

The forestry revolution in Uruguay

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CAETS 2009, Calgary- July 16, 2009

ABSTRACT

Uruguay, a small country in South America, has experienced since 1987 an unprecedented forestry development. The decline of the wool market price and the raise of forest products price were economic factors to enhance forestry development. Soils, rainfall and temperature properties provided forestry an opportunity for fast growing species. A legal framework provided incentives for forestry development.

As a result a forestry revolution happened to be. This meant rural development, infrastructure improving, and a progressive industry development, from raw materials to paper industry.

Engineering was strongly involved with investment and production, in this new field of economic activity. Environmental regulations and monitoring, made of forest industry a sustainable growing activity, taking care of environment impact on water resources, soils, biodiversity and improving the greenhouse gas balance sheet.

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INTRODUCTION

Let me introduce Uruguay to CAETS meeting.

Uruguay is a small country in South America, located between Argentina and Brazil and a gateway to the Plata basin, one of the more important river basins in the world.

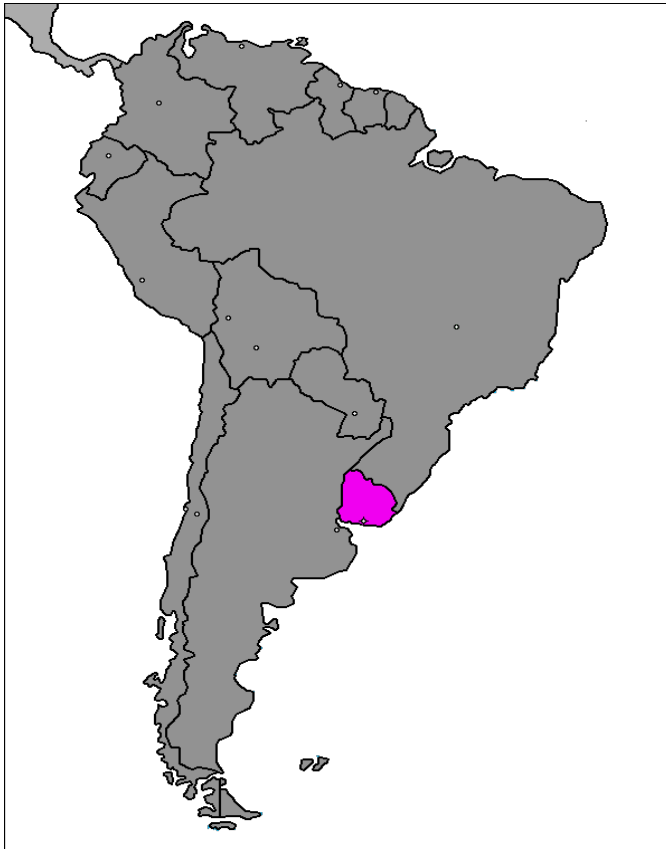


Figure 1 Uruguay in South America

Someone said once that “Uruguay was a farm, a port and a beach”, due to the traditional activities in the country.

The farm was oriented to livestock breeding (mostly meat, milk and wool) and to croplands (mainly rice, wheat and coarse grains).

The port was related to the historical role of the Port of Montevideo, linking the Plata basin to the world. A “ hub” port for the country and the region (the south cone of America).

Beaches are fine with white sands along the Rio de la Plata and the Atlantic Ocean and weather is mild and days are sunny, and these natural resources make of Uruguay an attractive place for tourism.

Average temperature is mild and evenly distributed all the year round, ranging between 6°C and 19°C.

Rainfall is also evenly distributed all the year round. Average rainfall is 1000/1200 mm/year.

Population is very low, about 3.4 million and population growth is the lowest in South America.

These climate properties make of Uruguay a natural green spot in the map.

THE FARM

Within the farm, the better soils were oriented to croplands and milk producing.

A significant part of the livestock area was oriented to sheep breeding in the poorer soils. These poor, most sandy and silty soils, cover 10% of the country surface land (1:870.000 há) and extended area reaches 20% (3.700.000 há)..

Lower wool prices conditioned the viability of sheep breeding farms.

As a result, land value decreased, profitability diminished, and the national and local tax level (high for the South American standards) was a heavy weight for sheep breeders.

At the same time, forest products increased their value in the global market due to shortage of supply and increased paper demand.

Traditional sheep breeding producers found very attractive a shift to forest production.

Sunny days and available water were also concurrent to forestry development.

Political decision makers envisaged this opportunity and developed a political framework to support forestry.

A law was passed by the Parliament that includes a subsidy for plantation, accounting for 50% of the plantation cost, VAT exemption for forest products,

property tax exemption for forestry lands and import tariff exemption for investments (mainly equipment) in forestry and forestry related activities.

So, natural conditions of soils, water and climate, were enhanced through an adequate legal and economic framework.

As a result, the market forces and the regulations moved the economy to forestry production.

FORESTRY IN URUGUAY

Nowadays, Uruguay, accounts for 850.000 hás (750.000 hás for 2007) of forest lands under project.

Located near the ports, the plantation are mostly Eucalyptus species for pulp and far away from the ports the plantations are Pines and Eucalyptus species for saw wood and value added wood products, as production has to face higher transport costs due to increasing distance. Eucalyptus are mainly oriented to pulpable wood and Pines are oriented for saw wood. Eucalyptus account for 75% of the total forest area and pines for 25%.

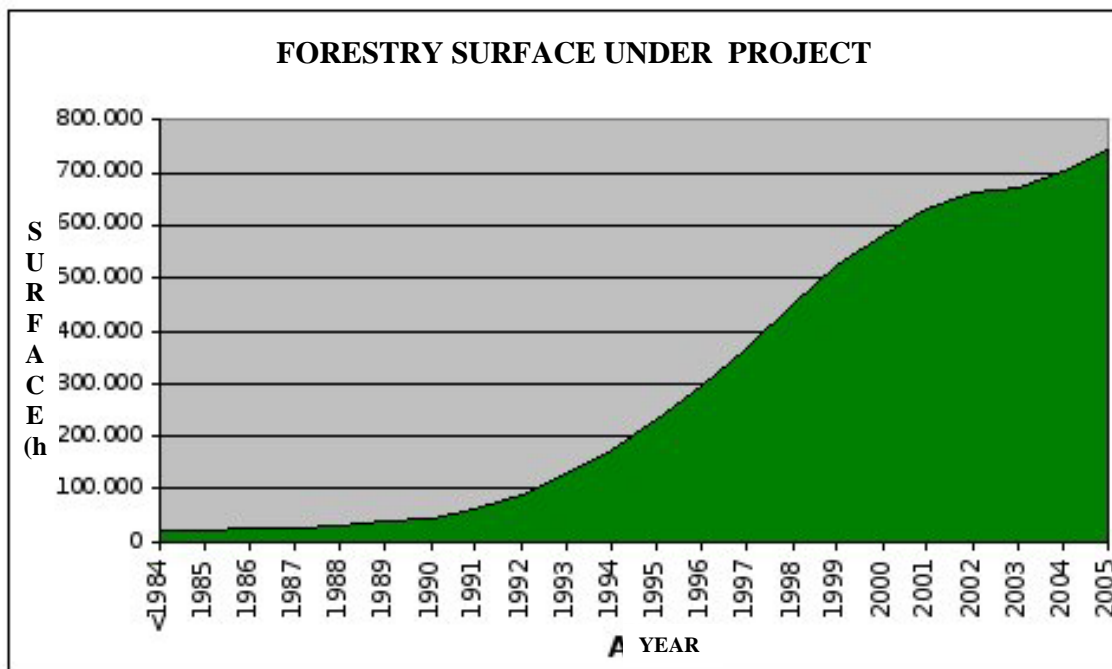


Figure 2 Plantation surface¹

¹ MGAP Direccion Forestal, 2007

From 30000 hács by 1987 when the law was passed to 750.000 hács by 2005 is a forestry revolution.²

The period since 1987, has been a plantation period, and this means, developing technical expertise in the selection of species, improving genetics, land use planning, and developing production procedures, facing the production target.

Agronomists had in all this period a main participation.

The period since 1997, was the trade period.

Forestry supply had reached a critical mass and exports began to develop.

At the very beginning it was logs. But soon after it was woodchips.

Forestry exports were oriented to pulpable wood as raw wood.

After Uruguay came to be Finland's main supplier of foreign raw wood, the paper industry put an eye on the country.

Simultaneously in the inland areas, saw wood producers began to increase plantation and production, although the slower growing ratio of pines determined that up to 2004, the critical mass was not reached.

Since then saw wood industries began to appear in the landscape and panels industry began to produce construction materials.

It has been a forestry boom for the country.

Land value increased, profitability of poor soils increased, exports increased and a value added process began.

The forecast was overwhelmed by reality.

² MGAP Censo Nacional Agropecuario 2007

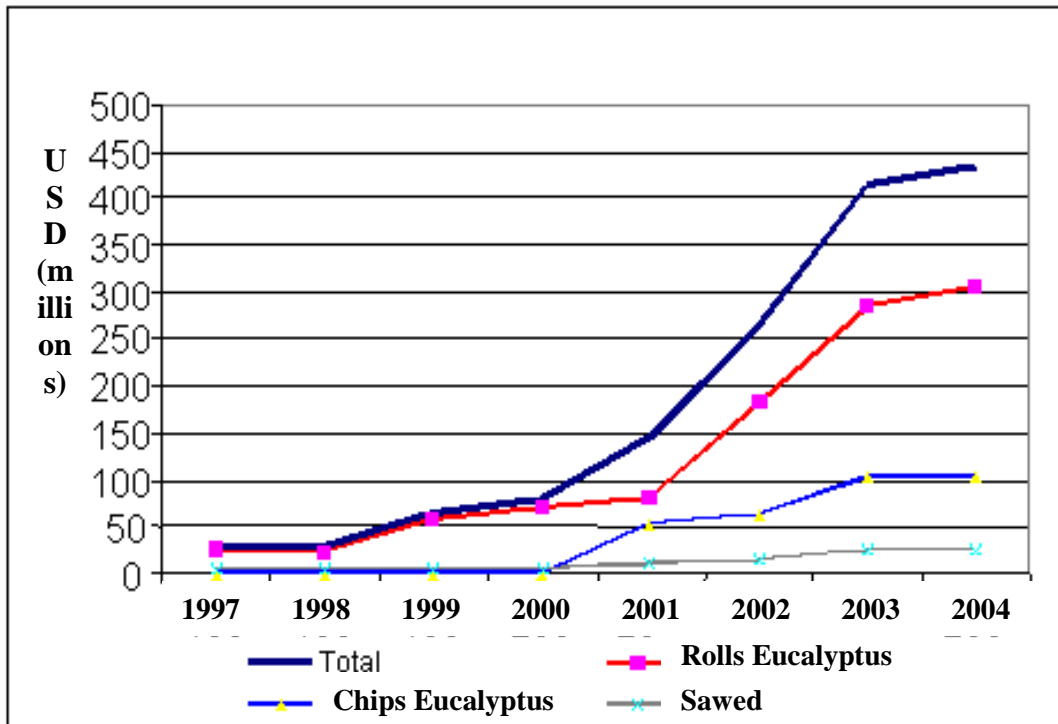


Figure 3 Demand forecast by 1997

By 1997, the market forecasts assumed that most of the production would be raw wood, for 20 years, but actual results have been much more optimistic than forecast. By 2008, 50% of raw wood is locally industrialized to cellulose pulp. Once more, engineering was there to help facing the new scenario.

FORESTRY RESULTS

Today we can already mark some forestry development results.

As expected, the destination of the forest products has been exports, particularly relevant for a small country that has to look for the world market to grow.

Exports account for 2007 for USD 300.000.000 (one half of the farm, the beach or the port), but it is expected to continue growing due that more forestry surface will be harvested in the years to come and value added industries will keep growing..

Forestry related exports reached USD 1 billion by 2008 (including pulp).

Table 1 Foreign trade

Forestry products exports, products, per year
(in 1000 US Dollars)

Origin:

MGAP - Dirección General Forestal
based on information by the BCU.

(*) Not available to
date of the report

PRODUCT	2000	2001	2002	2003	2004	2005	2006	2007
TOTAL	85.190	84.385	86.549	104.223	141.118	176.601	220.955	281.378
RAW WOOD	39.814	41.968	43.649	58.648	90.377	118.021	142.648	177.670
Non conifer wood	39.388	40.853	42.982	47.523	56.534	55.626	73.633	112.276
Chips	426	667	667	10.865	32.694	62.286	69.015	65.394
Conifer woodOD	0	448	0	260	1.149	109	0	0
SAWWOOD (total)	7.772	7.011	8.759	12.793	18.135	22.734	25.579	30.648
Non conifers	2.229	1.838	7.728	6.105	9.605	14.827	15.521	19.679
Conifers	5.543	5.173	1.031	6.688	8.530	7.907	10.058	10.969
Industrial Products								
Paper and similar	36.169	32.918	32.634	31.419	31.617	33.656	36.415	36.451
Paper and similar residues	1.394	1.758	1.491	1.321	977	1.622	1.423	2.761
Panels	0	0	9	4	0	0	0	32
Pressed panels	0	1	6	4	10	4	671	62
Construction wood	0	0	0	0	0	555	13.940	33.516
Pulp	19	708	0	34	2	0	0	(*)
Fiber panels	0	21	0	0	0	0	3	0
Others	21	0	0	0	0	9	276	238

The already installed mill produced by 2008, 1:000.000 ton of pulp and it means exports for USD 600:000.000 per year, taking reference of December 2008 prices , that have suffered the global crisis, going down 50% in relation to July 2008 prices³

Forestry means also more jobs for Uruguay in plantation, handling, harvesting, manufacturing and management. More than 10000 jobs have been created and it is forecasted that will be 14000 in the next 8 years. Official social security figures account actually for 11600 labourers registered and working in the forest process.

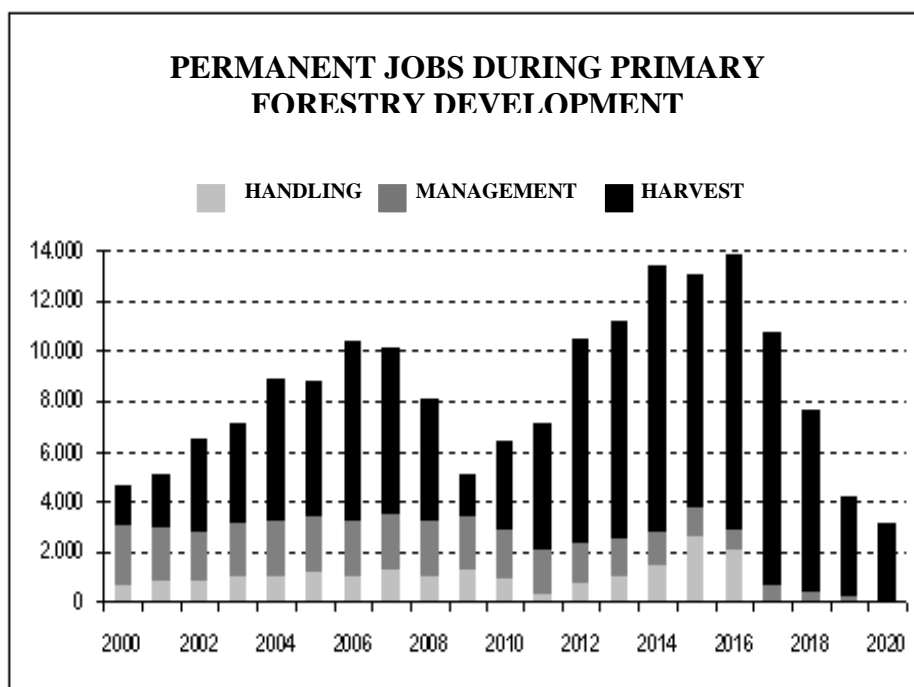


Figure 4 Permanent jobs

Investment in Uruguay related to forestry, has increased dramatically. The paper mill itself accounts for USD 2.000:000.000, the biggest single investment in the country's history and more than USD 1.500:000.000 of forestry plantations, a renewable resource.

³ DGF based on Central Bank Statistics Yearbook, 2008.

Land value in poor soils areas, has moved from USD 300/ha to more than USD 1000/há, and it means an increase in land asset value of more than USD 1.000:000.000.

FORESTRY FUTURE TRENDS

The forestry industrial revolution in Uruguay is actually beginning.

There are 2 pulp mills under project (Stora Enso- Arauco and a 2nd BOTNIA line) and Uruguay continues supplying raw wood to the foreign market.

Cellulose availability has also given impulse to paper industry and there is a huge expectation for an announced paper industry project under feasibility appraisal.

Construction wood and panels and compressed panels industry is growing fast (Weyerhaeuser and Urupanel), another value added stage for higher value products nowadays limited due to the global financial crisis,.

Industry increased power demand, and supply was limited and most dependable on oil prices and gas from Argentina. Uruguay is not an oil producer and natural gas from Argentina has suffered shortage.

So, lignine based power plants are already generating power for the pulp industry and selling the excess to the power market,

Raw wood availability and debris of wood , simultaneously to gas import shortage from Argentina and raising oil prices, shifted heat production in industries to wood heating both in industry and residential uses.

Engineering was there to develop heating equipment environmentally clean, based on wood pyrolysis , with economical benefits since the unit price for heat is one third the traditional fossil fuel price.

Charcoal industry, has not been developed in Uruguay, although, Brazil and Argentina increasing demand for their steel mills.

Carbonization process research, development and innovation, has been focused on pyrolysis. Rapid pyrolysis for liquid fuels production and slow pyrolysis oriented to gas production. Gas condensation enables to obtain liquid fuels and to catch and reduce gas emissions.

Pyrolysis industry, a technique adopted and developed in Uruguay as a result of 2nd world war oil shortage and the 70's oil crisis, is promising for the industry and for high value added byproducts.

Pyrolysis technology has enhanced research and innovation in fuel production and byproducts such as pesticides, health pharmacy, creosote, liquid smoke for the food industry and high quality carbon for activated carbon, carbon anodes, among others.

Synthesis process research on syngas technology (oriented to gasoline production and polymer production as an alternative to petrochemical industry by products), is already in the academic and industry agenda.

On the biochemical industry, bioethanol production is in the pilot stage and looking forward to production and continuous research, actually limited due to low oil market price.

Wood debris and sawdust availability, encouraged pellets industry development, for exports to European market for house heating.

All these new trends came as a result of wood availability and much research, development and innovation is on the way.

By 1987, everybody was thinking of forestry products for exports of raw wood. 20 years later, everybody has in mind final goods as paper, and final high valued products as furniture or agrochemicals, both for the local and foreign market.⁴

This process is not only an improvement of the forestry business economics, but an improvement of nationwide people's thinking on the issue that natural conditions

⁴ DGF-MGAP

have to be twined with technical knowledge and suitable regulations to improve the nation's wealth, promote growth and discover the endless way of progress.

FORESTRY EXTERNALITIES

The forest production meant increasing demand for transport infrastructure, pulp industry development, increased energy and power demand, and raised some environmental issues.

I will make a stop in transport externalities, both favorable and unfavorable and in environment .

TRANSPORT

The transportation demand increased significantly. By 1987, forest products did not account for a significant share in the agricultural tonnage moved across the country, but by 2007, forest products account for 50% of the total tonnage moved on the road system and for far more than that in the transport tonnage-km moved.⁵

So this means a whole new landscape of transportation demand, changing the origin-destination flow patterns, requiring heavier pavements for intense heavyweights, recycled and new port facilities to handle the new production, increased storage areas, improving transportation efficiency, etc.

Pavements had to be reinforced. Increasing to double the tonnage means reducing to a half the pavements residual life. Granular low volume roads were more intensely demanded and required upgrading to paved standards or at least, intensive maintenance. Heavy weights bypasses of cities and towns were required to lower urban-transport conflicts, regulations for trucks transit had to be approved by local authorities and in rural areas, producers had to enforce ethical use of roads after rainy days.

A new road network had to be developed inside the fields.

⁵ Cáceres,L based on MGAP statistics.

Trucks have to reach the storage areas, and forest equipment has to go from the plantation to the storage areas in the field. And this means a new market for road construction and maintenance.

Railways had their chance to attract and share the transport market, but in a small country with average 200 km transport distances, did not find their way, still an issue on the debt side.

Port facilities had to be recycled, improved and new ports had to be developed. Logs required storage areas near the ports, in order to load the vessels as fast as possible.

Equipment was required to load the trucks. The first loadings were using front wheel loaders due no specialized forklifts were available.

By 1987, Uruguay had a single facility for moving bulk products and no chipping facility.

Woodchips determined the need for increased facilities. New ports were developed, and actually 5 port facilities are able to handle these products.

At the same time the country had an aggressive policy for transit containers that summed up to forestry demand and determined dredging policies to increase the depth of access channels and rivers to reach the ports with higher draughts vessels. The port of Montevideo access channels improved from 28ft to 39ft, and as a result, most of the regional load was funneled through this port.

Although the country is surrounded by rivers, water transportation had little development and riverine cargo share was small, but since forestry production, it has increased, both in tonnage and fleet tonnage, introducing multimodal transport in the transportation supply market.

The traffic flow pattern changed, due to the location of the new facilities.

From the farm to the port, before the forestry revolution there was a single path to the port of Montevideo, but nowadays a complex network of traffic flows have changed radically the traditional pattern, and it has helped to decentralize the country's economical activity.

Trucks had to change their dumping boxes to large cages to handle high volume, low weight woodchips or flat platforms to stack logs.

As a result of increasing transport demand, freight prices increased, truck fleet investment grew, and the price effect reached all the agricultural sector, reducing the producer benefit (although market prices for grains were so high, that transport cost increase was not a relevant issue for the producers from 2002 to 2008) Infrastructure engineering was most involved and concerned with these externalities, preventing and reacting to reality.

FORESTRY AND THE ENVIRONMENT

Since the global industry began to look the forestry revolution in Uruguay, panels and paper mills producers began to consider Uruguay as a suitable location for their plants.

As a matter of fact, BOTNIA, a part of the METSO group installed a 1:000.000 ton pulp facility, developed his own riverside port and an overseas port by 2007.

As the process went on, some environmental issues were raised.

Industries pollution has been both a local and international subject.

Locally, non government environmental organizations questioned the environmental settlement of the paper mills due it was an ECF technology plant. But there was enough evidence in the EIA that environmentally safe and clean production was in the mind of the investors to reach Europe's standards.

The main problem was born in Argentina, where environmental organizations and border neighbors opposed the paper mill installation at the riverbank of the Rio Uruguay.

Bridges linking Uruguay and Argentina were closed to international trade and people movement.. For more than two years, the main international bridge linking Uruguay and Argentina at Fray Bentos (where the pulp mill is located) has been closed to transit by activists and the Government of Argentina has not enforced law to guarantee the right for freedom of movement, a Constitutional human right for local and foreigners and agreed in all the international multilateral and bilateral agreements.

A problem submitted to the United Nations' Court at The Hague, Netherlands, arbitration.

Nowadays, monitoring effluents and air, has shown that there is no pollution above the limits accepted both by Argentina and Uruguay, reaching international standards.

Engineering and the Academy, both from Argentina and Uruguay, had long previewed that no significant impact on environment was expected, as far as proper ECF technology was used.

Forestry itself was a matter of controversy about environment.

Desertification of soils, acidification of soils, water consumption, biodiversity loss, were announced, but none of these resisted the analysis and the evidence.

Uruguay is ranked in the world as one of the top environmentally classified countries.

This condition gave place to the national slogan of Natural Uruguay (Uruguay Natural)

Forestry came to enhance this condition.

The forestry area is a small percentage of the total country's surface. Less than 8%, and less than 0,5 há/ inhabitant, lower than the world's mean value and even lower than other intensive forested countries such as Finland, Sweden or Japan considered to be environmentally sound.

Increase in forestry lands in Uruguay will still show ratios below the world average level.⁶

Table 2 Forestry intensity per area and inhabitants

Country	Percentage of forest area	Forest area / inh.
Papua New Guinea	82.6%	10.33
Finland	60.7%	4.50
Japan	66.5%	0.70
Sweden	62.3%	3.22
Congo	61.8%	8.65
Brazil	57.6%	3.74
Canada	36.1%	12.52
USA	30.6%	1.11
France	26.9%	0.26
Australia	13.7%	6.00
Uruguay	8%	0.50
World average	28.8%	8.7

Another issue raised against forestry development was water consumption.

⁶Based in Japan Forestry Agency / FAO Production Yearbook 1997

Although the country has an even distributed rainfall of 1300 mm/year, and most of the water scours as surface water, some opinions considered that forestry was boosting land desertification.

In Table 3, it is shown that 1 ton of wood consumes some 350 tons of water, but alternative agricultural uses consume for each ton, 10 times more water.⁷

These figures may seem to be water intensive consuming, but water is evapotranspired to the air and returns to the system, so actually, only a small part, about 50% of wood weight is retained in the wood, and even less is retained after drying when harvest and manufacturing.

Table 3 Water consumption in agriculture

WATER EFFICIENCY IN AGRICULTURE
1 kg SUNFLOWER / 3250 l *
1 kg POTATO / 2000 l **
1 kg SOYBEANS-WHEAT / 1700 l ***
1 kg CORN / 1000 l **
1 kg SUGAR / 500 l **
1 kg WOOD / 350 l **

Some local and regional research, has proven that evaporation of soils moisture and evapotranspiration in grasslands (the natural coverage) in mild climate may be even much more intensive than in forestry areas.

As far as related to underground water, it has been proved an increase of clay in the soils B horizon, that reduces permeability, but there is evidence that roots may increase permeability so the balance sheet may still reach an even point.

Research is on the way to determine the water balance sheet of forestry areas for mild climate, between rainfall, surface drainage, underground water, evapotranspiration and soil evaporation in forest areas and wood constituent water.

⁷ * Sunflower hidric behaviour – www.asagir.org.ar/fo liar.asp#hidrico

** Novas et al, 1996 – IPEF

*** Rébori, M, 2003 – (7 months sequence)

Forestry is a strong consumer of calcium but is not a strong consumer of other minerals.

Bark is a stronger consumer of Ca than wood itself. But although forestry is a high calcium consumer, it is much less than the alternative crops consumption such as soybeans. Grains are, instead, high consumers of N, P and K.

So if forestry needs calcium, soil repairing will mean to supply calcium to compensate soil loss, a mineral locally available and cheaper than fertilizers for agriculture.⁸

Table 4 Minerals consumption

Species	Period	Components	Biomass (t/ha)	Nutrients consumption (kg/t)				
				N	P	K	Ca	Mg
Eucalyptus grandis	10	M	160	0,8	0,02	0,6	1,7	0,5
		C	23	3,0	0,27	3,0	3,1	1,0
E. grandis	6	M	62	2,3	0,11	0,8	0,5	0,2
		C	11	3,4	0,76	6,0	7,9	1,4
E. saligna	10	M	129	0,9	0,23	0,6	0,8	0,1
		C	8	3,1	1,51	6,0	9,5	3,9
Corn	Cicle	Grains	5	23,0	5,60	7,0	0,4	2,0
Soybean	Cicle	Grains	3	66,7	8,67	19,0	3,3	3,3

Biodiversity harm has been other question raised against forestry.

No doubt that eucalyptus or pines change the natural vegetal conditions of surface coverage, so it is possible that some impact may occur to biodiversity, in any case limited due to the relative small forest area.

But it happens that up to date, the impact has not been identified after 20 years of research and field surveying. On the contrary, it has been surveyed an increase in the number of local species per unit area and even some species considered to be extinguished and restricted to the riversides of the Rio Uruguay, are today widespread in the forestry areas.

⁸From de Moraes Gonçalves, JL – Recomendações de Adubação para Eucalyptus, Pinus e Espécies Típicas da Mata Atlântica. Instituto de Estudos e Pesquisas Forestais - IPEF. 1995

Forestry is a positive mean for carbon fixation and reducing greenhouse gas effects. Uruguay is considered as one of the better ranked countries in both per capita greenhouse gas emissions (due to poor industrialization, reduced fossil fuels and high hydroelectric energy matrix) and high carbon fixation due to forestry development, much more significant if related to deforestation in the region in favor of croplands, mostly in Brazil, Paraguay and Bolivia.

Carbon fixation by 1990 for a 100 years forecast was 2 Tg of equivalent CO₂ and by 2000, as a result of forestry it was increased to 12 Tg and it is estimated that today is reaching 20 Tg, almost the same as greenhouse gas emissions.

Table 5 Greenhouse gas emissions and C fixation

Potential for atmosphere heating (PAH) of the emmissions of greenhouse gas effects in Uruguay, considering a 100 years period (National Inventory of Greenhouse Gas, MVOTMA, 1997)

YEAR	CO ₂	CH ₄	N ₂ O	TOTAL
Tg CO ₂ EQUIVALENT #				
EMISSIONS 1990	7##	14,6###	10,5####	32,1
FIXATION 1990	2			2
FIXATION 2000	12,2			12,2

&

1Tg means 1:000.000 tons

51% from fossils fuels combustion and 30% from biomass combustion

84% from livestock emerging fermentation

92 % from livestock droppings and biological soils processes

& Information not included in the Inventory. Estimated for 300.000 há of new forest between 1990-2000.

More important than removing unproved environmental question marks, are the regulation development to secure sustainable development, be it enforced by laws and decree as well as meeting demand for environmental standards requirements. A National Code for Good Forestry Practices, regulations adjusting forest priority areas, and the Environment Protection Law (requires an EIA for more than 100 há projects) are part of the mandatory legal framework.

As far as the market requirements, ISO 14000 standards is widespread and Forest Stewardship Council Regulations-FSC requirements are met by 450.000 hectares already certified.

And continuous monitoring of air, soils and water will secure adequate practices for sustainable development of forestry and industry.

FINAL REMARKS

As it has been exposed, Uruguay has experienced a forestry revolution, be it in economics or environment, and it has been for good.

Engineering has been a main actor in the scene and research, development and innovation have triggered the engineering local capacity.

It has involved all the engineering practices, and particularly, agronomics and biology engineering, civil engineering, road engineering, ports engineering, transport engineering, logistics, industrial and chemical engineering and environmental engineering.

It has been a challenge for the Academy to encompass this revolutionary process and support sound engineering criteria, in any of the areas, but particularly assessing the Government in the international conflicts with Argentina where the academic point of view was shared with the colleagues from Argentina, because reason and knowledge does not know about political borders, both are always trying to surpass borders of ignorance.

Still much to be continued, but the country is on the way, in the green way of hope.