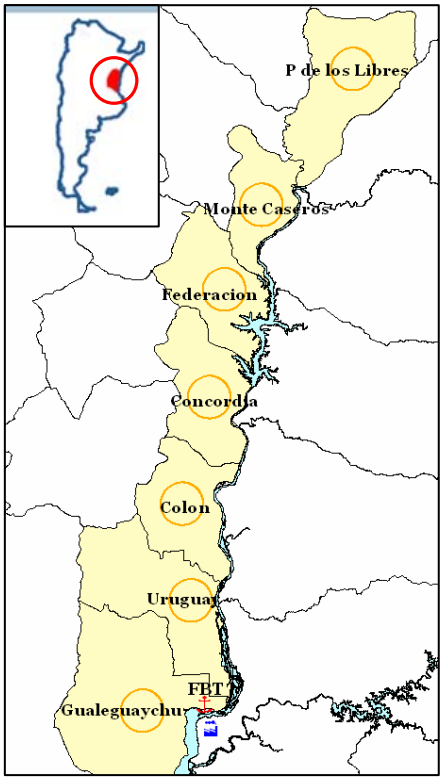
B2.3 Argentina

There are an estimated 95,000–100,000 hectares of eucalyptus plantations in eastern Entre Rios and southern Corrientes Provinces, as presented in Table B2.3-1 and Figure B2.3-1.

In 2001, SAGPyA (Secretaría de Agricultura, Pesca y Alimentacion, the agency responsible for forest administration in Argentina) estimated for this region an annual eucalyptus log availability of 2.0 million m^3 in 2005, increasing to more than 5.3 million m^3 by 2020.[15] For the period 2007 to 2020, the average annual availability of eucalyptus pulpwood in this region is forecast to be 2.1 million m^3. Although it was postulated that that as much as 400,000 to 450,000 m^3 of *E. grandis* pulpwood might be imported by Botnia and/or ENCE for their Uruguay mills,[16] it now seems less likely given the recently secured supply to the mills. However, some of this wood could be sourced in the event of any unforeseen short-term supply deficits in the Uruguayan portion of the PMAI.

[13] The term “Litoral Region” refers here to the departments of Paysandú, Rio Negro, and Soriano.
[14] Calculated for the 6 departments noted from statistics provided at http://www.statoids.com/uuy.html.
[15] Ré, Alberto; Gustavo Cetrangolo; y Jorge Glade PROYECCIÓN de la OFERTA y DEMANDA de MADERA ROLLIZA en el NORDESTE de ENTRE RÍOS y SUDESTE de CORRIENTES, 2001 a 2020 (Buenos Aires SAGPyA, April 2001).
[16] Wood Resources International. “Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M’Bopicuá, Uruguay”. Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.

Figure B2.3-1: Departments in Argentina[17]



[17] Wood Resources International. "Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M'Bopicuá, Uruguay". Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.

Table B2.3-1: Plantation Areas in Argentina[18]

Province	Department	Planted Area (ha)
Corrientes	Monte Caseros	10,782
	Paso de los Libres	18,842
Total for Corrientes		**29,624**
Entre Rios	Colon	21,638
	Concordia	30,895
	Federacion	10,277
	Gualeguaychú	1,120
	Uruguay	1,627
	(N/A)	49
Total for Entre Rios		**65,606**
Total Area		**95,230**

Such exports would likely be a small enough percentage of the total available supply that it would have only a minimal price impact in Argentina. Actual imports will depend on short-term needs and the relative economics of this wood versus other pulpwood supplies in Uruguay. At the present time, Argentina levies a 10% export duty on pulpwood exports, and companies are not eligible for the 18% VAT rebate. Whether this pulpwood from Argentina could arrive to the pulp mills in Uruguay at a competitive price remains to be seen.

Demand for eucalyptus pulpwood in Argentina is relatively small. Celulosa Argentina has two small pulp mills in Buenos Aires and Santa Fe provinces, which require less than 600,000 m^3 of eucalyptus pulpwood per year. Both Masisa and Sadepan have particleboard plants in Entre Rios which consume eucalyptus fibers, but these mills rely primarily on residual chips from sawmills, not on pulpwood. We are not aware of any other new projects being developed in Argentina, and understand from foresters there that there is a large surplus of small eucalyptus which currently has no market.

Historically, the eucalyptus plantations in Argentina supported a vigorous export trade. Eucalyptus pulpwood exports from Argentina peaked at more than 1.4 million m^3 in 1989. Exports were more than 1.0 million m^3 in 1995, but declined to less than 300,000 m^3 in 2000, and to only 35-40,000 m^3 per year in subsequent years.

[18] From: Wood Resources International. "Uruguay Eucalyptus Pulpwood Supply Study: Outlook for Wood Supply for the Proposed ENCE pulp mill at M'Bopicuá, Uruguay". Report Submitted to the International Finance Corporation and Banco Bilbao Vicaya Argentaria, S.A., November 2005.

Given the surplus of eucalyptus pulpwood in Argentina, and the fact that only a relatively small volume is likely to be utilized by the pulp mills in Uruguay, if any at all, there would not appear to be significant pressure to further convert grassland or agricultural land to man made tree plantations in Argentina. Argentina has had its own program of fiscal incentives[19] to encourage establishment of new tree plantations, therefore any plantings in more recent years (relatively modest) are more likely be attributed to that program, than to the anticipated possibility of future sales to the Uruguayan pulp mills.

B2.4 Regional Land Use Implications

The discussion above indicates that virtually all of the pulpwood needed for the pulp mills will be produced in western and central Uruguay from existing plantations (as of December 2005). It is therefore unlikely that significant amounts of additional land within or outside the Littoral will be converted from agriculture or grassland to eucalyptus plantations to produce pulpwood solely for the mills. However, if needed, additional pulp feed could be sourced from tree plantation thinnings and residual wood fibres from other existing plantations in Rivera and Tacuarembó. These plantations have been developed to supply new sawmills and plywood mills being built (and to be built) in this part of Uruguay. This additional supply would include some sub species of the *Eucalyptus globulus* species, such as *E. gloubulus* var. *globulus*, *E. maidenii* and *E. bicostata* that might not be favoured in the export markets.

Similarly, for existing plantations in the south-eastern regions of Uruguay, it is possible that some of this wood, if needed, could flow to the pulp mills rather than to Montevideo for export. This would depend on the relative economics of each market, the transportation options, species, and costs involved. Again, it is unlikely that landowners in these departments would establish new plantations with the intention of supplying pulp mills in western Uruguay, when Botnia and ENCE already own or are planting large areas near the mills to supply their pulpwood.

Thus, the pulp mills are not expected to have any significant further impacts on land use changes in the other regions of Uruguay.

B2.5 Perspective on Land Use Conversion for Plantations

For comparative purposes, it is useful to review the magnitude of the land use changes which have occurred to secure the supply of wood for the pulp mills. The sustained on-going supply to the mills will be sourced from about 220,000 ha of company-owned land and third party suppliers. Between the 2000/2001 growing season and the 2004/2005

[19] Argentina has had in place a system of incentives to encourage establishment of new forest plantations for more than 10 years. This includes afforestation with exotic pine and eucalyptus species. The incentives are primarily subsidies (from SAGPyA) that return a percentage of the planting costs to the landowner after successful establishment of the plantations. In addition, the province of Entre Rios has just announced a new plantation incentive program, though it remains unclear what, if any impact this will have on land conversion.

season, a total of 372,000 ha of soya beans were established in western Uruguay, on lands which had been used previously for other crops or for cattle grazing.

According to a recent report[20], most of these new soya plantations consisted of plant material which has been genetically modified to be resistant to the herbicide glyphosate. Of significance is that this land use change to soya is greater in magnitude, and has occurred at a much faster rate than the land use change to eucalyptus plantations. Typically, the soya plantations involve continuous yearly cropping, and heavy use of agrochemicals. Soil erosion measured in soya cropping is reportedly much greater than for maize, wheat, or grazing.

[20] Ismael Turban, "Impacto de la soja en Uruguay y su sistema productivo" Nuestro Agro, htt://www.nuestroagro.com.ar/noticia.asp?id=434&Fuente=2

B3.0 SOCIAL ASSESSMENT

As noted in the introduction, the principal social effects pertaining to the establishment and operation of plantations, relates to employment dynamics. Concerns have been expressed by some stakeholders that plantations offer fewer employment opportunities than other more traditional land uses such as livestock operations. Accurate quantification is difficult given the wide range of farm sizes and differing land management regimes (i.e., degree of mechanization, type of livestock, etc.), however, a number of studies and pilot projects have attempted to document employment dynamics resulting from land use change to plantations.

Arrarte (2000)[21] states that plantations, other than those producing "high quality" lumber, use mostly seasonal labour with poor working conditions. These statements, however are not supported by data nor does he provide direct supporting references. There is an accumulating literature based on the Uruguayan situation that suggests otherwise.

In general, tree plantation development in Uruguay has been found to have created more jobs than were previously available locally[22] through cattle raising. Tree plantations are recognized as creating more jobs, from field labour to management levels, as well as fostering the development of private contractors to provide support services. SGS Group,[23] in its certification assessment of some of the FOSA plantations for the Forest Stewardship Council states that the following employment multipliers can be applied in Uruguay:

- Cattle grazing – 0.0047 jobs/ha;
- Forestry – 0.0125 jobs/ha for permanent employment; and
  – 0.0255 jobs/ha for seasonal employment.

Assuming these figures are correct, for the 223,083 ha of plantations supporting the pulp mills, the number of permanent forestry jobs created would be approximately 2,800 and total permanent plus seasonal would be approximately 5,700. By comparison, the same area of land, if used for cattle grazing, would only be expected to generate approximately 1,050 jobs.

According to DIEA, Dirección de Estadística del M.G.A.P. (Statistical Office of the Agricultural, Cattle and Fishery Ministry), for the year 2003, the permanent workforce

[21] Arrarte, Carlos P. "Uruguay's Destructive Plantation Model", Seedling, The Quarterly Newsletter of Genetic Resources Action International, September 2000 (http://www.grain.org/seedling/?id=65).
[22] Geary, Thomas F., "Afforestation in Uruguay: Study of a Changing Landscape, " Journal of Forestry 99, no.7 (July 1, 2001): 35-39: Carrere, R. & L. Lohmann, Pulping the South: Industrial Tree Plantations and the World Paper Economy (London: World Rainforest Movement, 1996).
[23] SGS Group is accredited by the FSC to undertake certification of forest management systems. SGS was founded in 1878 and is currently the world's largest organization undertaking in-field 3rd party inspection and verification (http://www.fscus.org/news/archive.php?article=305&).

occupied by Forestry averaged 7 people per each 1,000 ha, compared to cattle raising and breeding which employed between 1.96 to 2.65 people per 1,000 ha.

MGAP's web page[24] indicates that the year 2000 Farming Census data, when compared to those of the Ministry of Labour (MTSS), show that the forest industry generates 7.98 permanent jobs per 1,000 ha in the agricultural phase, not taking into account tree nursery operations. If all operations are taken into account, the final job generation is about 11 per 1,000 ha.

ENCE's plantations are operated under an agroforestry regime, whereby a mix of agricultural activities are conducted in combination with forestry. In these cases at least one extra job per 1,000 ha is generated.[25] These data clearly show that forest plantations can generate between 4 and 5 times more jobs than cattle grazing alone. EUFORES generated 13 direct jobs per 1,000 ha in 2005 and early 2006 including those with the company and its contractors and not including agroforestry operations. FOSA and EUFORES encourage cattle and sheep grazing on their lands. This practice is mutually beneficial as the livestock keep company costs associated with the maintenance of the many fire lanes to a minimum and local farmers have access to larger grazing areas. Both companies also permit the installation of beehives along their perimeters and eucalyptus plantations are becoming known as a source of the popular Shiitake mushroom.

In a case study of an agroforestry plantation project in Uruguay, Martino and Castillo (2006)[26] showed that mixed land use involving eucalyptus forestry plantations resulted in increased employment by up to 8 to 10 times more jobs per unit area. The particular land use mix in the Ibirá project included eucalyptus plantation (51%), native trees (1.7%), protected areas (11.3%), improved pasture (21.6%), and grassland (14.4%). The project was reported to also have created safer jobs with 20% higher salaries, more job opportunities for women, rural development opportunities, and a 7-fold increase in the gross value of production for forestry over extensive livestock operations. The project also provided environmental benefits reducing greenhouse gas emissions from cattle and increasing carbon sequestration in soils, forest plantation, natural forests, and protected areas.

[24] See informe "Puestos de trabajo en la fase Agraria Forestal" (www.mgap.gub.uy/).
[25] Enrique Puricelli, Assistant to the Director General, CMB, response to Issue A7 of the Expert's Report prepared by Hatfield Consultant's, March 2006 pertaining to the Cumulative Impacts Study for the Uruguayan pulp mills
[26] Martino, Daniel L. and Castillo, Alvaro P. "Case Study of A/R CDM Ibirá Project in Uruguay: What is Solved, What is to be Solved." Power Point Presentation Tokyo, Japan, February 2006 (http://www.jifpro.or.jp/5promotion/disclosure/I-forum_H18_P05_Uruguay_Daniel_PP.pdf)

B4.0 ENVIRONMENTAL ASSESSMENT

Potential environmental effects of eucalyptus plantations are well documented but the degree and nature of long-term impacts remains an area of debate among academics, industry, and NGOs. The EIA Study prepared by Botnia did not address specific impacts relating to plantations, however ENCE's EIA[27] documented 16 actual or potential environmental and social impacts as follows:

1. Soil Compaction (negative);
2. Increased Soil Erosion (negative);
3. Increase in Nutrient Cycling (positive);
4. Waste Generation/Soil Contamination (negative);
5. Increase in Stream Runoff (positive);
6. Increase in Stream Sedimentation (negative);
7. Stream Contamination from Wastes (negative);
8. Air Quality Deterioration (negative);
9. Increase in Noise Pollution (negative);
10. Liberation of Carbon (negative);
11. Emissions from Road Construction Equipment (negative);
12. Loss of Vegetative Cover for Road Construction (negative);
13. Alteration of Habitats (positive/negative);
14. Deterioration of Local Roads (negative);
15. Landscape Alteration (negative); and
16. Increased Traffic on Local Roads (negative).

The above assessment is generally in accordance that of this CIS document, however the impacts to streamflow as being positive due to increased flow is not supported by other studies.

The degree of these impacts was shown to be low to medium in the ENCE study. In addition, such impacts should be weighed against the economic and environmental benefits of plantation forestry. Sedjo (1999)[28], for example, identifies some of these benefits which include reducing harvesting pressures on areas of natural forest.

Impacts associated with road construction, such as soil compaction, air emissions, and loss of vegetative cover, are actually comparatively minor since roads occupy only a small proportion of each plantation. Although new plantations will continue to be developed, there is currently sufficient plantation area to supply the mills. As these have already been developed and hence the impacts listed above (negative and positive) have already taken place. Also, agroforestry operations as conducted in FOSAs and EUFORESs plantations

[27] See study Addendum, Section 5.3 (pgs 83-87).
[28] Sedjo, R.A. The Potential of High-Yield Plantation Forestry for Meeting Timber Needs. New Forests, vol. 17, No 1-3: pages 339-360.

can mitigate many of the impacts, particularly in combination with on-going sustainable forestry certification programs.

The most serious potential environmental effects can be grouped into three major categories – biodiversity; water management (surface and ground water); and nutrient cycling.

B4.1 Biodiversity

Biodiversity effects associated with eucalyptus plantations relate to a change in vegetation (species, communities, and gene pools), change of habitat, and to some degree, the creation of new habitat. Most plantations in Uruguay have been established on flat to gently rolling lands, whose primary use to date has been for livestock grazing. For the most part, plantations are restricted to soils that are less suitable for other forms of agriculture, and Uruguayan law precludes tree plantations from being established in naturally forested lands and other restricted areas (Law No. 13.723).

Geary (2001) points out that impacts on biodiversity of the natural ecosystem as result of eucalyptus plantations are hard to identify, as the grasslands in Uruguay have been modified by human actions (such as livestock grazing) for hundreds of years:

> "Because of the small percentage of the land area in Uruguay to be converted to tree plantations, a significant impact on biodiversity might seem unlikely. Moreover, the effect on natural biodiversity could be hard to interpret as biodiversity has been modified by centuries of pastoral and agricultural uses. Exotic grasses and other exotic pastoral plants are often the common vegetation. Erosion probably has irreversibly changed the ecosystem."[29]

Geary does not attribute any adverse environmental effects related to eucalyptus plantations, although he does discuss a number of possible impacts such as the use of pesticides (Section B4.4.2) and expresses the need for more research and monitoring of potential impacts.

Plantation development in Uruguay occurs on lands already designated as "Forest Priority Soils", principally existing as grazing areas. The conversion of these lands to forest plantation essentially results in the substitution of non-endemic grasses with non-endemic trees. The agroforestry operations utilized by EUFORES and FOSA, which include grazing and other agricultural activities, will likely result in a higher biodiversity. If the new plantations follow the model proposed by Martino and Castillo (2006)[30], and described in the previous section (i.e., mixed use), then net biodiversity would increase, both in terms of

[29] Geary, Thomas F. "Afforestation in Uruguay: Study of a Changing Landscape," Journal of Forestry 99, no.7 (July 1, 2001): 35-39

[30] Martino, Daniel L. and Castillo, Alvaro P. "Case Study of A/R CDM Ibirá Project in Uruguay: What is Solved, What is to be Solved." Power Point Presentation Tokyo, Japan, February 2006 (http://www.jifpro.or.jp/5promotion/disclosure/I-forum_H18_P05_Uruguay_Daniel_PP.pdf)

vegetation species (including native species) and vegetative structure (trees, shrubs, grasses) and, thus habitat.

EUFORES has reported that under their Forest Stewardship Council (FSC) certification, they ensure sensitive areas, including areas formally designated at regional and national levels as High Value Conservation Areas (HVCA), are protected. As part of an initial impact assessment, the company defines management plans for such areas that include, natural areas (grasslands, wetlands, palm groves, natural forests, stream corridors, etc.) which have a high biodiversity.[31] Similarly, they include forests and woodlands that provide important water resource protection functions; areas defined under international agreement (Ramsar Convention on Wetlands, Convention on Migratory Species, Convention on Biological Diversity and so on); and areas of traditional cultural interest.

Monitoring programs conducted by the company in wetlands and palm groves over a 10-year period in their Santo Domingo operation (Department of Paysandú) have documented a wide list of species as well as the return of several formerly extirpated species as a result of wetland restoration programs.[32] They have documented at least 242 species including 13 amphibians, 17 reptiles, 191 birds, and 23 mammals in this area. Further, ENCE has on-going programs to re-introduce yacare and coati from breeding programs at their M'Bopicuá Breeding Station. The company has recently designated three new HVCAs and is currently preparing specific management plans for each. Studies conducted during 2005 have also shown that a number of indigenous species readily adapt to plantation establishment where patches of natural vegetation are included in the mix of land uses.

FOSA also prepares management plans for natural areas contained within their plantation properties. These include a variety of ecosystems such as natural forests, wetlands and designated protected areas.[33] Management plans include the documentation of native species and the development of monitoring plans. The management plans require the maintenance of natural biodiversity and ecological functions of each area. Monitoring is often conducted by independent consultants and, along with the management plans, are reviewed as part of their FSC audit process. Ecological monitoring in these areas includes documentation of any changes in vegetation, birds, and rare or threatened flora and fauna.

B4.2 Water Management

Although accounting for about 3% of the land area of the Littoral, the impact of eucalyptus plantations on streams and groundwater in the region has been an issue of significant and ongoing concern to local stakeholders. The concern regarding groundwater is particularly

[31] Bentancor, A. and Delgado, S. Caracterización de los Bosques Nativos de los Establecimientos Propiedad de EUFORES S.A. EUFORES S.A., July 2005.
[32] EUFORES S.A. Informe Final Relevamiento de la Diversidad de Vertebrados Tetrapodos Establecimientos Forestales EUFORES Uruguay. Unpublished Report, EUFORES.
[33] SGS Qualifor. Evaluation of Forest Management Operations. Qualifor Program, No. AD 65, Projects 6609-UY and 7021-UY, April 2000.

relevant given the presence of a portion of one of the world's largest freshwater aquifers in parts of Uruguay - the Guarani Aquifer.

Geary (2001) mentions the concern regarding stream flow reductions in his article, and this potential problem has been discussed in many countries.[34] It is commonly acknowledged that water stream flows are lower in plantations than in grassland ecosystems on the same soil type. Regarding the situation in Uruguay, Dr. Daniel Martino states that:

> "Forest plantations typically cause a reduction in surface runoff with respect to the grassland they replace. This is due to a combination of several factors, namely water interception by tree leaves, reduction of rainfall kinetic energy by tree biomass, and increased evapotranspiration (i.e., transpiration of the eucalyptus tree leaves rate is higher than grasses and may reduce soil moisture content). This may cause some reduction in the flow of water streams, particularly at the small watershed scale, where there is a high concentration of planted areas."[35]

However, the transpiration of the tree leaves provides a recirculation of the humidity in form of new clouds and/or rains, which may not fall in the same area they originally were produced.

A more recent global study by Jackson (et al.) of the environmental services of plantation forestry for carbon sequestration corroborates these findings.[36] The study noted that plantation may help control groundwater recharge and upwelling but reduce streamflow as well as alter soil chemistry. To address possible impacts on stream flow, FOSA commissioned a study by a South African consulting firm in 2000. This study, conducted by Dr. David Scott of CSIR Division of Water in South Africa, found that on the eucalyptus plantations of FOSA in Uruguay, stream flows in the tree plantations were reduced by an average of around 25%. Their study did not address water table levels.[37]

The fact that fast growing tree species should reduce stream flows compared to grassland ecosystems on the same soil type is not surprising. The question is whether or not this reduction causes any significant problems. Dr. Martino points out that the litter in a eucalyptus plantation has "a degree of hydro-phobicity", which may somewhat increase water run-off, and thus would "attenuate the effects of the other variables that reduce runoff."[38] Dr. Martino also points out that one reason to expect a reduced impact on stream flows from the tree plantations is the "presence of an illuvial high-clay Bt horizon in most Uruguayan soils." This layer limits root penetration by the eucalyptus, and "Virtually 99% of

[34] Geary, Thomas F. "Afforestation in Uruguay: Study of a Changing Landscape," Journal of Forestry 99, no.7 (July 1, 2001): 35-39.
[35] Dr. Daniel Martino, Aug. 17, 2005, personal communication
[36] Jackson, R.B., et al.. »Trading Water for Carbon with Biological Carbon Sequestration. *Science* (Vo. 310) 25 December 2005, pp. 1944-1947.
[37] Dr. David Scott, "Hydrological Effects of Afforestation and Forest Management by Forestal Oriental S.A., Uruguay", unpublished study, September 2000.
[38] Dr. Daniel Martino, Aug. 17, 2005, personal communication

the roots are concentrated within the top 1 m of soil. This restricts the volume of soil from which roots can extract water." This means that direct uptake by trees on plantations should have relatively little impact on the water table.

In addition, Dr. Martino points out that:

> "Most tree plantations in Uruguay are located in relatively small patches (due to topography, soil types and fire prevention regulations), and riparian areas are normally left unplanted. Effectively planted area seldom reaches 70% of total estate area. At the watershed level, planted areas usually do not reach 50% of a given area. Due to this, any effects of plantations are normally diluted."

This was also the conclusion reached by the study commissioned by FOSA: As long as the tree plantations do not cover too large an area within a given watershed, the impact on stream flow is not expected to be a problem. Nevertheless, the Government of Uruguay continues to confront a policy decision on whether to further limit the percentage of a Department or watershed which can be planted. In order for this decision to be fully informed, there is a requirement for additional or more comprehensive studies. Dr. Martino further states that "There are two long-term paired watershed studies established in the country, but they still are not able to provide enough information to take conclusions." Weyerhaeuser also states that on their Uruguay tree plantations, they have commissioned a joint study by a Uruguayan organization and North Carolina State University to monitor the impact of plantations on the water table.

Silvicultural practices in the management of forestry plantations also have an effect on water management issues. Different species of eucalyptus have differing water use requirements and impacts. Both EUFORES and FOSA plant different species of eucalyptus, i.e. EUFORES with *Eucalyptus globulus* and its sub-species *E. globulus* var. *globulus*, *E. maidenii* and *E. bicostata*, and FOSA with mainly *E. grandis* and *E. dunii*.

Both companies use mainly propagation seedlings (cuttings) but also use seeds, all being produced in their own or third party tree seedlings nurseries. Thus the eucalyptus tree planting programs in the field vary as do their consequences on water consumption.

Eucalyptus globulus has a much different tree crown formation, being small with leaves mainly in the vertical position which allows more sunlight to flow around and reach the soil. On the other hand, *E. grandis* has a larger crown if compared to *E. globulus*, and has a tendency to expose more sunlight to their leaves with less sunlight reaching the soil. This sole effect influences the humidity in the soil from transpiration and influences the evapotranspiration effect of the leaves and any water availability in the soil.

Rainfall and temperatures prevailing during the full year in the areas of influence of the planted areas also vary and it is noted that water deficiency in the soils used for the plantations may occur during the months of December to February (summer season). Temperatures can reach above 30ºC during the summer season and frost may occur

during the winter months (July-September). Rainfall averages 1,100 to 1,300 mm/year and a water deficiency of some 50 mm/year may occur.

Hence, water availability in the soil for the planted trees varies according to the types of soils present, tree species and mixes of species planted, seasonal temperatures, winds and rainfall and variations of the altitudes of the terrains. However, water retention may be improved or reduced, according to silvicultural management techniques.

EUFORES is currently participating actively in two research programs detailing the impacts of large-scale forestry plantations. These include studies by the Institute of Fluid Mechanics and Environmental Engineering (IMFIA) of the Engineering Faculty of the Uruguayan State University (Universidad de la República) and other studies by the Engineering and Agronomics Faculties of the Uruguayan State University and the forestry companies. In general, the focus of these programs are to maintain research and environmental monitoring including the evaluation of effects of forest plantations and plantation management on soil erosion, water quantity, and water quality. The researchers and analysts in this study include agronomists and engineers.

Similar studies have been carried out since 1998 by the Dirección General Forestal (Uruguayan Forest Service) of the Ministry of Agriculture, Animals and Fisheries. These studies provide information regarding water management in relation to forest sustainability and the impacts of tree plantations on water availability and soil erosion as compared to those in cattle grazing areas.

Monitoring of small water basins were installed in the EUFORES properties in the area of Paysandú. They permit the continuous observation of rainfall, stream flow, soil humidity, and wind. The quality of the water in the basins and their physical-chemical properties, soil erosion, and the impacts of the plantations with grazing cattle and sheep compared to normal grasslands with those same animals is also being monitored. The monthly water available balance and its effect on small water basins are being assessed as well al the rate of soil loss.

The Direccón General Forestal requires that no more than 65% of a demarcated plantation area to be planted with a target species such as eucalyptus sp. This requirement allows for natural forest succession or for multiple use of the remaining area for animal husbandry and other agricultural uses. Legally required fire lanes and other internal roads along with water ponds and swamp areas may also reduce the available area for planting. Both companies have large areas within plantations for conservation uses such as for threatened wildlife and plants. The existence of this mosaic of forest plantation, mixed use and fallow lands succeeding to natural vegetation contributes to improved conditions for surface water infiltration and runoff.

Both the FOSA and EUFORES plantations have been certified to criteria established by Forest Stewardship Council (FSC). The FSC auditing reports for both companies were undertaken SGS Group, an independent certification body accredited by the FSC. In the

most recent document available on certification in Uruguay (the report to FSC on EUFORES plantations, dated July 31, 2003), SGS states:

> "….the main environmental effect of Eucalyptus is known to be its heavy use of groundwater. Since water is not currently a limiting factor in Uruguay, this is apparently not of immediate concern. However, the international experience is such that pro-active research and management of its potential impacts need to be investigated." [39]

The Guarani Aquifer System (Figure B4.2-1) is considered as one of the largest groundwater reserves in the world. It has an area of about 1.175 million km^2 located mostly in southern Brazil (850,000 km^2) but also occupying parts of Argentina (225,000 km^2), Paraguay (70,000 km^2), and Uruguay (45,000 km^2).[40] The depth of the aquifer is known to reach more than 1,000 m. According to Foster et al. (2004)[41] most of the aquifer is of potable quality but some parts have high fluoride or salinity. Both the National University of Cordobá study and the work of Foster *et al.* note that the aquifer is currently not exploited to any significant degree with most of the use occurring in Brazil. Foster *et al.* also note that demand will grow considerably, particularly for agricultural and industrial applications, hence the need to manage the resource including water quality and quantity.

In general, eucalyptus species are shallow rooted and hence draw most of their water from surface runoff and very shallow groundwater, they do not directly impact deeper aquifers. However, the specific impact on groundwater quantity and quality of the Guarani Aquifer by forestry plantations is not well known. Given the large volume of this aquifer compared to the relatively small aerial extent of the FOSA and EUFORES plantations in western Uruguay, the magnitude of water quantity and quality impacts from these plantations to the aquifer is not likely to be significant but is another impact deserving of further study.

FOSA is currently commissioning an update of their 2000 study and is seeking a Uruguayan partner to participate in a monitoring study of stream flow and water table levels.[42] The SGS report for FSC on forest management does suggest that EUFORES initiate a study on the impact of eucalyptus plantations on the hydrologic cycle in Uruguay. Given the potential impact on water supplies by eucalyptus plantations remains in need of further study, this is a logical initiative for the two companies to combine their efforts and support an independent long-term monitoring program on the impact of the plantations on stream flows and water table levels. In regard to water quality, both FOSA have indicated

[39] Forest Management Certification Report, SGS Qualifor (July 31, 2003) p.29, http://64.233.187.104/search?q=cache:AkEBk0Bd0bsJ:www.qualifor.sgs.com/8365-uy-fm-eufores_ma2004.10_ad65-01_final-psummary__2_.pdf+%22Forest+Management+Certification+Report%22+Uruguay+SGS+Qualifor+&hl=en

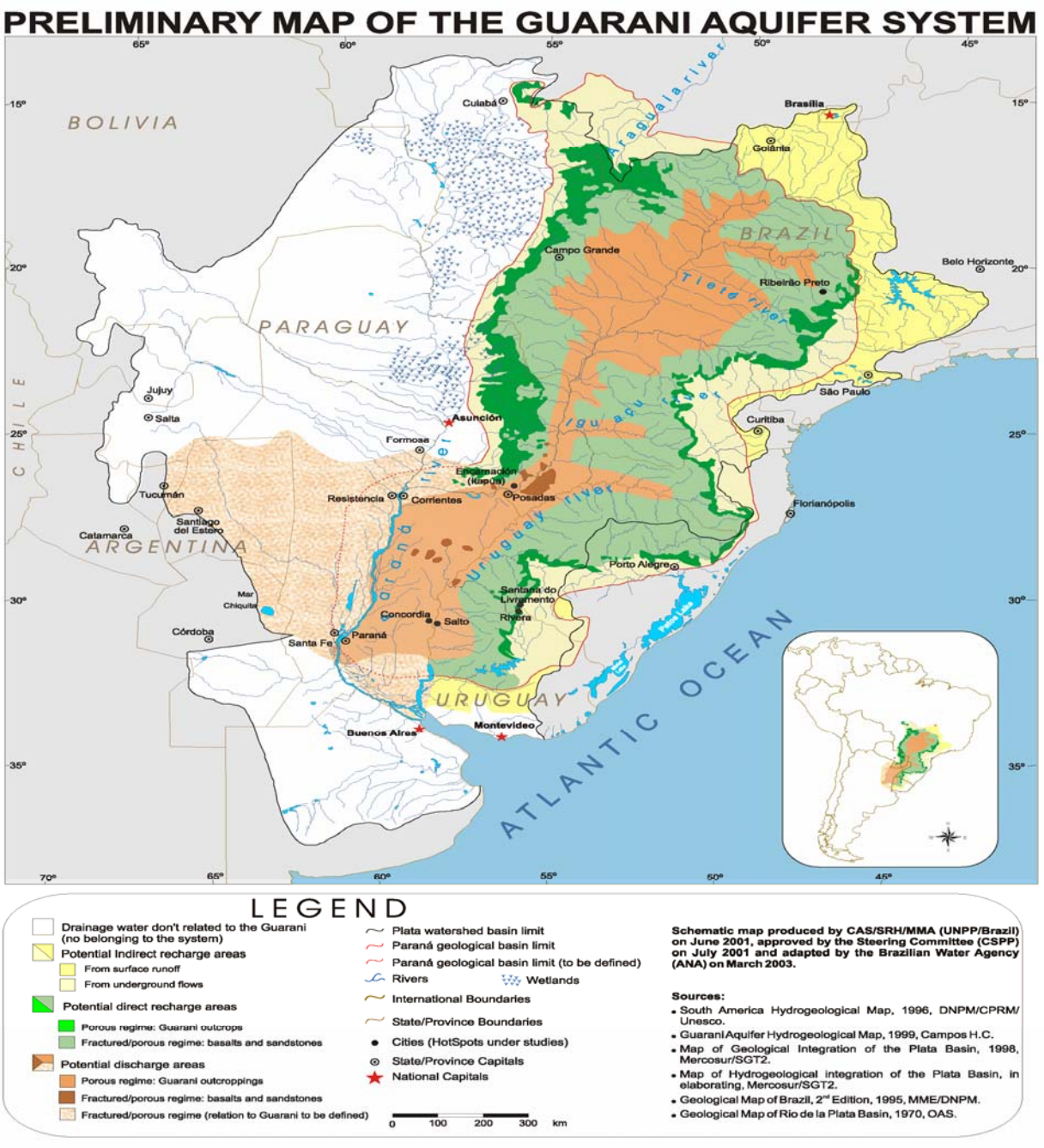
[40] Universidad Nacional de Córdoba, Facultad de Ciencias Exactas, Físicas y Naturales. "Informe Preliminar, Papeleras Sobre el Río Uruguay", September 2005.

[41] Foster, S., Kemper, K, and Garduño, H. "The Guarani Aquifer Initiative for Transboundary Groundwater Management". World Bank, Case Profile Collection No.9, December 2004.

[42] Eric Droomer, Forestal Oriental General Manager, August 18, 2005, personal communication.

Figure B4.2-1: The Guarani Aquifer

(from: www.sg-guarani.org/index/pdf/sistema_acuifero/mapa/Guarani_A4_EN.pdf)



they are taking steps to reducing the use of herbicides and pesticides and convert to less toxic products (Section B4.4.2).

B4.3 Soil and Nutrients

Soil effects related to compaction and erosion were noted by ENCE in their EIA study Addendum for the pulp mill project. In general, compaction impacts are highly localized (i.e., roads and handling areas) and erosion losses will be limited by the acknowledged reduction in surface runoff. Further, the sites are harvested every eight to nine years, reducing soil erosion and compaction impacts compared to areas under an annual harvesting regime. In the case of lands managed for the Botnia and ENCE mills, most are established on flat to gently rolling lands further reducing the potential for soil erosion and the loss of soil nutrients. These lands also occur in areas having an annual water deficiency of some 50 mm/year, reducing infiltration, mineral leaching, and runoff.

However, several soil nutrient effects have also been raised. These include general impacts on nutrient cycling amongst the forest biomass, soil, and runoff. In addition, Céspedes (2005)[43] raised specific issues pertaining to increased soil acidity, decreased cation exchange capacity, decreased soil organic matter, and soil structural changes in a eucalyptus plantation.

There have been few detailed studies of nutrient cycling in plantation forests compared to grasslands. In grazed grasslands, much of the above ground biomass nutrient content is recycled through cattle with a likely net loss to the animals. Grassland soils tend to have higher organic matter than eucalyptus plantations but may also experience greater loss of organic matter and associated nutrients due to the higher runoff regime of grasslands. Jackson et al. note that plantations not only have greater water demands than grasslands, but they typically have increased nutrient demands as well. Foelkel, in his on-line book and newsletter,[44] has provided a detailed and lengthy analysis of the literature pertaining to minerals and nutrients in eucalyptus plantations.[45] He notes that this work indicates that 60 to 70% of available soil nitrogen is returned to the soil and available for re-use by the vegetation. Similarly, 35 to 60% of the phosphorus, 55 to 80% of the potassium, 40 to 60% of the calcium, and 55 to 70% of the magnesium is returned to the soil.

Céspedes (2005)[46] undertook his studies in the Department of Paysandú, where some of the EUFORES and FOSA plantations are located, although his work was restricted to sandy soils which are more sensitive to acidification and the loss of nutrients. This is true in

[43] Céspedes, C. "Impacto de las Plantaciones de Eucaliptos en el Suelo". Informe de Guayubira, 2005 (http://www.guayubira.org.uy/plantaciones/suelo.html).
[44] www.eucalyptus.com.br/capitulos/).
[45] Foelkel, C. "Minerais e Nutrients das Arvores dos Eucaliptos: Aspectos Ambientais, Fisiológicos, Silviculturais e Industriais Acerca dos Elementos Inorgánicos Presentes nas Arvores". Eucalyptus Online Book and Newsletter. (www.eucalyptus.com.br/capitulos/capitulo_minerais.pdf).
[46] Céspedes, C. "Impacto de las Plantaciones de Eucaliptos en el Suelo". Informe de Guayubira, 2005 (http://www.guayubira.org.uy/plantaciones/suelo.html).

such soils under any cultivation regime. Finer-grained soils would not be expected to show the same magnitude of impacts. Further, the need to maintain productivity on a short rotation forest crop would dictate the use of appropriate silvicultural techniques to mitigate such impacts. Increased forest productivity is fundamental to this industry and can be attained by various methods, not only including the addition of fertilizers. Campinhos (1999)[47] has shown that the sustainable eucalyptus plantations for the production of mill fibre can readily be obtained. He noted a situation whereby productivity was increased from 5.9 air-dried t/ha/yr to 10.9 t/ha/yr simply by selecting trees more adapted to each site.

Specific silvicultural techniques employed by EUFORES include the use of heavy duty crawler tractors that loosen the soil to a depth of 80 to 100 cm, to improve the soil for root growth and water retention. Other techniques to reduce water and nutrient loss include the application of fertilizers directly into the root zone and not on the surface, plant spacing, and planting along contours. In some areas "dry well" may be dug to collect excess water.

B4.4 Other Potential Concerns

B4.4.1 Protected Areas

In order to qualify for the tax reductions and other benefits of the tree plantation incentive program, companies must have their management plans approved by the Dirección Forestal. Because most companies will not want to forego these tax benefits, it is very unlikely that any company would establish eucalyptus plantations on non-Forest Priority Soils. The Dirección Forestal has not designated any protected areas as having Forest Priority Soils, so it is very unlikely that any company would want to establish tree plantations in these areas. Without the tax advantage, financial returns from these plantations would be reduced. Furthermore, harvesting is not permitted in legally protected areas and it is highly unlikely that any commercial entity would invest in tree plantations in an area where they will not be permitted to harvest. As described above (Section 3.4.2),

B4.4.2 Pesticides and Fire Management

Geary (2001) identified three areas where, in his opinion, "immediate action" was needed: "stop using dodecachloro pesticides; undertake a comprehensive review of pesticides now used and of potential use for forestation in Uruguay; and evaluate the threat of tree plantation fires and develop best management practices to protect the plantations and surrounding properties."[48]

His primary concern appears to be the use of pesticides such as Mirex and Mirenex (both dodecachloro pesticides) to control leaf-cutter ants in the eucalyptus plantations. He states that the pesticide Blitz is much less toxic, and is preferred. Mirex and Mirenex are not

[47] Campinhos Jr., E. "Sustainable Plantations of High-Yield Shape Eucalyptus Trees for Production of Fibre: the Aracruz Case". New Forests, Vol. 17(1-3), January 1999.
[48] www.guayubira.ort.uy/plantaciones/impacto.html

permitted under the Forest Sustainability Certification and, hence neither EUFORES nor FOSA uses these pesticides. EUFORES is shifting to the use of Arbosan which is even safer than Blitz.

Regarding other pesticides and herbicides, SGS Group notes that both companies are taking steps to reduce chemical usage, and such steps are likely required to maintain FSC certification. This is an on-going effort at both companies, and the SGS documents contain mention of several programs (such as biological control of weeds through use of sheep and cattle) already being used by FOSA and EUFORES. It should also be pointed out that in comparison to agricultural operations which require at least annual pesticide applications, plantation forestry only requires the use of these chemicals once per rotation.

Geary, as of 1999-2001 also identifies the need to develop better management practices regarding fire prevention. and For example, Weyerhaeuser (Colonvade in Uruguay) hired external expertise to help them and other Uruguayan companies develop such an improvement program, and both FOSA and EUFORES have made significant adjustments in their fire control programs since 2001. These include the use of fire observation towers equipped with radio communication and maintaining fire-breaks in pasture for use by livestock.

B5.0 CERTIFICATION OF PLANTATIONS

FOSA and ENCE have demonstrated a strong commitment to ensuring that their tree plantations are managed in a sustainable fashion and do not have detrimental environmental and social impacts. Both companies are addressing this through achieving independent certification of their sustainable forest management practices via an international standard developed by the Forest Stewardship Council (FSC). This is a well-known standard which is supported by many environmental NGOs focused on the forestry sector. The standard, currently in the process of being updated by FSC, addresses a broad range of environmental, social and economic criteria. FSC applies its standard through a network of certifying bodies, which are independent third-party organizations (usually consulting firms) that perform audits against the standard and issue certificates of compliance. Both FOSA and ENCE contracted SGS Group -Qualifor (Societe Generale de Surveillance) to provide these audit services.

Forest Stewardship Council's Forest Management Principles
(from: http://www.fscus.org/standards_criteria)

PRINCIPLE #1: COMPLIANCE WITH LAWS AND FSC PRINCIPLES
Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

PRINCIPLE #2: TENURE AND USE RIGHTS AND RESPONSIBILITIES
Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

PRINCIPLE #3: INDIGENOUS PEOPLES' RIGHTS
The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognized and respected.

PRINCIPLE #4: COMMUNITY RELATIONS AND WORKER'S RIGHTS
Forest management operations shall maintain or enhance the long-term social and economic well being of forest workers and local communities.

PRINCIPLE # 5: BENEFITS FROM THE FOREST
Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and a wide range of environmental and social benefits.

PRINCIPLE #6: ENVIRONMENTAL IMPACT
Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

PRINCIPLE #7: MANAGEMENT PLAN
A management plan -- appropriate to the scale and intensity of the operations -- shall be written, implemented, and kept up to date. The long-term objectives of management, and the means of achieving them, shall be clearly stated.

PRINCIPLE #8: MONITORING AND ASSESSMENT
Monitoring shall be conducted -- appropriate to the scale and intensity of forest management -- to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

PRINCIPLE # 9: MAINTENANCE OF HIGH CONSERVATION VALUE FORESTS
Management activities in high conservation value forests shall maintain or enhance the attributes which define such forests. Decisions regarding high conservation value forests shall always be considered in the context of a precautionary approach.

PRINCIPLE # 10: PLANTATIONS
Plantations shall be planned and managed in accordance with Principles and Criteria 1 - 9, and Principle 10 and its Criteria. While plantations can provide an array of social and economic benefits, and can contribute to satisfying the world's needs for forest products, they should complement the management of, reduce pressures on, and promote the restoration and conservation of natural forests.

The World Bank, through its Forests Policy (O.P. 4.36), requires that proponents of commercial harvesting operations of natural and plantation forests obtain independent certification of sustainable forest management. This policy provides guidance on the content and implementation of acceptable certification systems. IFC has examined the FSC standard that has been applied by SGS Group in Uruguay, and has found that it is consistent with the World Bank policy.

For both pulp mill projects, the use of pulpwood certified to FSC standards is important to ensure that the tree plantations do not have a negative environmental or social impact on the country. FOSA and its partner the Otegui Group (whose forest operation is called COFUSA) had their tree plantations certified by SGS Group to FSC criteria in 2000. These were the first two companies in Uruguay to achieve this certification for their plantations. Currently both companies are in the process of re-certifying these plantations.[49] According to information provided, to the IFC,[50] these two operations will supply an estimated 72.9% of Botnia's wood needs during 2007-14. In addition, a number of third party suppliers to Botnia (including Caja Bancaria, Caja Notarial, Uruwood, etc.) are in the process of becoming certified to FSC criteria, so that the company plans to have a total of 85.2% of their wood is sourced from FSC certified forests. In ENCE's case, its subsidiary EUFORES had its operations certified in 2003, and these forests will supply an estimated 57% of the mill's wood needs in 2008-2015. In addition, several third party suppliers are either certified or in the process of becoming FSC certified, such that approximately 88% of the company's total wood needs will come from FSC certified forests.[51]

There is increasing market pressure being brought to bear on international pulp producers to demonstrate that their product comes from sustainably managed forests. In order for these companies to compete in the European market place, which is increasingly demanding a "green label" for forest and paper products, they need to ensure that their product is certified, and that this certification is maintained. This is particularly true for Botnia and ENCE whose end-use buyers seek assurance that their product is sourced from sustainably managed forests.

Some stakeholders have expressed concern that either Botnia or ENCE might introduce genetically modified organisms (GMO) into Uruguay, through their tree plantations of eucalyptus. However, neither company currently uses GMO's nor has either indicated any intention to do so. In addition, FSC criteria specifically prohibit the use of GMO's, so neither company would be able to use GMO's and maintain their FSC certification.

Additional concerns have been expressed regarding the introduction of non-indigenous tree species and it is true that the eucalyptus species being used to produce pulp are not native to Uruguay. At present, there are over 400,000 hectares of eucalyptus already planted in

[49] Certification is granted for a period of 5 years, so both companies are working to re-certify as of September 2005. In addition, Forestal Oriental has expanded its ownership, and wants to certify its newer lands as well.
[50] "Plantations area and wood supply, " http://www.ifc.org/
[51] Addendum, p. 68.

Uruguay, including all of the species to be used at the pulp mills. The debate with respect to the potential impact of non-indigenous species such as eucalyptus remains unresolved. The first introductions of eucalyptus species to South America likely goes back as early as 1824 in Rio de Janeiro (Couto and Betters 1995).[52]

[52]Couto, Laercio and David R. Betters, "Short-Rotation Eucalypt Plantations In Brazil: Social And Environmental Issues," Oak Ridge National Laboratory (February 1995), http://bioenergy.ornl.gov/reports/euc-braz/toc.html

B6.0 SUMMARY

The area of eucalyptus plantations required to supply the two pulp mills during the first eight years of their operation is conservatively estimated to be about 175,000 ha. A total of 208,000 ha of eucalyptus plantations will thereafter be required to supply all of the wood fibre for the mills (5.2 million m^3/yr) based on an eight year rotation. As of September, 2006 a total net area of about 220,000 ha of company-owned plantations and plantations of third party suppliers have been identified which could supply the mills. However, not all 3rd party contracts have yet been signed. All of these plantations occur within an economically viable distance from the mills and have been planted as of December 2005.

In the event of unforeseen supply shortages, or shortages due to age-growth factors, additional wood fibre could be sourced from existing and planned plantations in western and central Uruguay utilized principally for saw logs and export. Short-term supplies are also potentially available within the Pulp Mill Area of Influence in northeastern Argentina, although the economic viability of this wood may depend on export tariffs and Argentine taxes.

Significant criticism has been aimed at eucalyptus plantations in a number of countries. Arguments generally suggest that eucalyptus changes the climate by reducing rainfall, degrades the soil, drains the soil of its moisture, and reduces biodiversity. Forest plantations in Uruguay have predominantly been established on lands used previously for many years as grazing lands. Annual rainfall tends to be sufficient for tree demand, particularly where good silvicultural techniques are employed, such as proper selection of eucalyptus species to suit site conditions. Thus, moisture is not significantly limiting in areas planted with eucalyptus and in plantations managed for mixed land uses, including cattle grazing, these new plantations increase biodiversity over grazed lands by providing a range of habitat. With regard to the proposed Botnia and ENCE pulp mills, there are sufficient existing plantations to supply all of the required fibre. Hence, any impacts (positive and negative) due to the conversion of former grazing areas have already taken place. These plantations are managed using appropriate silvicultural techniques which, in ensuring high productivity, work to reduce impacts associated with soil compaction, soil erosion, nutrient loss, and water deficits. Further, most of these plantations will be FSC certified which requires management and operational procedures intended to mitigate environmental and social impacts including those relating to waste residuals, air emissions, water contamination, and health and safety.

Biodiversity concerns are important but should be viewed in terms of their development on the conversion of impacted grazing lands containing non-endemic species. Those plantations incorporating a mix of land uses including grazing, pasture, and natural forests actually result in increased biodiversity over grazing lands alone, not only in terms of vegetation species and communities but also in terms of vegetative structure.

Based on existing information, it would seem that the most serious potential impacts of the existing and planned plantations relate to water management issues – both surface water and groundwater. It is recommended that the forestry companies supplying the two mills continue their participation in the on-going Uruguayan State University studies pertaining to impacts on soils, surface water, and groundwater.

In addition, both EUFORES and FOSA should ensure surface and groundwater monitoring is established at all of their large-scale plantations. There are anecdotal reports of surface water supply impacts to local agricultural operations, particularly those of small producers. Should the existing studies or proposed monitoring confirm such impacts, the plantation owners should provide reparations to private landowners in the form of augmented water supplies. Any plantations located within the recharge area of the Guarani Aquifer should also study and monitor and assess groundwater quality (pesticides, herbicides, and nutrients) under their plantation lands.