'GUANARÉ' FOREST PLANTATIONS ON DEGRADED GRASSLANDS UNDER EXTENSIVE GRAZING

Document Prepared By Carbosur

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1 PROJECT DETAILS

1.1 Summary Description of the Project

The project will comprise a total of 21,298 ha of land previously under extensive grazing by beef cattle, on which forest plantations for obtaining high-value, long-lived timber products and for sequestering large amounts of carbon dioxide from the atmosphere will be established.

Forests will be based mainly on *Eucalyptus grandis* and to a lesser extent *Eucalyptus globulus, Eucalyptus dunnii, Eucalyptus maidenii and Pinus taeda* plantations in 22-year rotations, managed with pruning (to a minimum height of 12 m) and two to three thinning operations, to obtain knot-free, high-diameter logs suitable for saw-milling and veneering. Plantation will be completed by year 5 of project and forests will be replanted after clear-cut harvest. Practices will be compatible with FSC standard for sustainable forest management. Planted forests will remove carbon dioxide from the atmosphere and store it in different carbon pools (living above-ground and below-ground biomass, soil, litter, non-tree vegetation, dead wood and harvested wood products). Monitoring will cover carbon stock changes for living above-ground, litter and dead wood pools. Below ground biomass will be estimated indirectly based on above-ground biomass measurements. Non-tree vegetation and harvested wood products will not be accounted as per the methodology applied. The potential non-permanence of stored carbon will be considered by the non-permanence risk analysis and buffer determination, and by the fact that a significant fraction of the sequestered carbon will be stored in long-lived products which will not be accounted.

The baseline study determined that continuation of extensive grazing is the most likely use of the land. Additionality is demonstrated through the fact that the expected internal rate of return of the proposed project activity without considering carbon finance is lower than the benchmark internal rate of return for this type of investment in Uruguay. In addition, barriers analysis and common practice analysis showed that afforestation in the area of the proposed project activity is not likely to occur without carbon financing.

The project will result in a significant contribution to sustainable development of Uruguay, mainly through: i) increased employment and quality of employment; iii) rural development (decentralization); iv) increased gross value of production; v) improved fiscal balance; vi) biodiversity preservation and vii) improvement and preservation of soil quality.

Project activity consists in the establishment of forest on land that had previously been under grassland for more than 300 years. It will be developed under the VCS scope 14: “Agriculture, Forestry and Other Land Use” as an “Afforestation, Reforestation and Revegetation project. ‘*Guanaré*’ afforestation on degraded grazing land is a single GHG Project.

1.2 Sectoral Scope and Project Type

The activity implemented by the project is the establishment of forests on land that had previously been under grassland for more than 50 years, and therefore corresponds to the VCS category Afforestation, Reforestation and Revegetation (ARR). *‘Guanaré’ forest plantations on degraded grasslands under extensive grazing* is a single GHG Project.

1.3 Project Proponent

The project is proposed by *Guanaré SA* (hereinafter called *Guanaré*) on behalf of itself and *Guanaré AARL*, which are the owners of the land. Contact details of *Guanaré SA* are the following:

Rincón 487/201

Montevideo 11.000, Uruguay

Phone: (00598) 29162510

Guanaré's main activity is the implementation of livestock-forest-environmental projects on purchased land. All activities related to forest investments, marketing and management of *Guanaré* are implemented by a local company (*Forestal Atlántico Sur SA*, hereinafter called FAS), through contractual agreement. FAS was established in 2005, and its partners are highly experienced in managing forests.

All properties of *Guanaré* are legally owned and are covered by deeds duly registered with the National Records, registered with the corresponding number for the Registration of Real Estate. There are no conflicts related to tenure or use rights over the land affected to the project or its products.

1.4 Other Entities Involved in the Project

Guanaré has a contractual agreement with FAS for the management of its investment. FAS is internally well structured, with experienced staff in the area of forest investments, forest management and trade of timber. Internal organization chart and other information are made available for the validating team.

Carbosur has a contractual agreement with Guanaré for the development and management of the carbon component of the project. It is not a project proponent.

1.5 Project Start Date

The project start date is 24 April 2006, when the activities that lead to the generation of GHG emission removals (preparing land for planting) were first implemented.

1.6 Project Crediting Period

Project crediting period will be of 60 years, from 24 April 2006 to 24 April 2066.

1.7 Project Scale and Estimated GHG Emission Reductions or Removals

Guanaré Forest Plantations on Degraded Grasslands under Extensive Grazing is classified as a "project", according to its scale: it will remove a total amount of 7,644,973 tCO_2 in a period of 60 years. This means an average of 127,416 tCO_2 per year.

Table 1 *Estimated GHG emissions removals*

Project	X				
Mega-project					
Years	Estimated GHG emission reductions or removals (tCO_2e)	Years	Estimated GHG emission reductions or removals (tCO_2e)	Years	Estimated GHG emission reductions or removals (tCO_2e)
2006	3,128	2029	179,156	2052	-3,944,142
2007	20,498	2030	-3,165,964	2053	-3,266,852
2008	80,697	2031	-2,620,334	2054	-2,160,043
2009	414,306	2032	-1,740,208	2055	879,377
2010	573,861	2033	705,873	2056	431,358
2011	691,379	2034	346,848	2057	1,377,266
2012	783,242	2035	1,105,860	2058	688,657
2013	937,138	2036	553,019	2059	707,176
2014	493,100	2037	568,561	2060	764,097
2015	506,262	2038	613,422	2061	1,246,131
2016	541,448	2039	1,000,940	2062	1,037,381
2017	853,148	2040	833,370	2063	167,749
2018	718,617	2041	134,441	2064	164,804
2019	156,611	2042	133,228	2065	558,911
2020	156,788	2043	447,794	2066	1,284,529
2021	407,551	2044	1,031,617	2067	932,988
2022	877,639	2045	749,514	2068	-311,043
2023	651,238	2046	-249,940	2069	-166,562
2024	-152,042	2047	-132,639	2070	196,643
2025	-56,544	2048	156,655	2071	1,124,484
2026	170,339	2049	902,981	2072	872,488
2027	754,367	2050	700,815	2073	271,915
2028	577,165	2051	218,898	2074	-4,918,053
--	--	--	--	2075	-4,203,111
Total estimated ERs					**7,644,973**
Total number of crediting years					**60**
Average annual ERs					**127,416**

1.8 Description of the Project Activity

The project comprises a total area of 21,298 ha with a long history of grazing by beef cattle, activity that have caused soil erosion and land degradation. Forest plantation for obtaining pulp and saw wood and removing carbon dioxide from the atmosphere are being established since 2006.

The project activity is implemented on degraded land, which is expected to continue to degrade in the absence of the project and hence the land cannot be expected to revert to a non-degraded state without human intervention.

Forests consist of *Eucalyptus grandis* and to a lesser extent *Eucalyptus globulus, Eucalyptus dunnii, Eucalyptus maidenii and Pinus taeda* plantations managed with a rotation length of 22 years (one of the properties is expected to have a 16 year rotation). The plantations are established on land previously used for cattle grazing. The implementation of the project activity will not cause any displacement of cattle.

The main objectives of the project activity are wood production, land restoration and carbon sequestration through afforestation. Forest plantation will be completed by year 5 of project and forest will be replanted after clear-cut harvest. Project crediting period is 60 years and project lifetime is 100 years. All practices will be compatible with FSC standard for sustainable forest management.

Planted forests will remove carbon dioxide from the atmosphere and store it in different carbon pools (living above-ground and below-ground biomass, soil organic carbon, litter and dead wood). All these carbon pools will be accounted towards issuance of VCUs. However, due to methodology provisions, only above ground biomass, litter and dead wood will be monitored.

Following are the main features of plantation and forest management technology to be applied in *Guanaré* project:

Preparatory activities

• Site survey is performed based on aerial photographs, soils maps, digital terrain elevation maps, soil survey study and other sources of information. All the information was laid out on a Geographic Information System (GIS). Project GIS layers include cadastral identification, project boundaries, project strata, roads, fauna corridors, conservation areas and other relevant polygons or vectors.

• adjustment of GIS based on GPS data;

• Soil study is performed, including the preparation of a semi-detailed soils map of the property. Soil features among other parameters area analyzed indicating the forest aptitude of the site.

• A nursery is selected;

Site preparation

• Ant control over the whole area, using chlorine-free insecticides with reduced permanence in the ecosystem (insecticides are selectively applied on ant paths and nests (this continues until several months after plantation);

• Vegetation control by using glyphosate, an environmentally friendly herbicide (glyphosate can be applied over the whole area or just over 1-m wide strips where the tree rows will be located, depending on site-specific conditions);

• Soil tillage is done on the strips where the trees will be planted. The number of passes varies according to site specific conditions following the land contour. In-row deep tillage (sub-soiling) may be required in many cases. Soil disturbance is limited to site preparation before planting and is not repeated in less than twenty years.

• Herbicides may be necessary before planting (depending on site specific conditions and on tillage tools used); it is likely to combine glyphosate (to control existing vegetation at the time of planting) with pre-emergent herbicides (e.g., oxyfluorfen) to ensure a weed free environment for the establishment of seedlings;

Planting and fertilization

• The site is manually planted with 1,100 seedlings per hectare in rows spaced every 4 m

- Fertilization is applied around each seedling;

- Seedling establishment and survival control and reposition shall be monitored within the firsts few weeks after planting, checks are performed to identify and replace lost seedlings;

- Weed control continues for several months after planting (i.e., until the end of the first summer); this includes localized glyphosate spraying around each tree (using protective screens to avoid the herbicide coming into contact with the trees), and/or mechanized weed control of the inter-row areas.

- Planted forests will cover 50 to 60% of the total area of land owned by '*Guanaré*', with the rest being used mainly for grazing. Grazing will also occur within the forest stands.

Forest Management and livestock

- Permanent sampling plots are established at the beginning of forest management activities. A Continuous Forest Inventory will be established in order to monitor forest development, tree growth, forest health, fire risks and other common forest practices.

- Forest health is checked periodically. Corrective measures could be applied, such as an extra application of nutrients or the removal of trees which are unhealthy, dried up, twisted or bended.

- The first thinning will be at the year seven after planting, the operation will remove less than half of the volume, including those with thinner stems and badly shaped. A relatively reduced volume of low-priced merchantable wood will be obtained due to reduced wood volume of harvested trees. Felling will be mostly manual (i.e., using chain saws). All residues, including bark will be left on site.

- By the third year after planting, pruning activities will be conducted over the remaining trees. The height of pruning will be 2.5 m above ground, manual saws or pneumatic scissors will be used and all residues will be left on site;

- In the fourth year a second pruning of 450 trees, to a height of 5 m will be performed. Likewise, all residues will be left on site;

- The third pruning will be done five years after plantation to a height of 7.5 m. All residues will be left on site.

- The fourth pruning -until a height of 9 m- will be performed on selected trees (195), on the sixth year after planting. All residues will be left on site.

- The second thinning will be conducted at the twelfth year after planting. A relatively important volume of medium-priced merchantable wood will be obtained through totally mechanized operation. All residues, including bark will be left on site.

Final harvest

- Clear-cut harvest is planned to occur around the year 22 after planting; an important volume of high-priced merchantable wood will be obtained; this operation will be completely mechanized and all residues, including bark will be left on site.

- Site preparation for re-planting starts immediately after clear-cut harvest; tillage will be performed on the inter-row spaces, where the second-rotation trees will be established.

1.9 Project Location

The following map (Fig.1) shows the exact location of the project, and the cadastral units owned by *Guanaré*, where the project will be located.

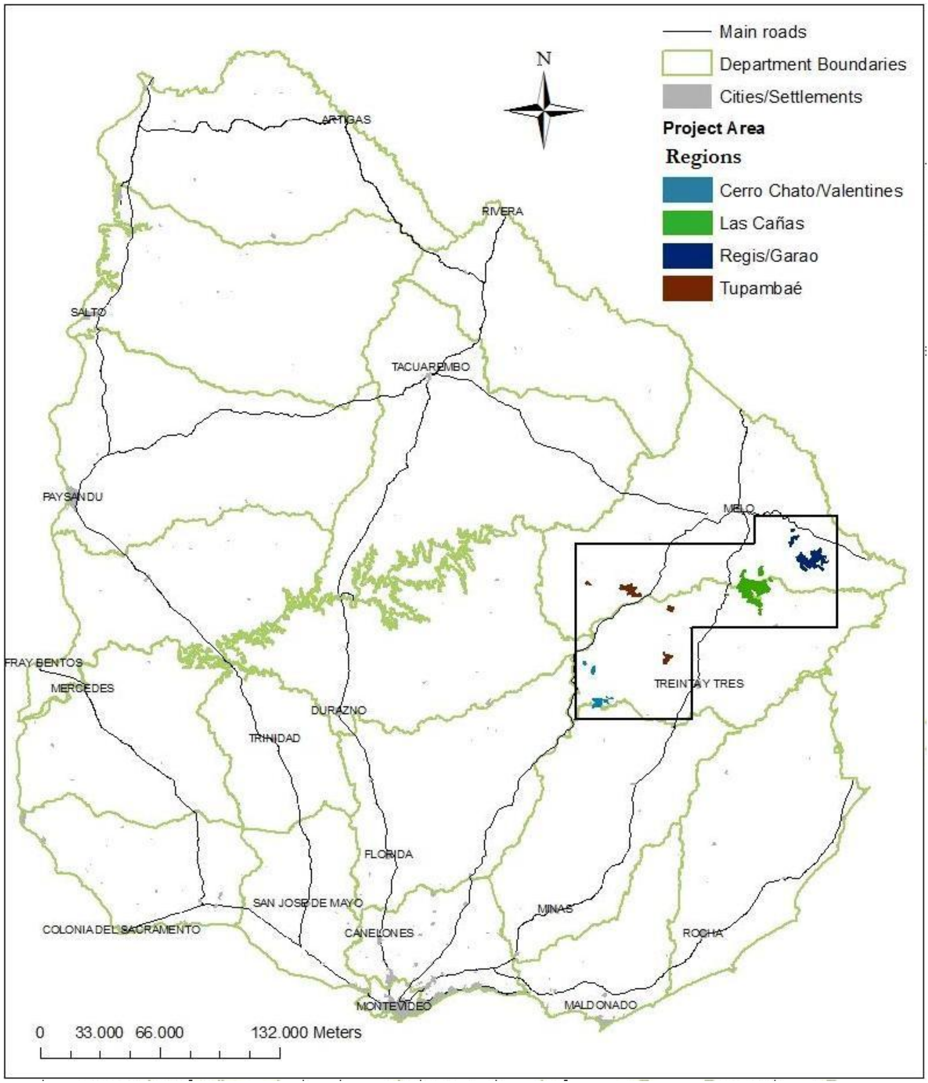


Figure 1*. Map of Uruguay showing the location of the areas included in the proposed project activity (black frame).*

For the purpose of defining the strata, the project area has been divided into four regions, which are shown from Fig 2 to Fig 6. The areas are homogeneous in terms of soil types, climate, land use history and socio-economic conditions. The division into four regions is entirely based on geographic location.

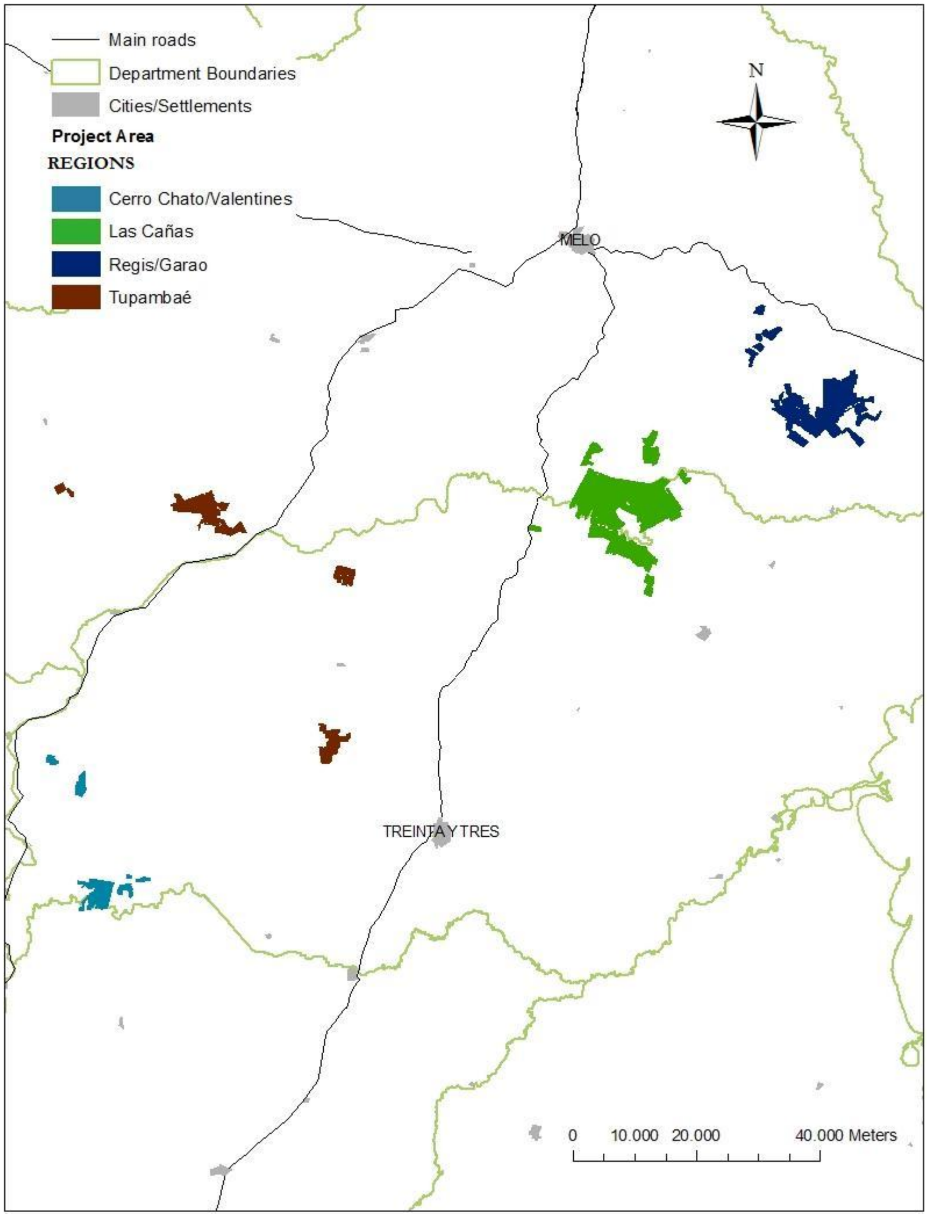


Figure 2. *Map indicating the four project regions divided in four different colors.*

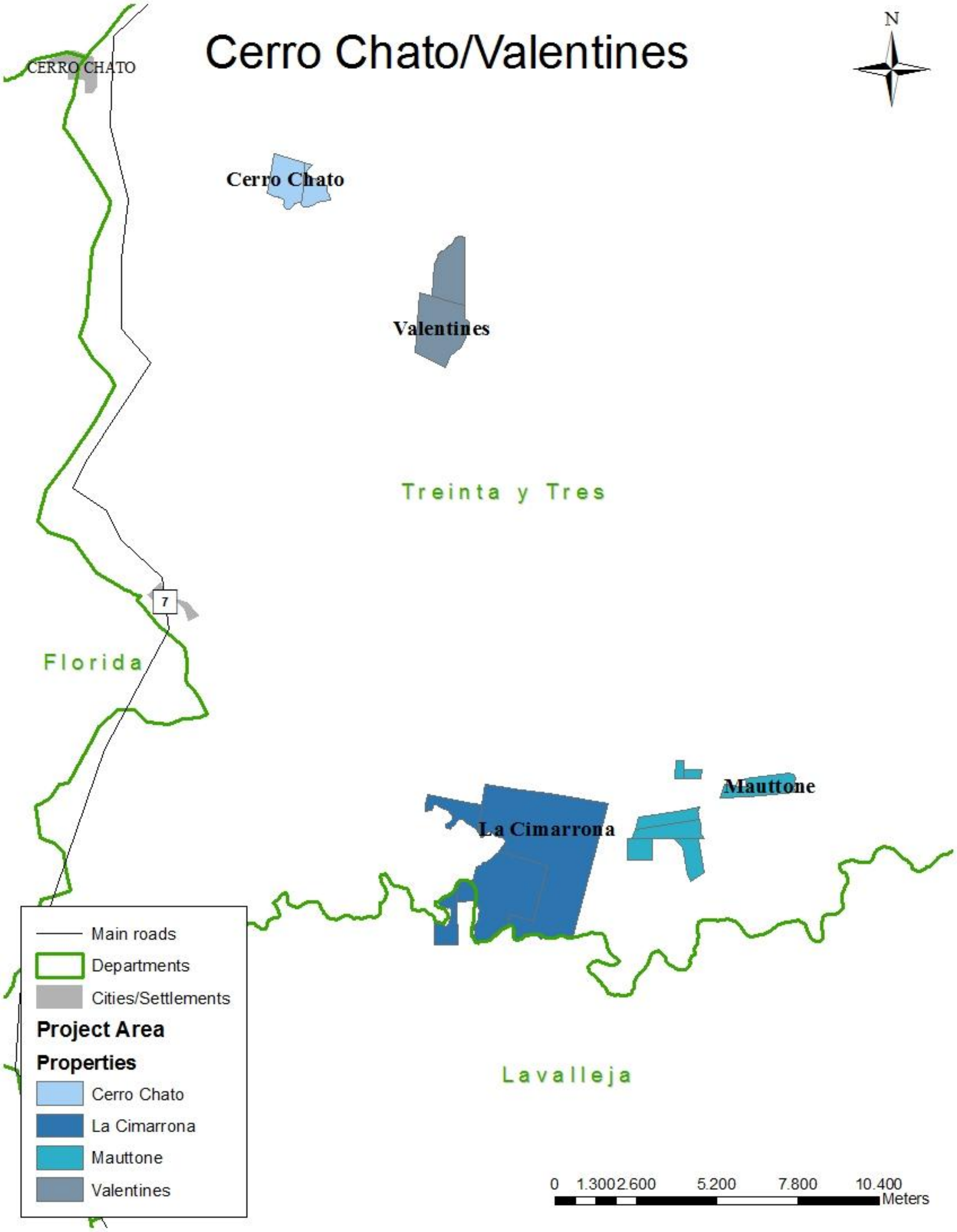


Figure 3. *Location of properties which make up the region Cerro Chato/Valentines*

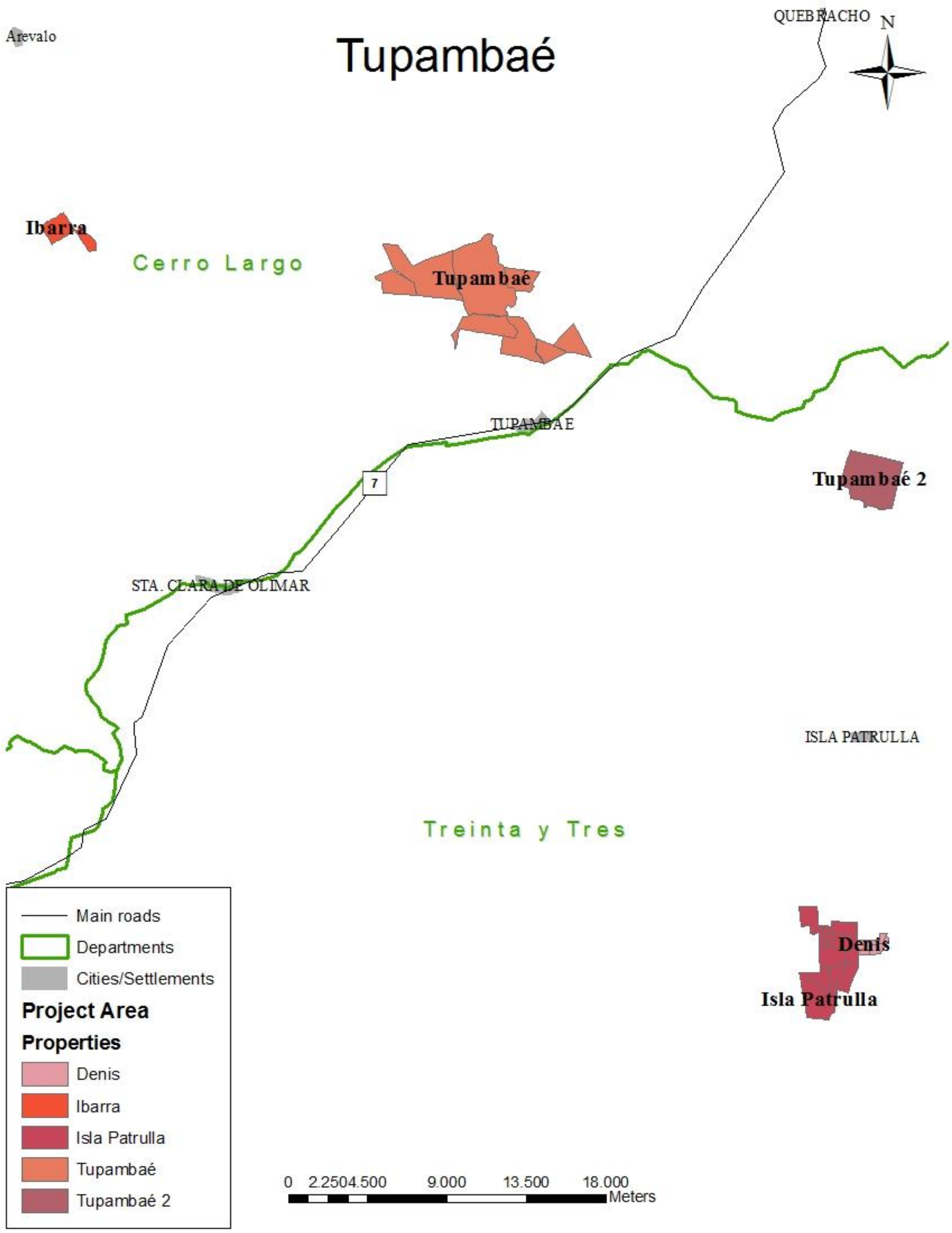


Figure 4. *Location of properties which make up the region Tupambaé*

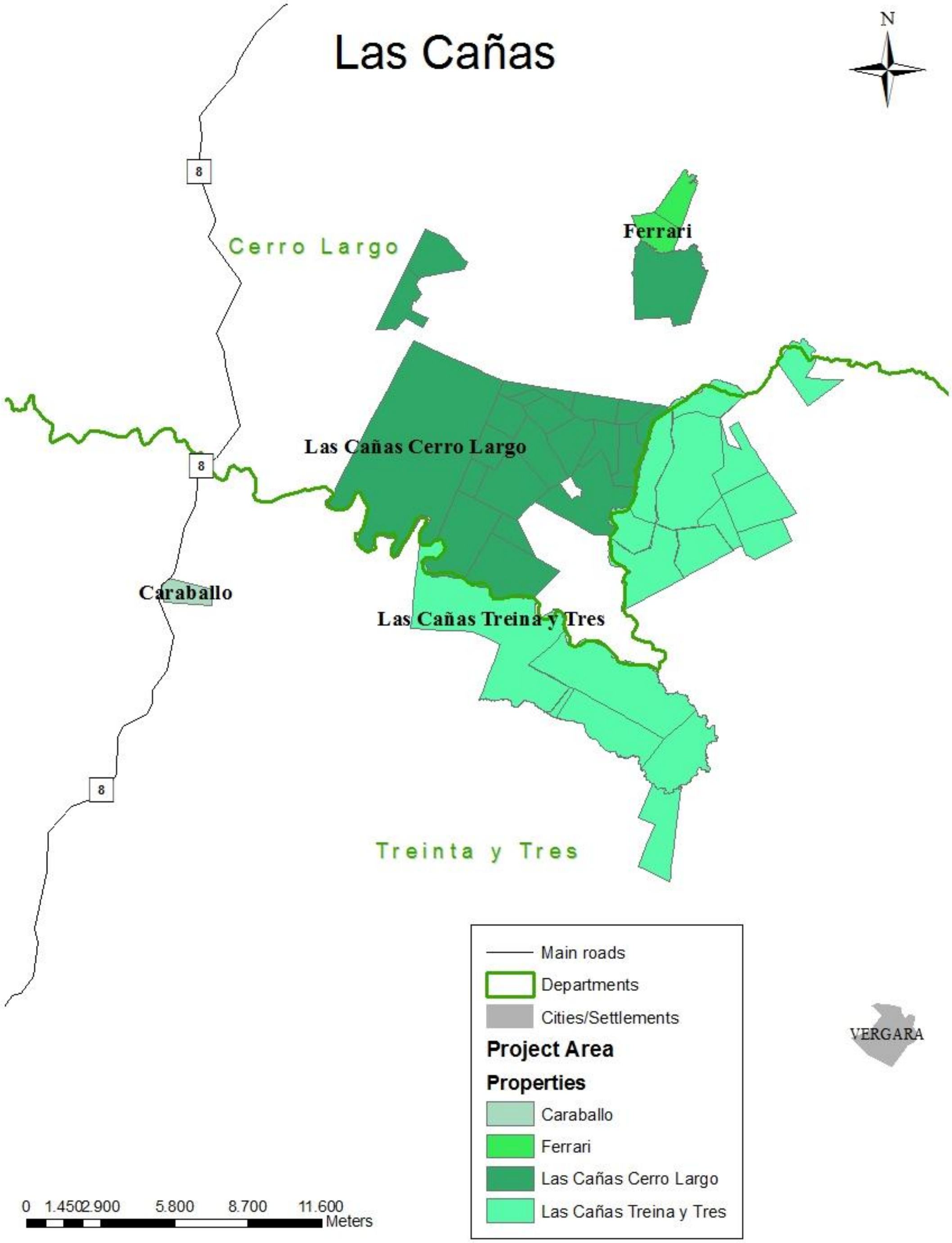


Figure 5. *Location of properties which make up the region Las Cañas*

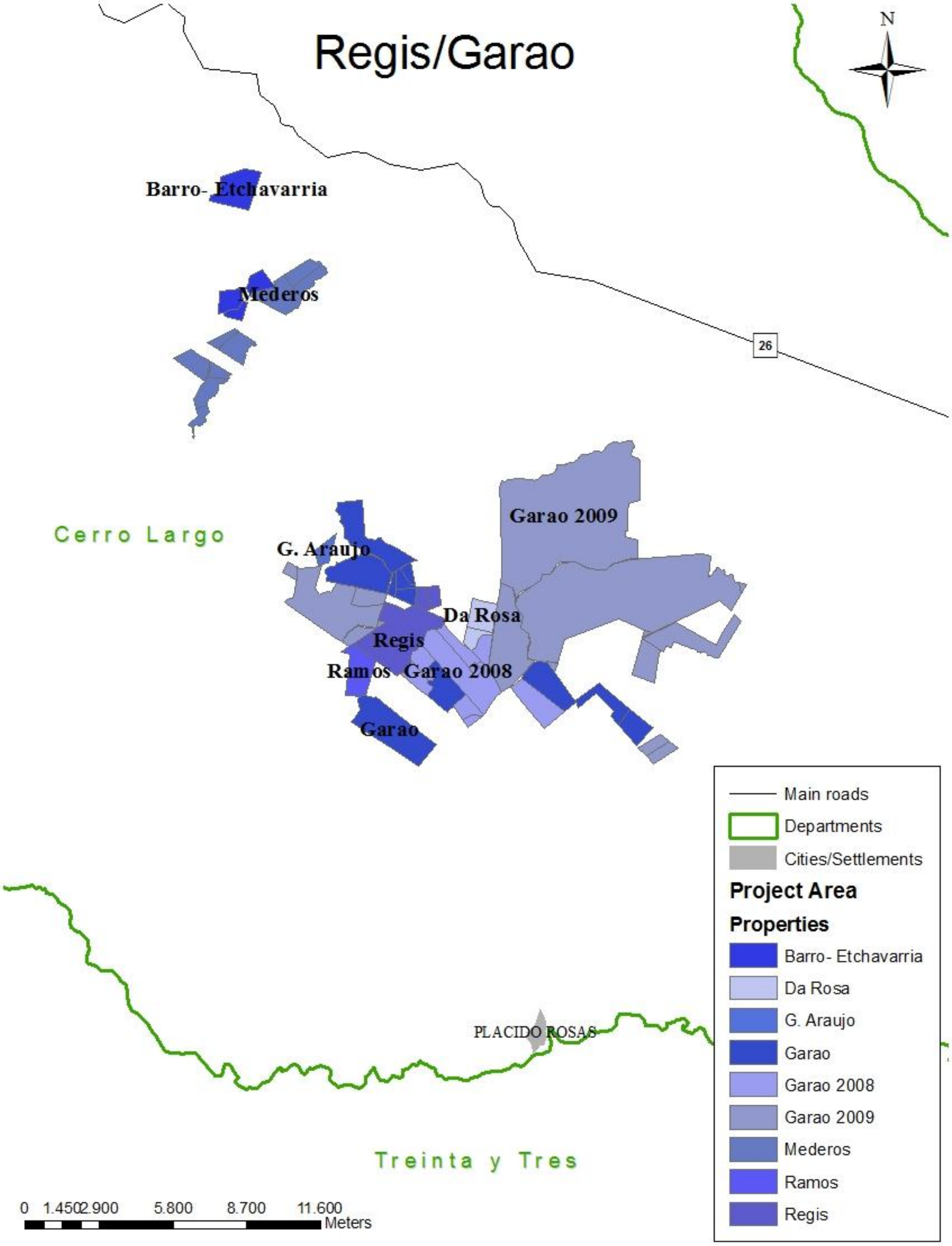


Figure 6. *Location of properties which make up the region Regis/Garao*

Table 2. *Indicators for unique identification of all project properties*

Region	Property name	Cadastral Unit N°	Area planted	Coordinates		Region	Property name	Cadastral Unit N°	Area planted	Coordinates	
Cerro Chato/ Valentines	La Cimarrona	2124	660	33°18´50.34"S	54°58´36.53"O	Las Cañas	Azotea de Ramírez	1809	615	32°42´38.83"S	54°06´28.30"O
		3465	281					4713	183		
		9115	35					4714	254		
		11593	8					6763	132		
	La Cimarrona -EXT	1956	37	33°18´50.34"S	54°58´36.53"O			6764	339		
	Mauttone	2085	62	33°18´41.42"S	54°54´52.99"O			6765	195		
		2086	48					6766	89		
		2092	9					6767	164		
		2094	71					6768	239		
		2119	44					6820	144		
		7457	12					7442	138		
		9663	53					12383	364		
	Salto de Agua	3894	42	33°07´49.17"S	54°04´13.17"O		Azotea Norte - VAZ	6409	411	32°41´26.65"S	54°01´54.82"O
		3895	68				Caraballo	9451	99	32°42´38.83"S	54°06´28.30"O
	Valentines	6069	186	33°11´26.39"S	55°00´42.42"O		El Yugo	778	729	32°42´38.83"S	54°06´28.30"O
		8173	104					779	66		
Regis/ Garao	Barro-Echevarria	2101	48	32°29´28.80"S	53°50´07.65"O			780	926		
		9605	44					2425	324		
		15416	24					5941	243		
		15812	138				Ferrari	999	115	32°42´38.83"S	54°06´28.30"O
	Carballo	3307	3	32°38´13.76"S	53°43´55.86"O			4723	109		
		3689	52				Las Cañas	892	1724	32°42´38.83"S	54°06´28.30"O
		6212	228					6401	147		
		12670	14					8538	115		
		13111	45					11294	69		
		13112	10					11295	59		
		13368	48					11296	149		
		14932	38					11297	115		

Region	Property name	Cadastral Unit N°	Area planted	Coordinates		Region	Property name	Cadastral Unit N°	Area planted	Coordinates	
		15059	43					11353	120		
	Casas	6254	75	32°38´13.76"S	53°43´55.86"O			11354	89		
		9619	122					11355	126		
		15595	74					11356	120		
	Da Rosa	12689	75	32°38´13.76"S	53°43´55.86"O			11357	32		
		14931	22					12376	207		
	Derley González	2085	329	32°38´13.76"S	53°43´55.86"O			12377	326		
		5345	43					12378	338		
		7810	11					12384	291		
	G.Araujo	16435	31	32°38´13.76"S	53°43´55.86"O			12470	58		
	Garao Norte	2313	32	32°38´13.76"S	53°43´55.86"O			12484	91		
		3348	21					13220	190		
		10284	20					15349	143		
		15655	184			Tupambaé	Ibarra	4860	131		
		15656	187					16441	49		
		15657	11					321	81		
	Garao Sur	12857	287	32°38´13.76"S	53°43´55.86"O			335	40		
		15058	90					341	73		
	Julio González	15471	33	32°38´13.76"S	53°43´55.86"O			348	67		
		15596	26					4776	244		
	Mary Lopez Ramos	6235	79	32°38´13.76"S	53°43´55.86"O			5188	43		
		7549	182				Isla Patrulla	5189	58	33°05´44.31"S	54°32´46.83"O
	Mederos	2106	105	32°29´19.35"S	53°48´47.12"O			5190	18		
		2204	40					5371	67		
		4093	34					5661	44		
		8463	87					5662	31		
		12188	47					7285	47		
		12189	19					7523	14		

Region	Property name	Cadastral Unit N°	Area planted	Coordinates		Region	Property name	Cadastral Unit N°	Area planted	Coordinates	
		15958	53					7524	14		
		15959	22					7525	8		
	Méndez	9618	125	32°38´13.76"S	53°43´55.86"O		Tupambaé	426	81	32°48´20.11"S	54°45´26.78"O
	Ramos	10240	100	32°38´13.76"S	53°43´55.86"O			14549	396		
	Regis	2078	306	32°38´13.76"S	53°43´55.86"O			15682	97		
		3732	23					15685	472		
		3906	24					15686	620		
	Santa Sofía	2072	2369	32°38´13.76"S	53°43´55.86"O			15687	135		
							Tupambaé2	512	331	32°52´02.75"S	54°34´11.97"O

1.10 Conditions Prior to Project Initiation

Topography of the area consists of rolling hills with less than 300 m altitude, with abundant water streams. The mean annual temperature is 18 ºC, varying from 12 ºC (July) to 25 ºC (January). Night frosts occur during the winter (from mid-May to early October), with an average of 30 days with frost per year, with temperatures seldom falling below –5 ºC. Annual precipitation in the area ranges from 1,100 to 1,300 mm, homogeneously distributed along the year, although periods of severe drought and severe water excess are rather frequent. Potential evapotranspiration is about 900 mm/year. Runoff and drainage are on average in the order of 300 mm/year, feeding an extensive network or rivers and the Guaraní Aquifer, one of the largest of the world.

Soils are generally not very deep, of medium-to-coarse texture, with low natural fertility. Dominant land cover in the area is grassland, with predominance of herbaceous vegetation (mainly grass species) with interspersed and not very abundant shrubs. The vegetation is highly determined by land use (grazing of cattle and sheep). Native vegetation before cattle was introduced in the XVII Century, was richer in shrubs and small trees, although grass and other herbaceous species were also abundant. In spite of high rainfall level and quite fertile and deep soils, trees appear naturally only at the side of rivers and streams, covering only 3 to 5 per cent of the land area. This has been attributed to the natural occurrence of frequent droughts which prevented slow growing trees from becoming established against an aggressive competition by grasses.

As it was stated above, the project area consists basically of grassland altered by many years of grazing. This would have caused a significant change in species, as well as some soil loss due to laminar erosion due to frequent over grazing. Due to the change in the regime of precipitation observed in recent years, with an increasing trend in both total precipitation and storm intensity, combined with the effects of overgrazing, particularly in dry periods, the soils in the project area would be subjected to increasing erosion and degradation pressures. The removal of vegetation by grazing cattle would also have caused a reduction in the annual inputs of organic carbon into the soil, thus causing a long-term reduction in the soil organic carbon content, which has been estimated at more than 20 per cent of the original soil organic carbon content.

This grazing-degraded grassland covers virtually all the project area. Associated with this, there are lowland, humid zones, with richer biodiversity and higher conservation value. The forests within the project boundaries will be planted on grazing-degraded zones, and it was designed with the objective of preserving the most valuable areas outside project boundaries but inside the land owned by ‘‘*Guanaré*’.

These conservation areas include natural forests alongside the rivers and minor water streams, composed by hydrophilic species close to the streams, and xerophytic species of shrubs and tall grasses surrounding them in a transition to the grasslands. These ecosystems have suffered alterations in the past, due to human intervention. Valuable tree species include *Salix humboldtiana*, *Sebastiana schottiana*, *Sapium sp.*, *Pouteria salicifolia* and *Erythrina crista galli*. Also, in the most humid areas *Lueha divaricata*, *Quillaja brasiliensis*, *Cupania vernalis*, *Ocotea acutifolia*, *Allophylus edulis*, *Sebastiana klotzschiana* and *Citharexylum montevidense* appear frequently. In intermediate zones, it is common to find *Schinus longifolius* and *Acanthosyris spinecens*, whereas the most common species in the drier zones are *Gochnatia malmei*, *Aloysia gratissima* and *Lithraea molleoides*.

Natural meadows found in this area are developed on hilly landscapes with shallow soils and a topography that determines a good drainage and runoff. Thus, meadows were affected by water deficit so vegetation is dominated by species with summer cycles; such as *Paspalum notatum, Setaria geniculata, Paspalum dilatatum* and *Axonopus compresus*. It can be found associated species providing forage in the rest of the year (*Stipa papposa, Stipa charruana, Briza minor, Aristida sp*.). Some larger sized species with more than 30 cm (*Baccharis trimera, Baccharis coridifolia, Eryngium paniculata* and *Eupatorium buniifolium)* could also be found.

On the other hand, favored by overgrazing, appears *Cynodon dactylon* which has been naturalized and has progressively colonized the soil, occupying the spaces left by species less resistant to trampling. Once established it gives no place, being considered as a noxious weed and as a sign of land degradation (decreased site productivity)

Guanaré project will be established with a long-term perspective, with the ultimate purpose of achieving long-term sustainability and improving soil quality. Sustainable timber and cattle production and climate change mitigation are part of *Guanaré's* objectives. The selection of forest management practices based on uneven lengths rotation cycles in a region far from timber markets is only possible with the additional carbon financing.

1.11 Compliance with Laws, Statutes and Other Regulatory Frameworks

The project activity complies with the National law and binding regulations, since forest investment has been approved by the General Forestry Directorate (entity of the Ministry of Agriculture, Livestock and Fishery) and the National Environment Directorate (entity of the Ministry of Housing, Territorial Planning and the Environment). The former ensures that the project activity complies with National Law N° 15.939 and all binding decrees and decisions[1], while the second granted the environmental authorization.

1.12 Ownership and Other Programs

1.12.1 Proof of Title

Notarial certificates stating that the land units within project boundaries are owned by the project developer will be provided to the validation team.

1.12.2 Emissions Trading Programs and Other Binding Limits

GHG removals generated by the project will not be used for compliance with binding limits to GHG emissions since such limits are not enforced in Uruguay, and there is no emissions trading program in place in the country.

1.12.3 Participation under Other GHG Programs

Guanaré is a new afforestation project and is not registered in any other GHG program.

1.12.4 Other Forms of Environmental Credit

The project will only generate credits from the storage of carbon in forest pools, and these are claimed only under the VCS program

1.12.5 Projects Rejected by Other GHG Programs

Guanaré afforestation is a new project and has not been rejected by any other GHG program.

1.13 Additional Information Relevant to the Project

Eligibility Criteria

'Guanaré is a single project.

[1] http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,417,O,S,0,,

Leakage Management

The methodology selected for the project activity identifies activity displacement as the only potential source of leakage. The project does not cause any displacement of activities. The only activity in the project area prior to the start date is extensive grazing by beef cattle, which continues to occur after project start. Therefore, there is no need for a leakage management plan or for leakage mitigation measures.

Commercially Sensitive Information

No commercially sensitive information has been excluded from the public version of the project description.

Further Information

Guanaré project activity consists of the afforestation of degraded lands under extensive grazing in the Northeast of Uruguay. This region is not only characterized for its reduced development in terms of infrastructure and industry, but also for its socio-economic situation. Guanaré project will contribute to the sustainable development of this region through the creation of quality employment and the production of timber that may eventually lead to opportunities for new services and industrial development in the area.

1. Background of forest activity in Uruguay

Uruguay has traditionally been a grassland country. Natural forests cover an area of only 0.8 Mha (4 per cent of total land area), and are mostly located on the margins of rivers. Tree planting was first introduced in the country in late 19th century. Small areas of *Eucalyptus sp.* were established in ranch farms, with the objectives of providing shade and shelter for the cattle, and obtaining wood for building fences and for cooking. Today, thousands of these small patches of trees are found all over the country. At the same time, pine trees, and to a lesser extent eucalypts, were established on coastal areas in the south to stabilize sand dunes. These coastal forests are not harvested, but are frequently disrupted by summer fires mainly caused by tourists. Together, forests planted in ranch farms and in coastal dunes add up to an area of 80,000 ha.

Commercial forest did not start until mid-20th century, when the first large scale plantations were established. These first investors included pension funds, small pulp mills, other private investors, and the National utility company (UTE). The first regulation that provided incentives for commercial forest plantations was a law passed in 1967 (Law No. 13723). The mechanism was a partial exemption on income tax proportional to annually planted area, which resulted in a doubling of annual planting rate to 2,750 ha/yr during the period from 1968 to 1979, when the incentive was abolished.

By 1988, commercial forests covered 31,000 ha of plantations distributed all over the country. Most of this area consisted in short-rotation eucalypts (10 years) and pines (25 years), planted with very precarious technology based on poor genetic materials, intensive soil tillage, mechanical weeding, and lack of use of fertilizers. Frequently, these plantations suffered from damage caused by cattle grazing on young stands. Growth rates were relatively low, and pulp logs, low-grade timber and firewood were the main products.

A major breakthrough in the history of Uruguayan forestry was the adoption in 1987 of a forestry promotion policy based on a set of instruments contained in Law No. 15,939. Regulations under this law required that forestry activity be based on projects subject to approval by Forestry Directorate, and forests be located on forest priority soils comprising nearly 3.6 million ha of low agricultural productivity and/or high susceptibility to erosion or degradation.

The central objectives of this policy were to create a new source of exports and a sustainable supply of firewood while protecting natural forests. This policy was highly successful, and resulted in a remarkable growth of forested area, with an estimated total investment, including a significant amount from foreign sources, of more than US$ 1 billion in the 1990's.

This new policy also marked a sharp change in the characteristics of Uruguayan forestry. New technological practices were adopted, resulting in better quality, more vigorous, and more homogeneous tree stands. Modern concepts, such as long-term planning, environmental management systems and social responsibility, were introduced in forest company management. Good sustainability standards were achieved, and several companies have obtained, or are in the process of obtaining, FSC or ISO 14,000 certification.

Annual plantation rate reached its maximum in 1998, with ca. 60,000 ha/year, continuously declined thereafter to less than 10,000 ha/year in 2003 and 2004, and increased again between 2005 and 2008 particularly due to the development of large-scale pulp mill plants and to the expectation of carbon finance availability for forests developed on sites with limited access to markets (e.g., in the Northeast of the country). The elimination of plantation subsidies and of tax exemptions occurred in 2005 were factors affecting negatively the investments in new forest plantations.

2. Least Developed Forestry Regions in Uruguay

After the forest promotion policy implemented in 1987, an extensive afforestation process occurred in the West and North regions of Uruguay, making use of the proximity to harbours, excellent soils and the availability of reasonably good infrastructure, services and relatively well-qualified labour force. This development was later followed by investments in forest industries. The Southeast region of Uruguay also saw the establishment of numerous forest plantations, mostly for production of pulpwood in short rotations lured by the proximity to Montevideo harbour, In spite of the availability of large areas with soils declared by the government as of forest priority, the Northeastern region of Uruguay (Departments of *Treinta y Tres* and *Cerro Largo*)was not considered as attractive by investors, mainly because of the long distance to harbours or industries, and also due to relatively poor quality of soils and infrastructure. Grassland under extensive grazing continued to be the dominant land use within this region.

According to the current legislation, the total extension of forest priority soils in the NE part of Uruguay is around 1,020,000 ha. This amount represents 45 per cent of the total area of *Cerro Largo* and *Treinta y Tres* Departments. However, according to official statistics, during the last 35 years only 6 per cent of that area was actually planted, mostly in the period during which plantation subsidies and soft credits from *Banco de la República* were available.

3. Lack of industries in the region

Wood primary industries currently in operation in Uruguay include sawmills, chipping plants, pulp and paper mills, wood preservation plants and plywood plants. Some of these industries –small sawmills and pulp/paper plants- were established well before the strong development of forest plantations of the 1990's. According to Pike Consultora Forestal there are more than 200 sawmills in Uruguay. The vast majority of these sawmills are extremely small, very inefficient units, which do not have a significant aggregated demand for wood. In general, the rest of those sawmill have a reduced scale, with the largest ones being *Urufor* (Rivera), *FYMNSA* (Rivera) and *Maserlit* (Rio Negro). The smaller sawmills are mainly concentrated in Paysandú and Montevideo and their surrounding areas.

In recent years, two new plywood plants have been established in Tacuarembó (*Weyerhaeuser Productos* and *Urupanel*). Both plants have similar size, and have a combined capacity to consume more than 400,000 m^3 of wood per year.

There are a few wood preservation plants scattered throughout the country, all of them small. The largest ones are *UTE* (State utility), located in Rincón de Bonete (Tacuarembó) and *Matra*, located in Trinidad (Flores).

The largest pulp mill currently operating in the country is *UPM*, established in 2007 (Río Negro), which has a capacity to produce 1.1 million tons of cellulose per year. Montes del Plata (an association of Stora Enso and Arauco) is building a 1.5 million t/year cellulose plant in Colonia, which will start operating in late 2013. In addition, there are two small pulp mills located in the Southwest part of Uruguay: *Pamer* in Mercedes (Soriano) and *Fanapel* in Juan Lacaze (Colonia). The combined productive capacity of these two plants is 120,000 t/year of pulp paste. Finally, there are four chipping plants in operation, with a combined capacity for processing 2.1 million m^3/year of round wood, located in Fray Bentos (1) and Montevideo (3).

As it can be appreciated in Fig. 7, all the current industries and mills present in the country that result in a possible market site for *Guanaré* wood, are located in the North, West and South regions. All of them, as well as the country's ports, are located at more than 300 km by road from the project site, thus imposing high transportation costs to the harvested wood.

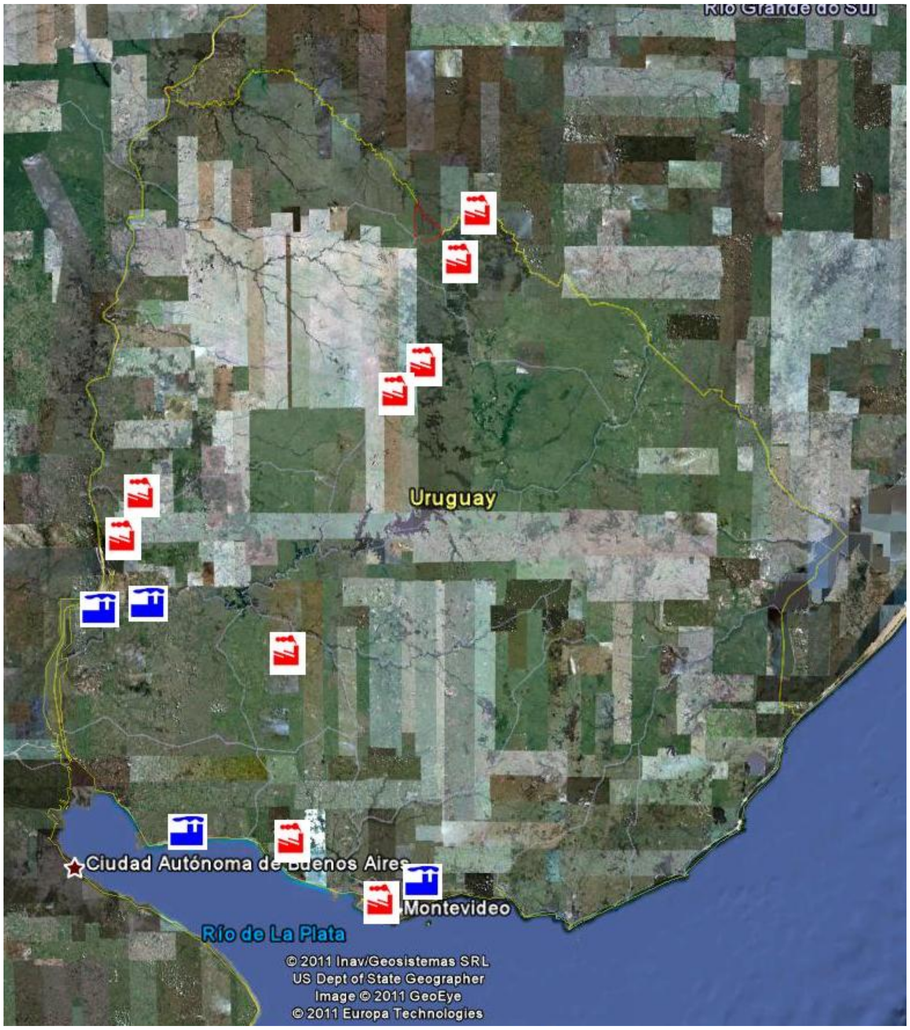


Figure 7. *Largest pulp mills and chipping plants (blue icons) and sawmills (red icons) located in Uruguay*

4. Social issues related to the project activity

Rural poverty is the origin of the main social problems in Uruguay. The region where *Guanaré* has developed its project is particularly affected by a lack of development. Rural poverty has caused the internal migration from rural towns to precarious urban settlements in Montevideo and other cities, increasing marginality, criminality, lack of education, drug-addiction and other social problems. The region around the project site has a dominance of an extensive livestock system of production, which is characterized with a very low productivity level, very low employment, and precarious working conditions and reduced opportunities for women and youth, among other problems. '*Guanaré*' forest activity is expected to increase the gross value of production per unit area of land by six to eight folds, besides promoting a number of new activities which will multiply this impact.

Creation of employment is one of the main social benefits of the project. Typically, an extensive livestock production system employs 1.4 persons every 1,000 ha. *Guanaré* project is expected to multiply that figure by more than 10.

Beyond an increased number of jobs, the project is expected to contribute to the development of the region and the country pursuant the priorities defined by Uruguayan government (promotion of small family businesses, increase in exports, eradication of rural poverty, incorporation of technology, increased nationally added value, development of new productive chains and geographic decentralization of development) as follows:

- Promotion of small family businesses

As it was mentioned above, '*Guanaré*' project activity will generate several job opportunities, creating nearly 1,000 job positions when the sustainable production be reached. The vast majority of employees will be hired by contractors. The majority of the outsourced contractor companies currently working with *Guanaré*, are registered in Uruguay as "PYMES" (small and medium sized companies), mostly family companies.

- Internationally tradable products

The entire production of *Guanaré* project (wood, meat and carbon credits) will have the international market as the final destination.

- Eradication of rural poverty

The main contribution of *Guanaré* project activity to the eradication of rural poverty will be through the generation of high quality and stable employment, in a region of Uruguay with elevated levels of poverty. A study by Carámbula and Piñeiro (2006)[2], demonstrate that forestry projects oriented to the production of high value timber, generates high positive impacts in the eradication of poverty in rural areas and reverting the process of internal migration to big cities.

- Incorporation of technology

The project incorporates the best available and affordable technology for optimizing wood productivity and quality through the selection of seeds, site preparation, plantation, weed and pest control, forest management and wood harvesting and logistics, and achieving sustainability objectives. *Guanaré* has a program for applied research, continuously testing various practices in order to achieve continuous improvement over time, and collaborates with other companies and public institutions in this regard.

- Increased nationally added value to forestry products

Guanaré project will produce timber that can be used for high-value products. As discussed above, currently there are no wood industries located within a reachable distance from the project site. However,

[2] Carámbula, M. y Piñeiro, D. La Forestación En Uruguay: Cambio Demográfico y Empleo en Tres Localidades

the presence of *Guanaré* and of other similar initiatives in the area which have already secured (*Posco Uruguay*) or are also seeking carbon finance (*GFP*, *Weyerhaeuser* and others) may induce in the future the establishment of industries in the region. And even in the case that no industries are developed, the saw logs and veneer logs produced by Guanaré could be exported through Montevideo harbour at prices which will be higher than those that could be obtained by selling pulpwood, which is the traditional wood product exported from Uruguay.

In addition, the forest management adopted by *Guanaré* would increase the amount of carbon sequestered by trees, thus increasing the carbon embedded value in wood products.

- Development of new productive chains

Guanaré has no plans to not invest in the industry sector. Nevertheless, as mentioned above, *Guanaré* forest plantation may contribute to promote the establishment of industrial investments in the area.

- Geographic decentralization of development

As it was mentioned above, Guanaré project will bring about a number of socio-economic benefits that will mostly impact on its surrounding area, which is currently one of the less developed ones in the country. This would create a development pole away from Montevideo and other areas which concentrate most of the economic activity in the country

2 APPLICATION OF METHODOLOGY

2.1 Title and Reference of Methodology

The consolidated CDM methodology AR-ACM0001 “Afforestation and reforestation of degraded land” (version 05.1.1, EB 60) was applied.

The following methodological tools, to which the selected methodology refers to, are used:

- Version 01 of “Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities”;
- Version 01 of “Combined tool to identify the baseline scenario and demonstrate the additionality in A/R CDM project activities”;
- Version 01 of “Tool for the identification of degraded or degrading lands for consideration in implementing A/R CDM project activities”;
- Version 03.1 of “Estimation of non-CO_2 GHG emissions from burning of biomass attributable to a CDM A/R project activity”;
- Version 01 of “Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity”;
- Version 01.1 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities”;
- Version 02.1.0 of “Calculation of the number of sample plots for measurements within A/R CDM project activities”;
- Version 01 of “Tool for testing significance of GHG emissions in A/R CDM project activities”;
- Version 01 of “Guidance on application of the definition of the project boundary to A/R CDM project activities”.
- Version 01 of “Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity”
- Version 01 of “Estimation of carbon stocks and change in carbon stocks in deadwood and litter in A/R CDM project activity”
- Version 02 of “Guidance on conservative choice and application of default data in estimation of the net anthropogenic GHG removals by sinks”

2.2 Applicability of Methodology

The selected methodology defines five applicability conditions. Following is an assessment of the application of those conditions to the proposed project activity, as well as a justification of the choice of the methodology.

1. Applicability conditions

   1.1 Degraded land

“The A/R CDM project activity is implemented on degraded lands, which are expected to remain degraded or to continue to degrade in the absence of the project, and hence the land cannot be expected to revert to a non-degraded state without human intervention”

The project will be implemented on degraded lands which are expected to remain in a degraded state in the absence of the project. Evidence is provided here showing that, due to extensive grazing activity practiced for more than 300 years, with frequent periods of overgrazing, lands have lost the original vegetation and a fraction of the soil organic matter, an essential component determining land productivity, leading to constraints to productivity, particularly in those areas affected by severe erosion. In addition, due to frequent periods of overgrazing causing the soil to become exposed to erosive processes (i.e., due to lack of vegetation cover) combined with dominating moderate slopes in the terrain, erosion gully processes have affected most of the lands within project boundaries.

Native vegetation in the project region was originally composed mainly by tall grasses and shrubs. The turnover of plant residues maintained relatively high levels of organic matter in the soil. Introduction of cattle in the 17th century brought about a degradation of the vegetation, which became dominated by grasses that were kept short by grazing, particularly after introduction of sheep a few decades later. The sheep and cattle extensive grazing activity has prevailed, more or less unchanged, until present. Due to the extensive nature, the production system is vulnerable to climate extremes, the relatively frequent droughts that occur in Uruguay (e.g., dry periods every summer, with extreme droughts every 10 years or so) are associated to overgrazing.

Grazing practices applied on all the lands included within project boundaries during long periods of time have resulted in significant losses of carbon, nitrogen, phosphorus and other nutrients from the soil, and have also resulted in significant alterations to the vegetation cover and the biological diversity.

The change in vegetation due to grazing reduced the turnover of plant residues and, consequently the organic matter content of the soil, thus leading to a more degraded state of soils. Some recent studies support this statement. Piñeiro et al (2006)[3] have found that 370 years of grazing have caused, on average for 11 grassland sites in Argentina and Uruguay, decreases in soil organic nitrogen content (−880 kg ha^{-1} or −19%), soil organic carbon content (−21,200 kg ha^{-1} or −22%) and net primary productivity (−2,192 kg ha^{-1} or −24%). The conditions in which this study was conducted match those of all the sites included in the project activity.

Another study prepared by Altesor et al. (1998)[4] arrived to similar conclusions. Five sample plots on grassland sites in North Uruguay were measured in 1935 and revisited in 1990. It was concluded that continued grazing causes an increase in the amount of weedy species and decreasing the palatable forage species. This is an indicator of a presently and continuous degrading process. The findings of this study are applicable to all sites included in the project activity.

The First Report of Uruguay to the UN Convention to Combat Desertification prepared by DINAMA (National Environmental Directorate) in 2000[5] states in its Section 2.1 that the way in which extensive grazing is practiced deteriorates the natural pasture due to the fact that it is based on the assumption that the natural grassland ecosystem can support mismatches between grazing pressure and forage availability induced by weather and/or market. The report also states that the strong fluctuations in the prices of major agricultural products hinder an adequate planning of the production units, which is

[3] Piñeiro, G., Paruelo, J.M. and Oesterheld, M. 2006. Potential long-term impacts of livestock introduction on carbon and nitrogen cycling in grasslands of Southern South America. Global Change Biology 12:1267–1284.

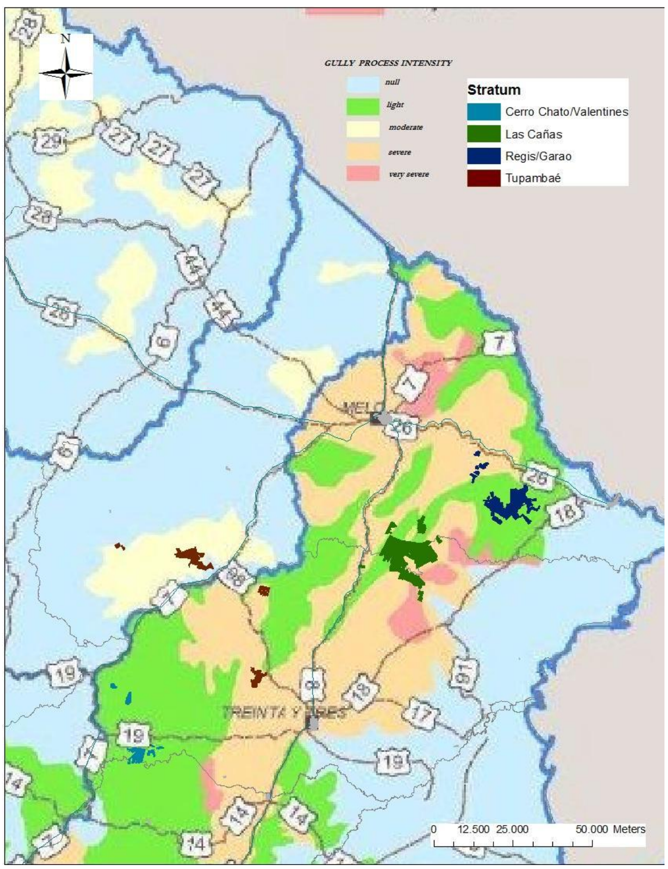
[4] Altesor, A., Di Landro, E, May, H. and Ezcurra, E. 1998. Long-term species change in a Uruguayan grassland. Journal of Vegetation Science, 9:173-180

[5] First National Report (2000) submitted by DINAMA (acronym in Spanish of Uruguayan National Environment Direction) to UNCCD (United Nations Convention to Combat Desertification)

essential for the conservation of natural resources. In Section 1.6 of this report, it is stated that the climatic variations frequently produce “forage crises” both in summer and winter times, resulting in overgrazing and a consequent loss of species. The concepts included in this report are valid for all land units included within project boundaries, since previous land use in all sites has been extensive livestock production based on grazing.

According to Zanoniani, R. (1997)[6] the fundamental feature of Uruguayan grasslands is that in spite of having a good productive stability, due to their species composition diversity, it would be hard to find areas in a steady state, since they evolve continuously towards degradation. In addition, he also suggests that the criteria currently used for selecting the number of grazing animals per hectare grazing, almost purely based on the demand of forage rather than on the loading capacity, is the main cause of degradation of the grasslands in Uruguay, leading to the decrease or extinction of the most valuable species and the survival of those more unproductive or tolerant to unsuitable management practices.

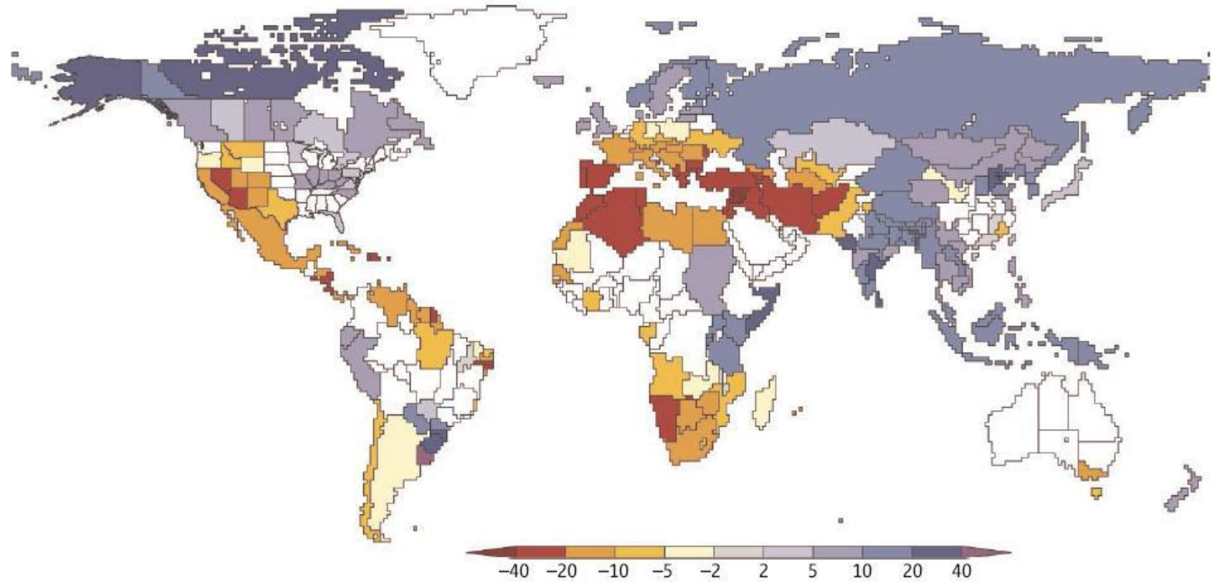
One of the consequences of overgrazing and improper grazing practices is the erosion of the soil, which is more intense in sloppy terrain. The project area, characterized by moderate slopes, is located on the areas affected by various degrees of gully erosion, according to the map of gully process intensity on Uruguayan soils prepared by the Ministry of Livestock, Agriculture and Fisheries (Fig. 8).



[6] Zanoniani, R. (1997). Síntomas de degradación productiva y medidas preventivas para su control. Cangüe, vol 4 no.10. p. 22-26

Figure 8. *Occurrence of soil erosion gully processes in Uruguay.*[7]

The main driver of soil degradation is livestock overgrazing, which will continue to be present under the baseline scenario identified below (continuation of extensive grazing by beef cattle). The intensity of soil erosion is expected to increase with time due to climate change. According to the National Institute of Agricultural Research (INIA), the precipitation in the region where the proposed project activity is located has increased by 400 mm yr^{-1} during the period 1930-2000[8], with a sharp increase during the spring and summer months. This increase is associated with an increase in the intensity of precipitation, thus leading to higher erosion pressure. A global assessment (Milly et al, 2008[9]) has estimated that Uruguay is the country with the highest expected increase in runoff during the period 2000-2050 (Fig. 9). This evidences that the soil erosion pressures are expected to increase in the future.



Human influences. Dramatic changes in runoff volume from ice-free land are projected in many parts of the world by the middle of the 21st century (relative to historical conditions from the 1900 to 1970 period). Color denotes percentage change (median value from 12 climate models). Where a country or smaller political unit is colored, 8 or more of 12 models agreed on the direction (increase versus decrease) of runoff change under the Intergovernmental Panel on Climate Change's "SRES A1B" emissions scenario.

Figure 9. *Projected increase in the surface runoff in different regions of the world during the period 2000-2050. Source: Milly et al, 2008 (Science, 329:573-574)*

1.2 Litter removal

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[7] Source: 'Ministerio de Ganadería, Agricultura y Pesca' of Uruguay (Ministry of Agriculture). (http://www.mgap.gub.uy/Renare/SIG/ErosionAntropica/intdelprocesodecarcavas.jpg) Web site visited 15th February 2011.

[8] Giménez, A. et al. 2006. Cambio climático en Uruguay y la región. Available in www.inia.org.uy/gras

[9] Milly, P.C.D, Betancourt, J., Falkenmark, M., Hirsch, R.M., Kundzewicz, Z.W., Lettenmeier, D.P and Stoufler, R.J. 2008. Stationarity is dead. Whither water management? Science 319:573-574

The methodology requires that *“Litter shall remain on site and not be removed in the project activity”.*

Litter will not be removed from the project site

1.3 Wetland

“The land does not fall into wetland category”.

There are no wetlands in the project area.

1.4 Drainage of organic soils

“If at least a part of the project activity is implemented on organic soils, drainage of these soils is not allowed and not more than 10% of their area may be disturbed as result of soil preparation for planting”.

There are no organic soils in the project area.

1.5 Tillage conditions (to account for changes in soil organic carbon pool)

“Ploughing/ripping/scarification attributable to the project activity, if any, is:

i) Done in accordance with appropriate soil conservation practices, e.g. follows the land contour; and

ii) Limited to the five first years from the year of initial site preparation; and

iii) Not repeated, if at all, within a period of 20 years”.

Soil organic carbon will not be accounted in an area of 400 ha within project boundaries, on which the rotation length is projected to be of 16 years. That area would not comply with condition 1.5 iii, since tillage would be repeated within a period of less than 20 years. The rest of the project area is done in accordance with applicability conditions for accounting soils organic carbon, which will be estimated according to the “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities”.

2. Justification of the choice of methodology

The project activity complies with all applicability conditions of the selected methodology.

2.3 Project Boundary

Project boundaries include all the areas of Guanaré that will be afforested. These areas have been defined based on the criteria discussed below.

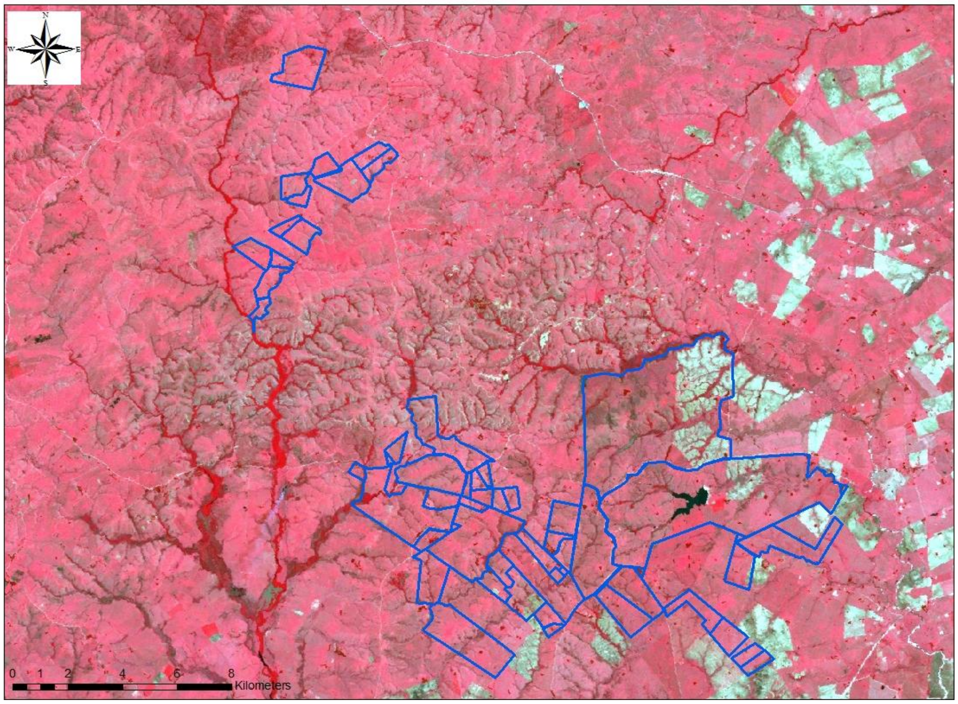
- Forest area effectively planted is delineated by the use of GPS technology and aerial photographs. Project boundaries are organized in GIS–format polygons. Polygons are grouped by property; properties are grouped by region, and the group of all regions comprising the total land area constitutes the project boundaries.

- Only areas complying with land eligibility requirement of the methodology (i.e., areas of land within project boundaries must not have been under forest since at least 1990) and with methodology applicability conditions (e.g., land must be degraded) are included within project boundaries.

- Regarding VCS eligibility requirements (AFOLU requirements 3.1.5), grassland vegetation dominating before project start is not the native ecosystem of the land within project boundaries. The native condition was modified by the introduction of beef cattle and sheep in the 17th and 19th centuries, respectively, and by the introduction of exotic species during the last three centuries.

• <u>Land eligibility for afforestation under the provisions of the selected methodology</u>: It is demonstrated though application of step 2(a) of the *"Procedure to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities"* that vegetation on the land has been below the forest threshold since 1988 until the project start date. The result of a remote sensing analysis is shown below. The analysis of satellite images shown in Figures 10 to 13 show that afforestation process did not start within project boundaries until 2006. The red coloured areas in these images indicate the presence of forests.

Garao Site November 1988



Garao Site December 2000

Garao Site November 2006

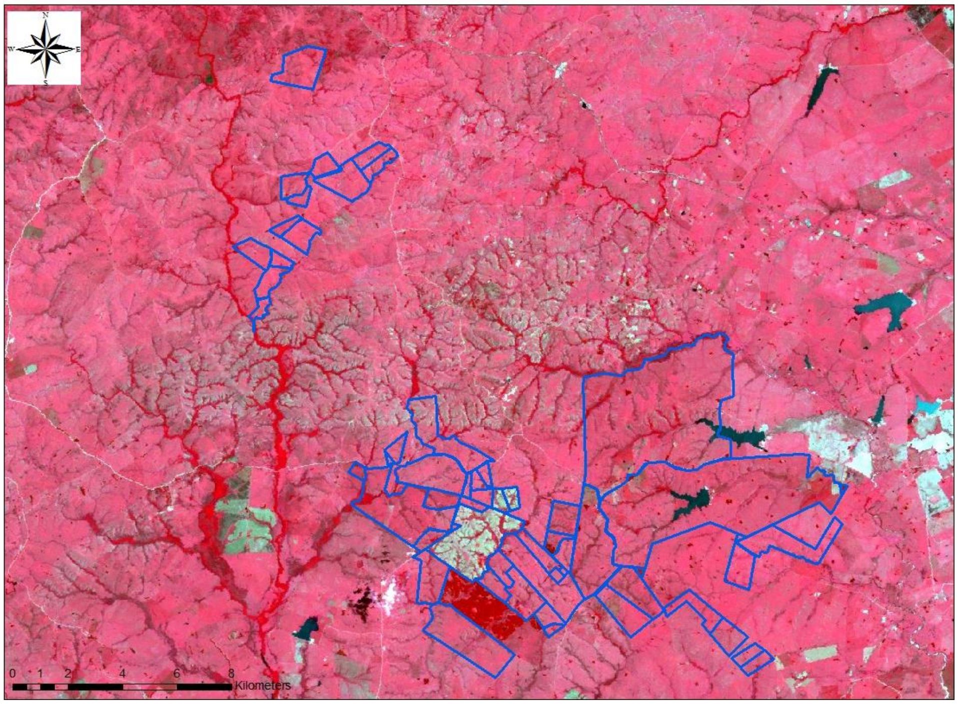
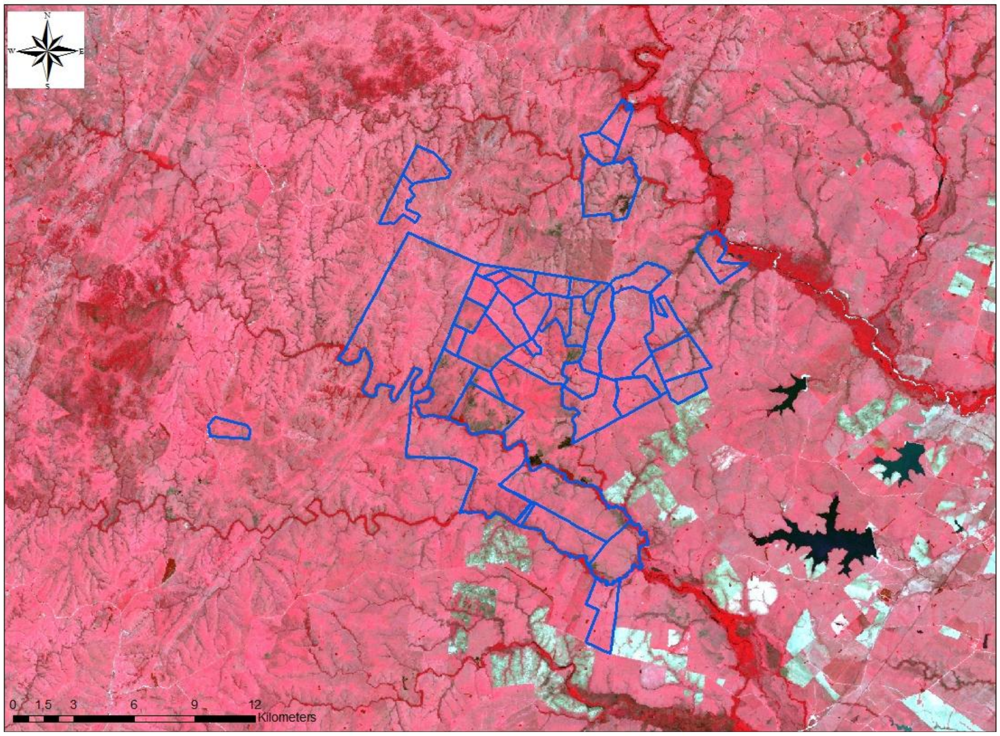
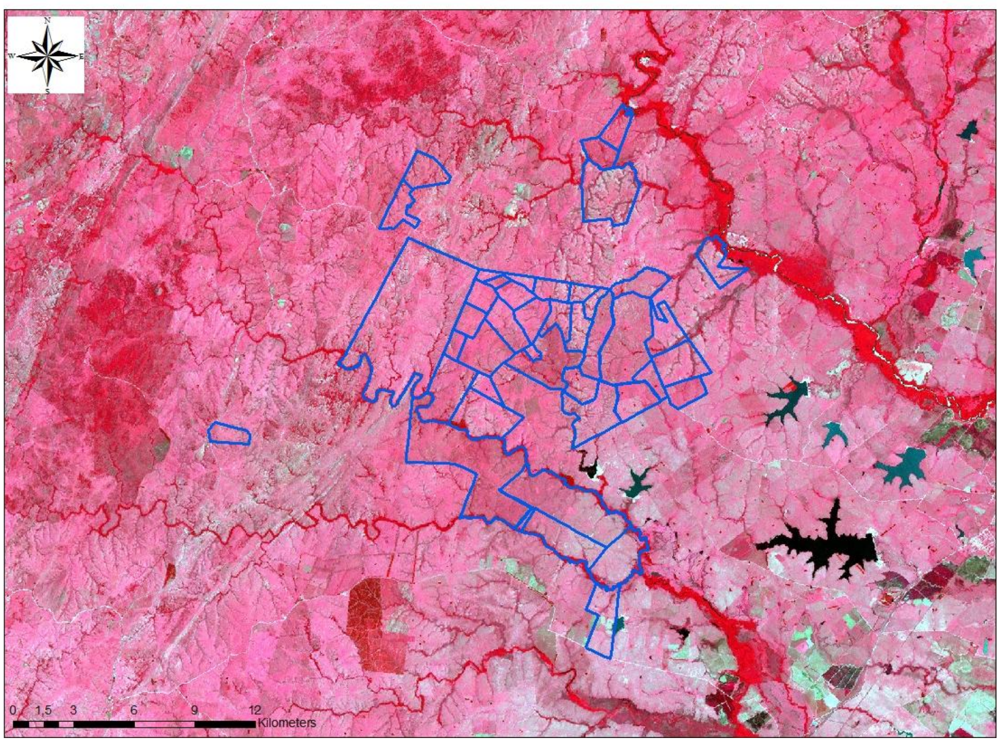


Figure 10. *Landsat images of 'Regis/Garao' region corresponding to November 1988, December 2000 and November 2006. Note: the red block in the lower central portion of the 2006 image indicates soil tillage in an area where site preparation had already started.*

Las Cañas Site November 1988



Las Cañas Site December 2000



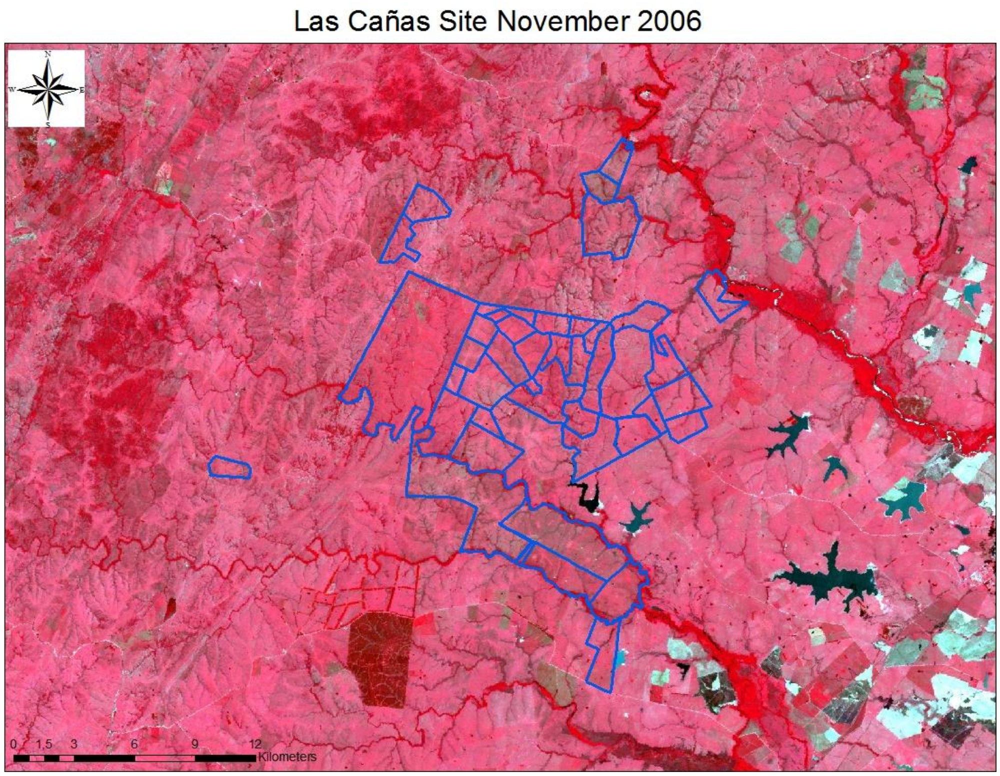
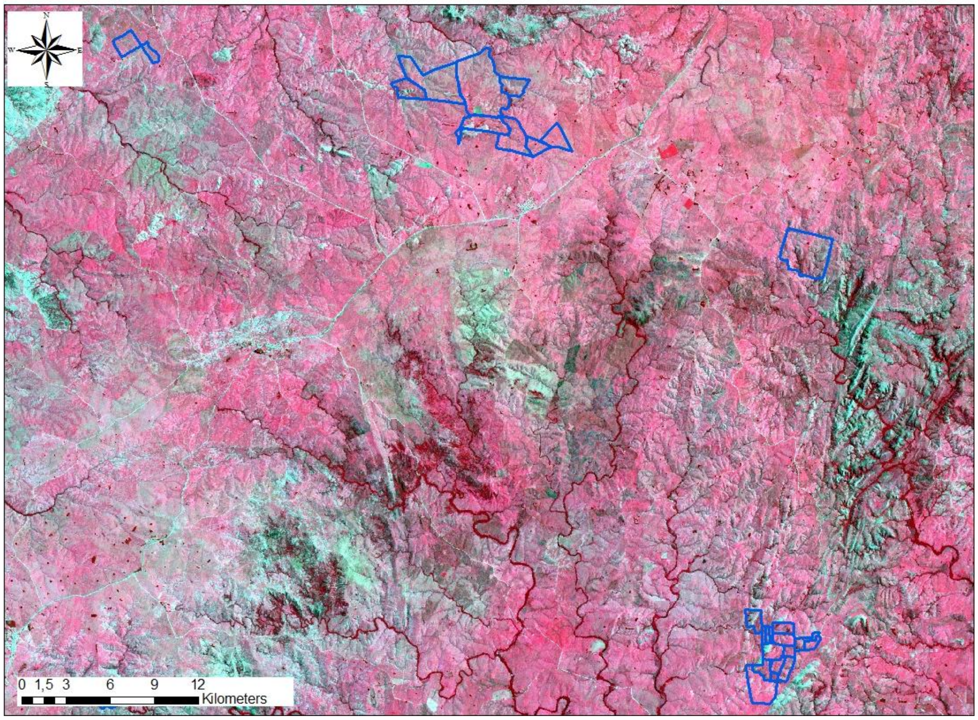
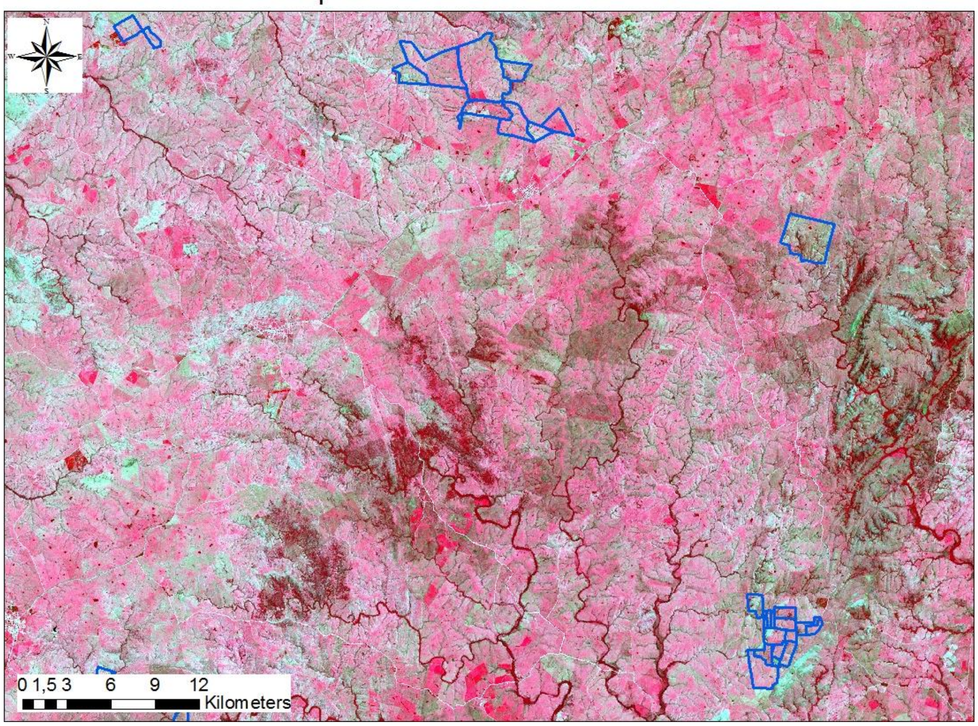


***Figure 11**. Landsat images of 'Las Cañas' region corresponding to November 1988, December 2000 and November 2006.*

Tupambaé Site March 1987



Tupambaé Site November 1999



Tupambaé Site Nov 2006

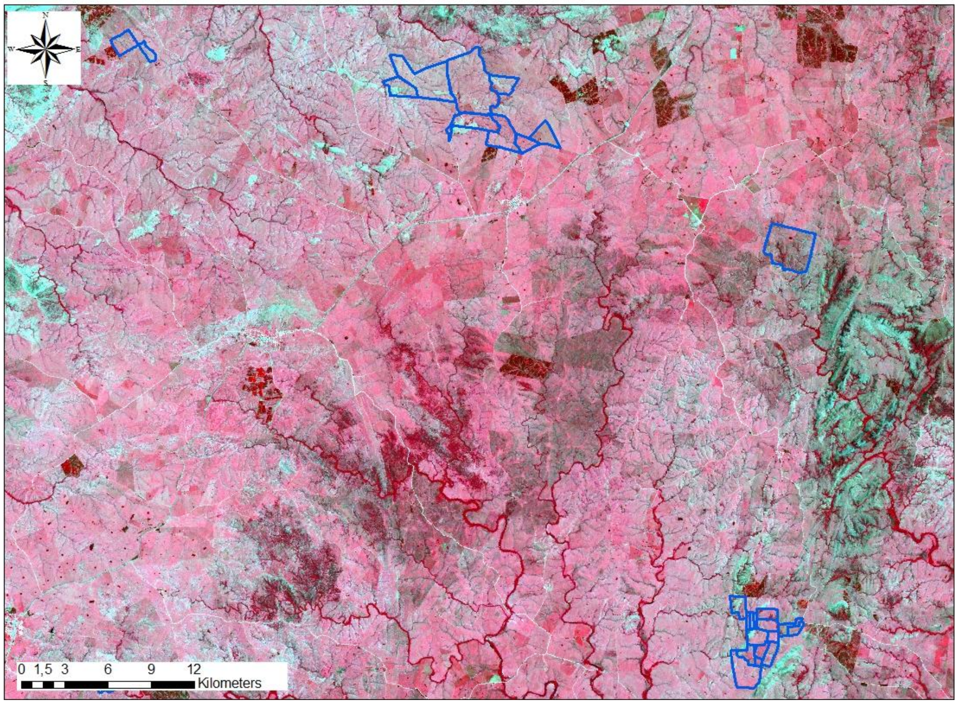
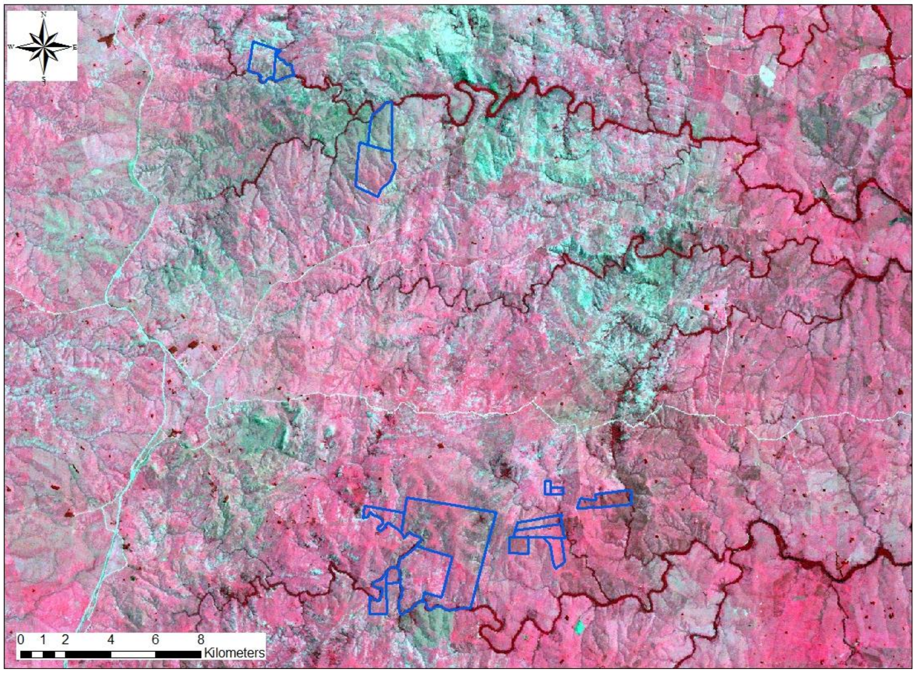


Figure 12. *Landsat images of 'Tupambaé' region corresponding to November 1988 and November 2006.*

Cerro Chato/Valentines Site March 1987



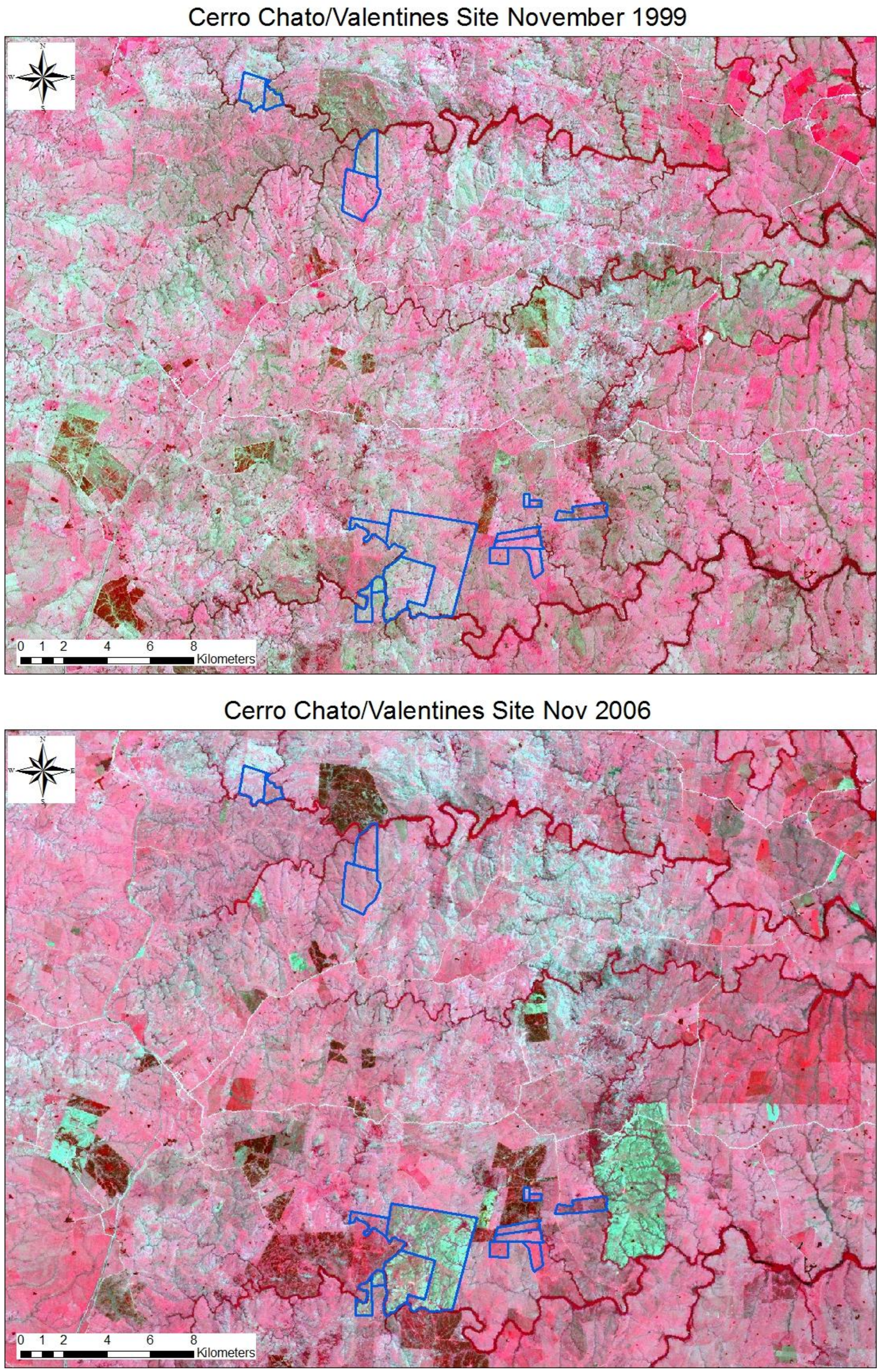


Figure 13. *Landsat images of 'Cerro Chato/Valentines' region corresponding to March 1987 and November 2006. Note: the green block in the central portion of the 2006 image indicates soil tillage in an area where site preparation had already started*

• Soil map and topographic position: those areas imposing restrictions to tree growth or with high vulnerability to water erosion were excluded; for instance, soils too shallow were discarded because soil water storage capacity is very low, or because tree root anchorage may be impaired, or because there is a risk of frost damage; soils occupying low areas were excluded because of risk of frost or water logging damage; areas with very steep slopes were excluded to prevent serious soil erosion loss.

- Site aptitude for tree species to be planted: areas suitable for Eucalyptus trees were included.

- Biological richness and diversity value: buffer zones and fauna corridors are excluded from project area. Buffer areas will be created at the interface between eucalypt plantations and native forests. These buffer zones will be basically 20-m wide strips on the edge of eucalypt planted areas, where special management and harvest practices will be adopted (e.g., no interventions during nesting periods of certain birds) in order to avoid disturbing fauna in the protected zones. Fauna corridors will connect key native forest restoration areas, to allow for communication between isolated groups of animals. Cattle could graze these areas.

- Firebreaks: a network of 20-m wide firebreak strips will separate forest blocks with a maximum size of 50 ha, according to Uruguayan regulations. Cattle will graze these firebreak areas, in order to minimize the fuel volume and prevent fires. These areas are not included in the project boundaries.

- Infrastructure needs: areas needed for infrastructure (e.g., areas needed for roads, cattle fences, buildings, stocking of harvested wood, and other) were excluded from the project area.

Project boundaries have been identified using a GPS, and have been laid on a geographic information system. No visible landmarks have been established on the field. Maps with project boundaries for each of the four project regions are shown from Figure 1 to 6.

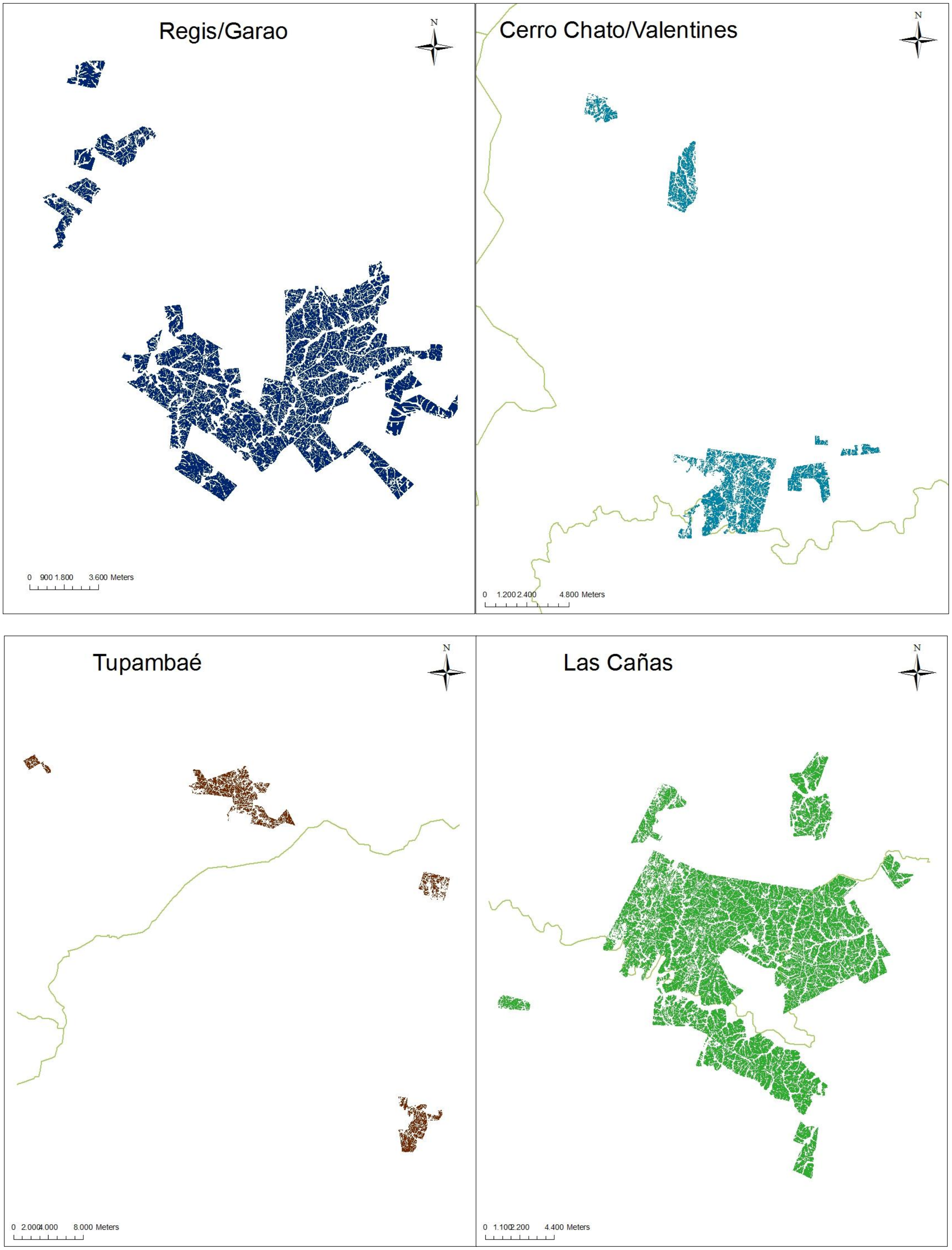


Figure 14. *Project boundaries (delimited painted areas) in 'Regis/Garao' 'Las Cañas' 'Tupambaé' and 'Cerro Chato/Valentines' region.*

Five carbon pools are selected: above-ground and below-ground biomass, dead wood, litter and soil organic carbon. Harvested wood products were not selected because it is not eligible under the selected methodology. Above-ground and below-ground biomass must be selected according to the methodology. All other carbon pools are optional, and they are also selected because they are expected to increase by the implementation of the proposed project activity. It is very clear in the case of dead wood and litter, since these pools do not virtually existent in the pre-project situation, and will appear under forest. In the case of soil organic carbon the situation is more complex. Even though soils are degraded, there still may be a transient reduction in soil organic carbon due to site preparation (e.g., tillage). However, the establishment of forest is expected to cause an increase in net primary productivity and, therefore, in the turnover of plant residues into the soil. This would lead to a long-term increase in the soil organic carbon pool.

From the GHG emission sources indicated in the methodology, only CH_4 from biomass burning of woody biomass is selected.

Table 3. *GHG emission sources*

Source		Gas	Included?	Justification/Explanation
Project	Burning of woody biomass	CO_2	No	Carbon stock decreases due to burning are accounted as a change in carbon stock
		CH_4	No	Fire for site preparation is not part of forest management and will not lead to emissions of methane
		N_2O	No	Potential emissions are negligibly small

2.4 Baseline Scenario

The baseline scenario was defined by using the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities", version 01. Since only one stratum was identified for the baseline scenario, the procedure is only applied once. Following is a description of the application of this tool.

Step 0 Preliminary screening based on the starting date of the A/R project activity

The incentive from the planned sale of carbon credits was seriously considered in the decision to proceed with the project activity. This is clearly documented in the reports submitted to the National Forest Agency from the '*Ministerio de Ganaderia, Agricultura y Pesca*' (Ministry of Livestock, Agriculture and Fisheries) since before the project start date. Project documents are prepared and submitted for government approval for each estate before planting and afforestation cannot start without the National Authorization. The several documents, all titled "livestock-forestry and carbon sequestration project", submitted to the government stated very clearly that carbon sequestration by forests and the sale of carbon credits were key objectives of the project. Dated and signed (by a Ministry's officer) copies of all the documents that were submitted are kept in project documentation archive. It was stated in these documents that carbon sequestration was one of the main objectives of *Guanaré* project.

Guanaré started its afforestation project on April 2006, this is before the registration date and after 31 December 1999. The analysis of satellite images shown in Figures 10 to 13 show that afforestation process did not start within project boundaries until 2006.

Step 1. Identification of alternative land use scenario to the proposed ARR project activity

According to the National Agricultural Census done in 2000 (http://www.mgap.gub.uy), grassland under extensive grazing (i.e., beef cattle and wool sheep) is the dominant land use in this area, being the main source of income in 79% of the properties present in the region, as shown in Table 4.

Table 4. *Land uses prior project initiation, categorized by main source of income per property*

Main income source	Cerro Largo	Treinta y Tres	Percentage
Fruit production	24	5	1%
Vineyards	2	0	0%
Horticulture	63	19	1%
Grains	127	90	4%
Dairy	156	67	4%
Beef cattle	2052	1458	64%
Wool sheep	536	272	15%
Forest	42	7	1%
Pigs and birds	128	45	3%
Others	152	58	4%
No income	164	15	3%
TOTAL	3446	2036	100%

Sub-step 1a. The following realistic and credible alternatives to the proposed project activity are identified:

1. Continuation of pre-project land use (extensive cattle grazing with no pasture improvement)

Cattle and sheep production has been the traditional rural activity in the project area and in all it surrounding region since the 17th century. In soils of low productivity -like the ones in the project area-, the main products obtained are wool to be sold to textile industry, and calves to be sold for fattening on more fertile soils. A combination of sheep and cattle is the preferred production mix. This production system has remained more or less the same for decades. The main change has been almost the complete displacement of sheep by beef cattle, due to the decline in wool prices during the last 10-15 years. In spite of the relatively low productivity of this system (30-60 kg meat per hectare per year), it has survived due to its very low cost and low risks.

2. Afforestation

This is the proposed project activity. Afforestation for pulpwood (short rotation) is the most common type in Uruguay. These plantations are normally combined with extensive grazing of forest service areas. The extension of forest plantations in the regions of the project is low. The type of forest management to be applied in the proposed project activity (long rotation with pruning and thinning) is not widespread in Uruguay.

3. Other alternatives

No other possible alternative scenarios have been identified.

Sub-step 1b. Consistency with enforced mandatory applicable laws and regulations.

All land use alternatives identified above comply with all mandatory regulations in the country. No alternatives are eliminated based on this criterion.

Step 2. Barrier analysis

Sub-step 2a. List of barriers

Following is a list of possible barriers for the land-use alternatives identified above:

- *Investment barriers*

  -Lack of access to credit (long term)

- *Barriers related to land tenure, ownership, inherence and property rights, inter alia:*

  -Possibilities of large price risks due to the fluctuations in the prices of products over the project period in the absence of efficient markets and insurance mechanisms;

  -Lack of incentive for land owners to invest in their lands

  -Remoteness of land area and undeveloped road and infrastructure incur large transportation expenditures, thus eroding the competitiveness and profitability of products from the land use

  -Land tenure specific features

- *Barriers due to local ecological conditions, inter alia:*

  -Degraded soil

  -Pervasive opportunistic species prevailing land use

  -Unfavorable meteorological conditions

  -High erosion risk (e.g. steep slopes)

  - Low soil quality

- *Technological barriers*

  -Lack of capacity to predict systems productivity (e.g. doubtful growth models)

- *Barriers related to local tradition, inter alia:*

  -Traditional knowledge or lack thereof, laws and customs, market conditions and practices

  -Traditional equipment and technology

- *Barriers due to prevailing practice, inter alia:*

  -The land use scenario is the "first of its kind": No activity of this type is currently operational in the host country or region

Sub-step 2b. Elimination of scenarios prevented by barriers

Alternative 1

It is not prevented by any barrier. It is the current land use, and the one that has been practiced for more than 300 years.

Alternative 2

Forest plantation is not a common practice in the region. In fact, this production system in terms of local tradition is not well known. This activity started to develop in the 1990's as a result of the forest policy implemented in 1987. In comparison with cattle grazing (more than 300 years from its introduction) is a new form of production. Therefore, knowledge and technology for its implementation is starting to be developed and diffused in the region. There is a noticeable difference between the return periods considered by landowners -who are used to expect a yearly income from their production-, while forestry projects have a period of 10 or more years for return on the investment. In addition, land owners in the region generally lack the capacity and equipment for conducting forestry activities.

This alternative is also prevented by remoteness of land area, which imposes high transportation cost for wood products (developed in the investment analysis section).

In terms of technology, the adoption of a 22-year rotation imposes uncertainties about wood productivity and quality; wind damages; and harvesting of thick logs, which are additional to other uncertainties applicable to shorter-rotation plantations (e.g., pest and disease outbreaks).

There are uncertainties related to the productivity that can be reached, particularly considering that the soils in the project area are of lower quality than those soils in the North and West regions in Uruguay where most long-rotation plantations have been developed. The only growth model for *E. grandis* available in Uruguay (INIA SAG-grandis) has been validated for rotations up to 16 years, and growth rates for ages higher than that had to be estimated with a large degree of uncertainty. Finally, adopting a long rotation implies sticking to the same genotypes for long periods, thus missing the opportunity of capitalizing on progress through plant breeding, which would be achieved by more frequent replanting. Finally, the quality of the wood to be obtained (i.e., whether it would be suitable for the high-price market it is targeted for) is also subjected to uncertainty. The underlying assumption in the design of the project activity is that logs to be obtained at clear-cut harvest will be of a quality at least similar to that of logs that could be obtained in shorter rotations. However, there is no evidence about a lack of deterioration of wood if trees are let to grow longer.

Another uncertainty relates to an eventual increase in felling off or damage to trees by wind storms. Intensive thinning of eucalypt plantations is known to increase the risk of wind damages due to the opening of wide spaces within the forest that may channel the wind and increase its speed, aggravated by the vulnerability of tall trees. There is no information on an eventual increase in this vulnerability in thinned stands with very tall trees such as those with ages 20 or more, but there have been some cases of plantations losses due to strong wind storms.

Risk of erosion within location area is moderate to high, very steep slopes which could reach 40% result in high vulnerability of soils. Besides, considering overgrazing history during summers in the region, this alternative is subject to uncertainty about wood productivity due to the degradation process suffered by soils in the project area which, as discussed in the section above about "assessment of applicability conditions", have lost a fraction of their net primary productivity due to grazing, aggravated by the gully erosion process

Sub-step 2c. List of scenarios that are not prevented by any barrier

Application of the decision tree of sub-step 2c (considering the outcome of sub-step 2b) leads to the following conclusions:

- Continuation of pre-project activity has been identified as the most plausible scenario in the absence of the proposed project activity.

2.5 Additionality

Additionality has been demonstrated through application of Steps 0 to 2 above and through Common Practice Analysis in Step 4 (in this section below). Despite the fact that sub-step 2c resulted in only one land use scenario and according to the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" it is the baseline scenario, the investment analysis was conducted in the afforestation activity to reinforce the conclusion that forest activity in the area was not meant to be developed without being registered in a carbon scheme and generating carbon certifies.

Investment analysis

Sub-step 3a. Determine appropriate analysis method

The Investment analysis will not determine which of the remaining land use scenario is the most economically or financially attractive because there is only one land use scenario remaining. However, it will demonstrate that the IRR for each location does not reach the benchmark IRR.

Option III, benchmark analysis is selected.

Sub-step 3b. Apply benchmark analysis

The benchmark is to represent standard returns in the market, considering the specific risk of the project type, but not linked to the subjective profitability expectation or risk profile of a particular project developer.

The IRR is selected as the indicator for the benchmark analysis. The Capital Asset Pricing Model (CAPM) is used to estimate the expected internal rate of return on unleveraged project activity that compensates the investor on risk and time value of money (k_e)

For a developing country, *ke* is determined according to the following equation:

$$k_e = r_f + [E(R_m) - r_f]\beta + prs$$

Where:

k_e = project cost of capital (benchmark project IRR, %)

r_f = risk free rate (%)

$[E(R_m) - r_f]$ = premium for market risk (%)

β = systematic risk of the project activity (dimensionless)

prs = premium for sovereign risk (%)

The estimation of the benchmark IRR was done for each one of the years the investment analysis was developed. Four of the investment analysis were done in the year 2006; Tupambaé, Regis/Garao, Las Cañas and Cerro Chato/Valentines (22 year rotation) and investment decision of Cerro Chato/Valentines (16 year rotation) on the year 2007.

Determination of the risk free rate r_f

The chosen value for r_f is the yield of 30-year US Treasury bonds.

r_f equals 4.9%, 4.8% in 2006 and 2007 respectively in accordance with the US Department of the Treasury (http://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=yieldYear&year=2006).

Determination of the premium for market risk $[E(R_m) – r_f]$

The arithmetic average annual premium for market risk with respect to US Treasury bonds is selected. It is a conservative value, from a well documented source (Damodaran, 2011) who calculated the premium for market risk for the period from 1928 to 2011 (a period of 20 years before the project initiation was selected). The following procedure was followed to obtain the selected value for this parameter:

Go to http://pages.stern.nyu.edu/~adamodar/

1) Click Valuation Icon
2) Go to point 3. TOPIC
3) Click Datasets icon
4) Go to Data sets chart
5) Click historical Returns on stocks, Bonds and Bills – United States

Other possible sources for premium for market risk would yield a similar result. These include:

Ibboston Associates (www.ibboston.com)

Barra (www.barra.com)

Bloomberg (www.bloomberg.com)

The estimated values are 5.6% and 4.8% (set it in chronological order)

Determination of the systematic risk of the project activity: β

It has to be considered that systematic risk of forestry activities depends greatly on the markets where the industries are located. As an example, average unleveraged β values for paper/wood/forestry sectors for the year 2006 are estimated to be 0.82 (USA), 1.27 (emerging markets), 1.04 (Japan), 0.75 (Europe) and 1.09 (Australia/Canada) by the New York University L.N. Stern School of Business (Damodaran 2011).

Uruguay is an emerging market. The average value of β for these markets (considering Paper & Related Products and Forestry) for the period 2006-2007 was 1.27. However, for the purpose of this analysis a more conservative value of 0.88 was selected, which corresponded to an Argentinean company (Celulosa Argentina) in 2006. For 2007, since there was no value reported for the same company or similar, the 2006 value was selected. This value was derived by the following procedure:

1) Go to http://pages.stern.nyu.edu/~adamodar/
2) Click Valuation Icon
3) Go to point 3. TOPIC
4) Click Datasets icon
5) Second chart (individual company information)

There are other possible sources for obtaining a suitable β value would yield similar results. These include:

Ibboston Associates (www.ibboston.com)

Barra (www.barra.com)

Bloomberg (www.bloomberg.com)

Determination of Premium for Sovereign Risk, *prs*

Sovereign risk reflects the amount of additional market risk for public bonds from one country as compared to the reference case (in this case, the US). The difference in yield between bonds issued by the US Treasury and those from another country constitutes the Premium for Sovereign Risk. Average premium for sovereign risk for Uruguay for year 2006 was calculated at 2.36, and in 2007 was 1.82 percentage points. Reputable and public sources of information were used[10].

Calculation of benchmark Internal Rate of Return for the afforestation activity

$k_e = r_f + [E(R_m) - r_f]\ \beta + prs$

2006 Values: k_e = 4.9 + [(5.6)*0.88] + 2.36 = 12.2%

2007 Values: k_e = 4.8 + [(4.8)*0.83] + 1.82 = 10.9%

In conclusion, the benchmark IRR for an afforestation activity without carbon finance in the project area is estimated to be **12.2%** (2006) and **10.9%** (2007).

Sub-step 3c. Calculation and comparison of IRR

The cash flow estimated for the afforestation activity in the project site without the financial benefits from the carbon credits will be available for the validation team as part of the PD documentation. The cash flow included all relevant costs and revenues along the crediting period.

Five cash flows were developed –one cash flow per region –in order to estimate the IRR. Three of them are consistent with three of the forest regions delineated before (Regis/Garao, Las Cañas and Tupambaé), two of the cash flows matched with the fourth region missing (Cerro Chato/Valentines). In this region it was necessary to estimate two IRRs since part of this region is projected to have a rotation length of 16 years, while the other would have 22 years as the rest of the regions.

The estimated IRRs for afforestation without carbon finance in the project area are 6.4% for Tupambaé region, 5.5% for Regis/Garao region, 6.9% for Las Cañas region, 9.0% for Cerro Chato/Valentines (22-year rotation length) and 8.3% for Cerro Chato/Valentines (16-year rotation length).

The estimated IRRs for afforestation in the project area without profits from carbon credits are therefore lower than the estimated benchmark IRR (10.9% and 12.2%).

It is again concluded that the continuation of the pre-project land use is the baseline scenario. A sensitivity analysis was made to make the conclusion that the project activity does not meet the benchmark more robust.

[10] www.rafap.com.uy

Sub-step 3d. Sensitivity analysis

The sensitivity analysis was performed by using the Montecarlo simulation method (Fischman 1996). Probability density functions for several parameters used for estimation of the cash flow were defined, and 1,000 estimates of the IRR were made for random combinations of those parameters. The analysis showed that the probability of the IRR of being lower than the benchmark for the three locations where the project activity is being held is 100%. Thus, the conclusion above is again highly robust.

Following is the summary (table and graph showing the distribution of the simulated IRR values for the 1,000 runs) of the results obtained by the Montecarlo simulation for each location (assumptions made for the simulation can be found at annex):

Summary:
Entire range is from 6,0% to 7,7%
Base case is 5,5%
After 1.000 trials, the std. error of the mean is 0,0%

Statistics:	**Forecast values**
Trials	1.000
Mean	6,7%
Median	6,7%
Mode	---
Standard Deviation	0,3%
Variance	0,0%
Skewness	0,3316
Kurtosis	2,67
Coeff. of Variability	0,0462
Minimum	6,0%
Maximum	7,7%
Range Width	1,8%
Mean Std. Error	0,0%

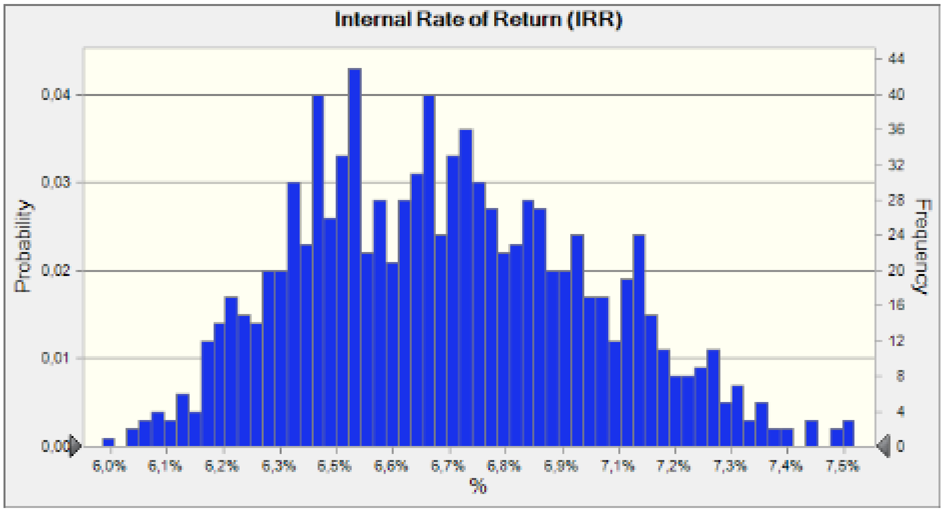


Figure 15. *Outcomes of the sensitivity analysis for Regis/Garao Region*

Summary:
Entire range is from 8.0% to 9.8%
Base case is 6.9%

Benchmark (2006) 12.2
After 1.000 trials. the std. error of the mean is 0.0%

Statistics:	**Forecast values**
Trials	1.000
Mean	8.8%
Median	8.8%
Mode	---
Standard Deviation	0.3%
Variance	0.0%
Skewness	0.1153
Kurtosis	2.60
Coeff. of Variability	0.0365
Minimum	8.0%
Maximum	9.8%
Range Width	1.7%
Mean Std. Error	0.0%

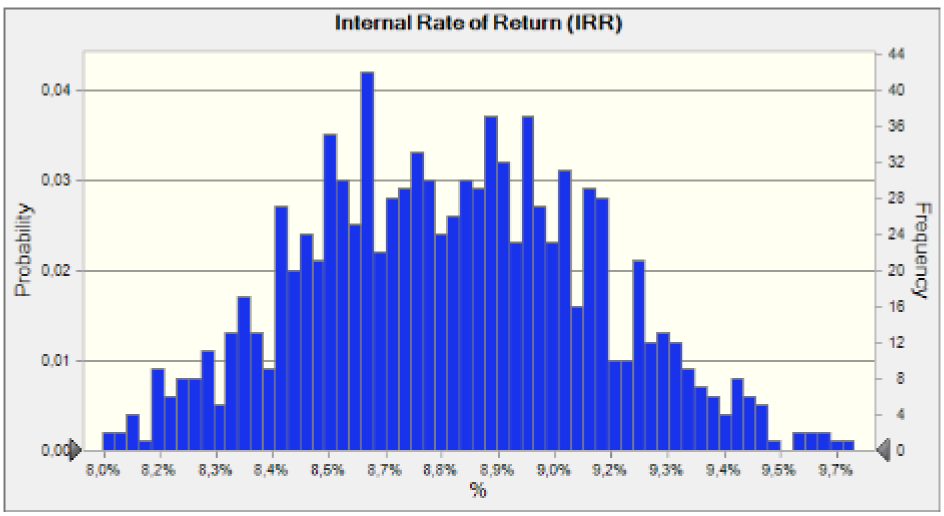


Figure 16. *Outcomes of the sensitivity analysis for Las Cañas Region*

Summary:
Entire range is from 9.6% to 11.5%
Base case is 9.0%
Benchmark (2006) 12.2
After 1.000 trials, the std. error of the mean is 0.0%

Statistics:	**Forecast values**	
Trials		1000
Mean		10.48%
Median		10.47%
Mode	---	
Standard Deviation		0.32%
Variance		0.00%
Skewness		0.18
Kurtosis		2.77
Coeff. of Variability		0.03

Minimum	9.56%
Maximum	11.51%
Range Width	1.95%
Mean Std. Error	0.01%

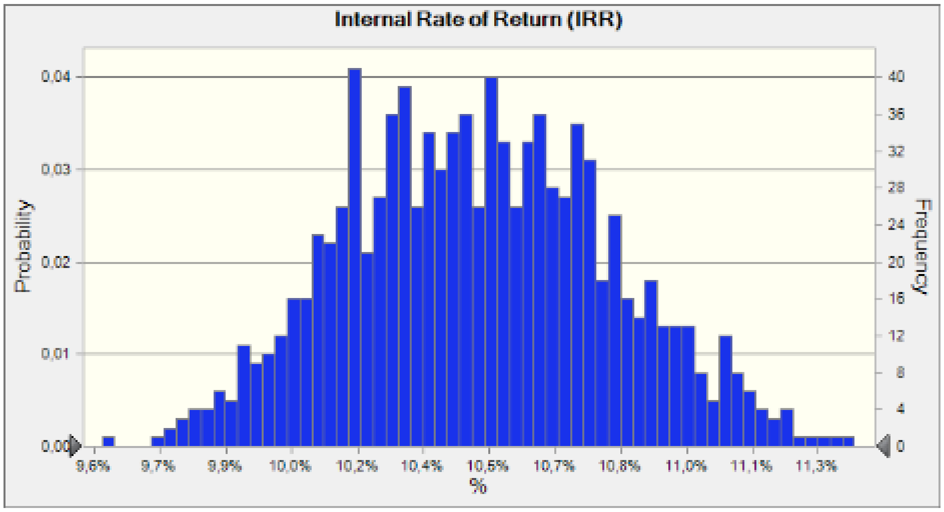


Figure 17. *Outcomes of the sensitivity analysis for Cerro Chato/valentines Region (22 years rotation)*

Summary:
Entire range is from 8,9% to 10,6%
Benchmark (2007) 10.9%
Base case is 8,3%
After 1.000 trials, the std. error of the mean is 0,0%

Statistics:	**Forecast values**
Trials	1.000
Mean	9,7%
Median	9,7%
Mode	---
Standard Deviation	0,3%
Variance	0,0%
Skewness	0,2534
Kurtosis	2,66
Coeff. of Variability	0,0327
Minimum	8,9%
Maximum	10,6%
Range Width	1,7%
Mean Std. Error	0,0%

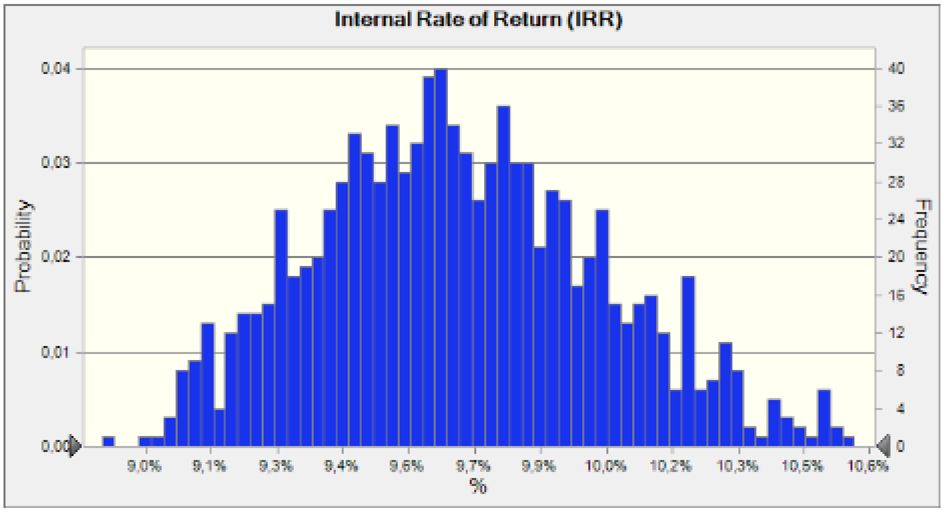


Figure 18. *Outcomes of the sensitivity analysis for Cerro Chato/valentines Region (16 years rotation)*

Summary:
Entire range is from 6.9% to 8.3%
Base case is 6.4%
Benchmark (2006) 12.2
After 1.000 trials, the std. error of the mean is 0.0%

Statistics:	**Forecast values**
Trials	1.000
Mean	7.6%
Median	7.5%
Mode	---
Standard Deviation	0.3%
Variance	0.0%
Skewness	0.2524
Kurtosis	2.56
Coeff. of Variability	0.0341
Minimum	6.9%
Maximum	8.3%
Range Width	1.4%
Mean Std. Error	0.0%

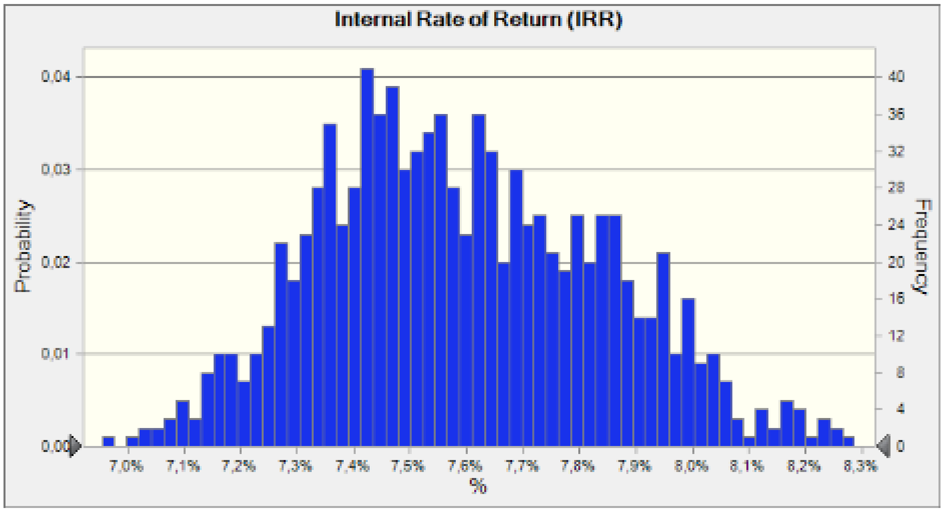


Figure 19. *Outcomes of the sensitivity analysis for Tupambaé Region*

Step 4. Common practice analyses

In spite of a large extension of forest priority soils in the Departments of Treinta y Tres and Cerro Largo, the forest promotion policy implemented in 1987 resulted in only a limited extent of afforestation. This represented a very different scenario from that in the other forest regions of the country. As it was explained above, the reasons for this lack of response are to be found in the long distances to wood delivery points (industries or ports) and in the poorer quality of the soils as compared to the North and West regions.

The relatively small area that was forested in the NE region (Cerro Largo and Treinta y Tres) during the period 1987-2005 was in response to the existence of a plantation subsidy, the availability of soft credits from *Banco de la República* and the exemption of all income and land taxes. As the subsidies were gradually decreased since 2002 until their complete suppression in 2005, the rate of plantation also declined (Fig. 20). The soft credits and several of the tax exemptions were also eliminated between 2003 and 2005.

The subsidies, depending on the year, had a value of up to US$ 200 per hectare affected to the plantations (including plantations and servicing areas, which normally amount to 50 to 60 per cent of the effectively planted areas). The value of the subsidy was equivalent to more than 50 per cent of the price of the land.

The soft credits for forest planting provided by *Banco de la República* had low interest rates (LIBOR plus 1.5 to 2.0 per cent per year) and a grace period of 10 years for both principal and interests. They were conceived for short rotation cycles (i.e., 10 years), clearly not appropriate for the NE region of Uruguay due to the relatively low value of pulpwood (the only product that can be obtained in such a short period). And when the time of repayment came for plantations made in the early 1990's, forest owners were forced to renegotiate their debts with the bank because they just could not sell their wood. Many were even forced to sell their properties later. It must be also noted that, after the sharp decline in the LIBOR occurred in 2001, the *Banco de la República* unilaterally decided to change the rules and applied a value higher than LIBOR for calculating the interest rates. This aggravated the situation of debtors. This line of soft credits was gradually modified after 2002 and was later phased out.

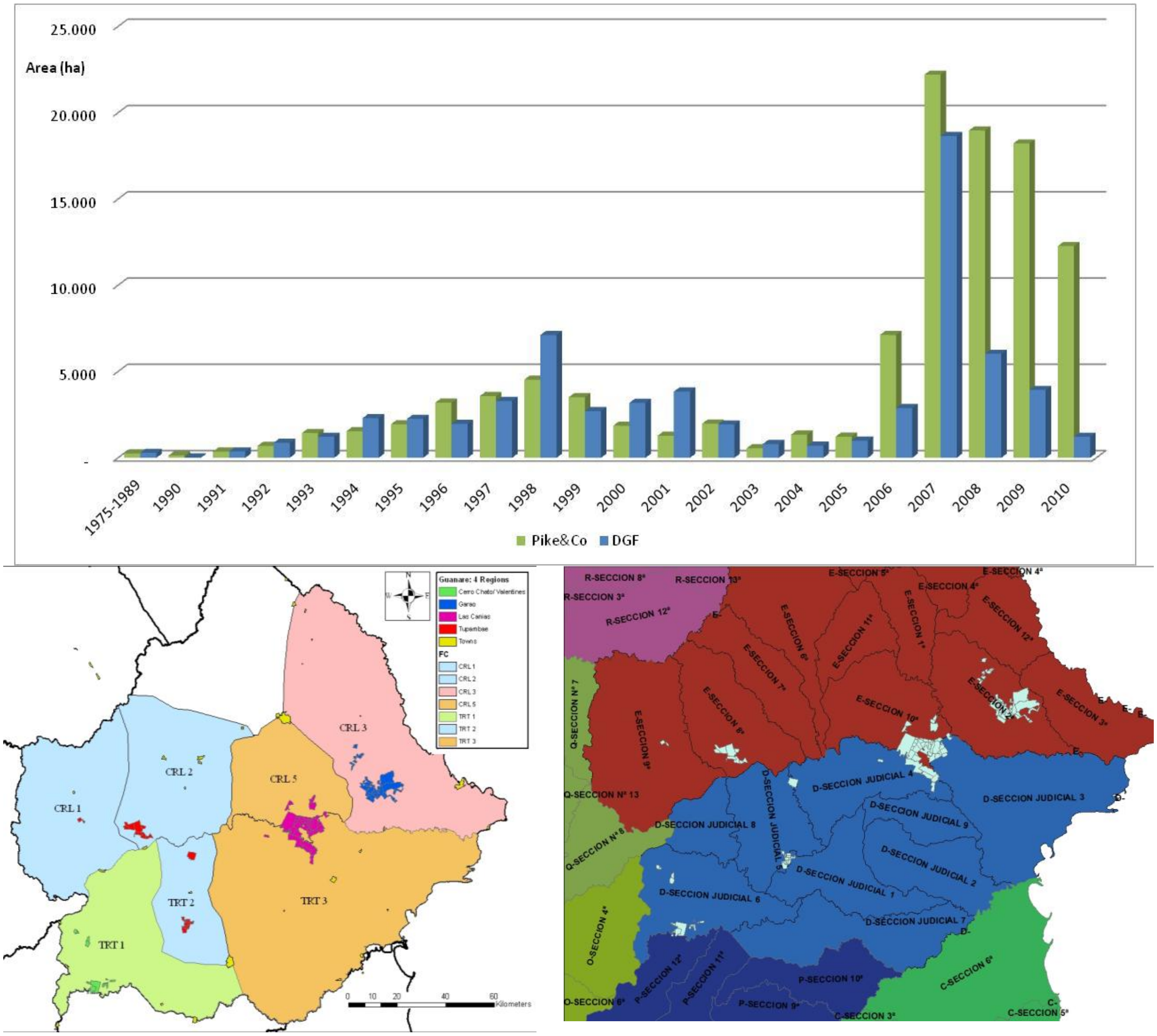


Figure 20. *Above: historical annual forest plantation rates in the region of the project according to two sources of information (private data from Pike & Co. and official statistic from Forest General Directorate); Lower left: map with a detail of project area and the geographic units ("foricenters") included in Pike & Co's statistics reported in the graph above; Lower right: map with a detail of project area and the geographic units ("Judicial sections") included in DGF's statistics reported in the graph above. Statistics from both sources have almost exact consistency with regard to the areas of land covered.*

The situation after 2005 corresponded to a completely different scenario. The rate of plantation in the region increased sharply, in spite of a lack of policy incentives. This increase is highly associated to the consideration of carbon finance by investors. As shown in Table 5, 94 per cent of the forests planted during the period 2006-2011 corresponding to a total of more than 77,000 ha, are either procuring or have already achieved registration under carbon programs (CDM, CCX and VCS).

Table 5. *Forest area planted between 2006 and 2011, by owner, in Guanaré project region.*

Company Name	**Eucalyptus**	**Pinus**	**Total**	**Seeking Carbon finance**
'*Guanaré*'	22,605		22,605	Yes (VCS)
GFP	332	19,806	20,138	Yes (VCS)
Weyerhaeuser	15,723	2,142	17,865	Yes (VCS)
RMK	4,446		4,446	Yes (CCX)
Pradera Roja	3,826		3,826	Yes (VCS)
Others	1,776		1,776	Not known
Posco Uruguay	1,432		1,432	Yes (CDM)
Caja de Jubilaciones Profesionales	1,327		1,327	Not known
ITAA	1,186		1,186	Yes (VCS)
Bulgheroni	906		906	Not known
San Ignacio	850		850	Yes (VCS)
Tierras Forestales	501		501	Not known
Fernández	187		187	Not known
Yandian	107		107	Not known
Agrosocio Brasilero	72		72	Not known
Saps Krazemblum	53		53	Not known
Total	**55,328**	**21,948**	**77,276**	**94%**

The common practice analysis was done following the requirements set in the Step 4 of the "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities". It was analyzed in it, to which extent similar forestation activities to the one proposed have been implemented previously or are currently underway. Similar forestation activities are defined as that which are of similar scale, take place in a comparable environment, *inter alia*, with respect to the regulatory framework and are undertaken in the relevant geographical area.

Throughout the analysis is concluded that there are similar forest activities (in terms of scale, species, etc) in the area (table 5). However, 94% of those companies established in the area are seeking carbon finance. There was not identification of similar forest activities without requiring carbon finance (paragraph 33 of the tool). Therefore, there is no need to compare the proposed project activities to others (paragraph 34 of the tool). In conclusion, similar activities cannot be observed, then the project activity is not the baseline scenario, and hence it is additional.

2.6 Methodology Deviations

No deviations from the procedures indicated by the methodology have been made.

3 QUANTIFICATION OF GHG EMISSION REDUCTIONS AND REMOVALS

3.1 Baseline Emissions

Since continuation of an activity that has been applied without changes for more than 20 years has been selected as the baseline scenario, it is assumed, in agreement with IPCC Good Practice Guidance for Land Use, Land Use Change and Forestry (2003) that the net GHG removals by sinks in the baseline equals zero.

3.2 Project Emissions

The net anthropogenic GHG removals by sinks is estimated as the actual net GHG removals by sinks minus the baseline net GHG removals, minus leakage. The following general formula described in the methodology is used to calculate the net anthropogenic GHG removals by sinks of an A/R project activity, in t CO_2-e:

$$C_{AR-CDM} = \Delta C_{ACTUAL} - \Delta C_{BSL} - LK$$

Where:

C_{AR-CDM}	Net anthropogenic GHG removals by sinks; t CO_2-e
ΔC_{ACTUAL}	Actual net GHG removals by sinks; t CO_2-e
ΔC_{BSL}	Baseline net GHG removals by sinks; t CO_2-e
LK	Total GHG emissions due to leakage; t CO_2-e

The actual net greenhouse gas removals by sinks were estimated using the following equation described in the methodology:

$$\Delta C_{ACTUAL} = \Delta C_P - GHG_E$$

Where:

ΔC_{ACTUAL}	Actual net greenhouse gas removals by sinks; t CO_2-e
ΔC_P	Sum of the changes in above-ground and below-ground tree biomass, dead wood, litter and soil organic carbon stocks in the project scenario; t CO_2-e
GHG_E	Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e

The following formula described in the methodology is used in order to estimate GHG emission:

$$GHG_E = \sum_{t=1}^{t^*} GHG_{E,t}$$

Where:

GHG_E Increase in GHG emissions as a result of the implementation of the proposed A/R CDM project activity within the project boundary; t CO_2-e

$GHG_{E,t}$ Increase in Non-CO_2 emissions due to biomass burning of existing vegetation as part of site preparation in year t; t CO2-e

T 1,2,3,……..,t* years elapsed since the start of the A/R CDM project activity

The tool for "*Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*" has been considered. The use of fire for site preparation and/or to clear the land of harvest residue prior to replanting is specifically excluded from the project management and therefore project emissions are estimated as zero.

Carbon stock changes

ΔC_P is the sum of the changes in above-ground and below-ground tree biomass, dead wood, litter and soil organic carbon stocks in the project scenario. For *ex-ante* estimation, dead wood and litter pools were conservatively neglected. Calculations for tree biomass (above and below) and soil organic carbon are described below.

Biomass carbon pools

Above and below ground biomass have been estimated according to the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activity*". A summary of the main factors used and each source of data are presented in the table below. Estimations are archived as part of the project documentation and will be available for the validation team. Data used for estimating tree biomass are shown in Table 6.

Table 6. *Assumed parameters used for estimation of tree biomass carbon stocks*

Parameter	**Symbol**	***E. globulus and E. grandis***	**Source**
Mean Annual Increment ($m^3.ha^{-1}.yr^{-1}$)	MAI_j	From 13.5 to 28	Local growth model (SAG grandis and SAG globulus)
Wood basic density ($Mg.m^{-3}$)	D_j	0.52 and 0.46	Country-specific values
Biomass expansion factor (dimensionless)	BEF_{1j}	From 1.15 to 3.4	IPCC Good Practice Guidance for LULUCF (2003), Table 3A.1.10
Carbon fraction (dimensionless)	CF	0.5	Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"
Root-to-shoot ratio (dimensionless)	R_j	From 0.2 to 0.4	Tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"

Soil organic carbon

Estimations of soil organic carbon (SOC) stocks were done in accordance to the "*Tool for the estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activity*". As suggested by the tool, it is assumed that the implementation of the project activity increases the SOC content of the lands from the pre-project level to the level that is equal to the steady-state SOC content under native vegetation. The increase in SOC content in the project scenario takes place at a constant rate over a period of 20 years from the year of planting. The project meets the applicability conditions of this tool since:

- the areas of land to which the tool is applied do not fall into wetland category, do not contain organic soils and are not subject to any of the land management practices and application of inputs listed in Tables 1 and 2 of the tool;
    - Since the land use prior to project start is grassland, only Table 2 applies. For the temperate warm moist climate region corresponding to the project activity, none of the three combinations included in Table 2 are applicable;
- litter remains on site and is not removed and soil disturbance is in accordance with appropriate conservation practices, limited to site preparation and not repeated within 20 years.

Table 7. *Parameters used for estimation of SOC*

Parameter	**Symbol**	**Value**	**Source (SOC estimation tool, V01.1.0)**
Reference SOC (tC/ha)	$SOC_{REF,i}$	88	Table 3 HAC soils, warm temperate
Land use factor	$f_{LU,i}$	1	Table 6 All permanent grassland
Management factor	$f_{MG,i}$	0.95	Table 6 Moderately degraded grassland Overgrazed or moderately degraded grassland, with somewhat reduced productivity (relative to the native or nominally managed grassland) and receiving no management inputs
Input factor	$f_{IN,i}$	1	Table 6 Grassland without input of fertilizer

SOC at the beginning of the project ($SOC_{INITIAL,i}$) is estimated by multiplying the factors in Table 7 by the reference SOC. As per the tool, a loss in SOC ($SOC_{LOSS,i}$) is applied in the case that soil disturbance occurs on more than 10 per cent of the land area, which is the case of *Guanaré* project. The following methodological formula is used for calculating the annual change in SOC stock

:

$$dSOC_{t,i} = \frac{SOC_{REF,i} - (SOC_{INICIAL,i} - SOC_{LOSS,i})}{20}$$

Where:

$dSOC_{t,i}$	The rate of change in SOC stock in stratum i of the area of land, in year t; t C/ha/yr
$SOC_{REF,i}$	Reference SOC stock corresponding to the reference condition in native lands by climate region and soil types applicable to stratum i of the area of land; tC/ha
$SOC_{INICIAL,I}$	SOC stock at the beginning of the A/R CDM project activity in stratum i of the areas of land
$SOC_{LOSS,i}$	Loss of SOC caused by soil disturbance attributable the A/R CDM project activity, in stratum I of the areas of land ; tC/ha

Application of the equation results in an estimated increase of 0.64 t C/ha/year in soil organic carbon.

3.3 Leakage

The methodology requires the assessment of sources of leakage due to activity displacement (conversion from grazing land to forestry). Application of the tool "*Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity*" led to the conclusion that this source can be neglected. The application of the *"Guidelines on conditions under which increase in GHG emissions related to displacement of pre-project grazing activities in A/R CDM project activity is insignificant"*, which is one of the applicability conditions of the tool, resulted in the conclusion that the project will not cause any displacement of the activity occurring before project implementation.

Beef cattle breeding (cow-calf) was the dominant activity in the pre-project land (Eastern hilly areas of Uruguay). Cattle were based on a breeding herd where heifers are mostly placed with bulls at the age of 3 years. Sales include culling cows to be fattened, surplus heifers, and calves (at weaning). Average production is 33 kg per ha per year[11]. Existing cattle in the pre-project situation may either stay within project boundaries or in an area controlled by project participant, or be sold to the market. (calves and surplus heifers are normally sold in the market for fattening on other grazing areas, while cows, heifers and a reduced number of bulls are sold to slaughterhouses). It is *Guanaré*'s policy that land owners can continue with their activities for a period of six months to one year after the purchase of the land, so that they have time to reduce the population of their cattle. In some cases, they may even stay in the land with long-term rental contracts.

Furthermore, according to data gathered from governmental Livestock Controller Division (DICOSE)[12] there has been a smooth increase in the beef cattle and sheep stock in the departments of Cerro Largo and Treinta y Tres (where the project activity occurs) in the last decade (from 1.75 million livestock units, LSU, in 2003 to 1.92 million LSU in 2009). On the other hand, according to data taken from National Forest Directorate (DGF)[13] forest plantations have also been increasing for the same period of time (from 37 thousand hectares in 2003 to 72 thousand hectares in 2009) in the same departments. In addition,

[11] INIA., 2001. Tecnologías forrajeras para sistemas ganaderos de Uruguay. Boletín de Divulgación 76.

[12] http://www.mgap.gub.uy/DGSG/DICOSE/dicose.htm

[13] http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,442,O,S,0,,

native forest has been also increasing in terms of area in the last 43 years at the National level. According to National Forest Inventory (2010)[14] and to the forest maps based on aerial photographs of 1967[15] native forests have increased 21% in terms of area. The fact that total forest area and amount of livestock have been increasing, analyzing Cerro Largo and Treinta y Tres official data, is an evidence that project activity does not result in displacement of the previous productive system. Therefore, leakage is assumed to be zero.

3.4 Summary of GHG Emission Reductions and Removals

Baseline net GHG removals and total GHG emissions due to leakage are zero, thus *ex-ante* estimation of C_{AR-CDM} equals ΔC_{ACTUAL}.

According to VCS version 3 AFOLU requirements, the amount of carbon credits must not exceed the long term GHG benefit of the project. The period over which the long term average GHG benefit is calculated is 71 years (to include the harvest in the last rotation cycle started before the end of the crediting period). The total GHG benefit, calculated as the sum of stock changes along the 71 year period, is 7,644,973 t CO_2 (Table 8).

[14] http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,440,O,S,0,,

[15] URUGUAY MAP. Forest Directorate.- First Forest Chart. Montevideo: MAP, 1979 (http://www.mgap.gub.uy/portal/hgxpp001.aspx?7,20,410,O,S,0,MNU;E;2;15;125;1;MNU;,)

Table 8. *Estimated net GHG removals*

Years	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)	Years	Estimated baseline emissions or removals (tCO_2e)	Estimated project emissions or removals (tCO_2e)	Estimated leakage emissions (tCO_2e)	Estimated net GHG emission reductions or removals (tCO_2e)
2006	0	3,128	0	3,128	2041	0	134,441	0	134,441
2007	0	20,498	0	20,498	2042	0	133,228	0	133,228
2008	0	80,697	0	80,697	2043	0	447,794	0	447,794
2009	0	414,306	0	414,306	2044	0	1,031,617	0	1,031,617
2010	0	573,861	0	573,861	2045	0	749,514	0	749,514
2011	0	691,379	0	691,379	2046	0	-249,940	0	-249,940
2012	0	783,242	0	783,242	2047	0	-132,639	0	-132,639
2013	0	937,138	0	937,138	2048	0	156,655	0	156,655
2014	0	493,100	0	493,100	2049	0	902,981	0	902,981
2015	0	506,262	0	506,262	2050	0	700,815	0	700,815
2016	0	541,448	0	541,448	2051	0	218,898	0	218,898
2017	0	853,148	0	853,148	2052	0	-3,944,142	0	-3,944,142
2018	0	718,617	0	718,617	2053	0	-3,266,852	0	-3,266,852
2019	0	156,611	0	156,611	2054	0	-2,160,043	0	-2,160,043
2020	0	156,788	0	156,788	2055	0	879,377	0	879,377
2021	0	407,551	0	407,551	2056	0	431,358	0	431,358
2022	0	877,639	0	877,639	2057	0	1,377,266	0	1,377,266
2023	0	651,238	0	651,238	2058	0	688,657	0	688,657
2024	0	-152,042	0	-152,042	2059	0	707,176	0	707,176
2025	0	-56,544	0	-56,544	2060	0	764,097	0	764,097
2026	0	170,339	0	170,339	2061	0	1,246,131	0	1,246,131
2027	0	754,367	0	754,367	2062	0	1,037,381	0	1,037,381
2028	0	577,165	0	577,165	2063	0	167,749	0	167,749
2029	0	179,156	0	179,156	2064	0	164,804	0	164,804
2030	0	-3,165,964	0	-3,165,964	2065	0	558,911	0	558,911
2031	0	-2,620,334	0	-2,620,334	2066	0	1,284,529	0	1,284,529
2032	0	-1,740,208	0	-1,740,208	2067	0	932,988	0	932,988
2033	0	705,873	0	705,873	2068	0	-311,043	0	-311,043
2034	0	346,848	0	346,848	2069	0	-166,562	0	-166,562
2035	0	1,105,860	0	1,105,860	2070	0	196,643	0	196,643
2036	0	553,019	0	553,019	2071	0	1,124,484	0	1,124,484
2037	0	568,561	0	568,561	2072	0	872,488	0	872,488
2038	0	613,422	0	613,422	2073	0	271,915	0	271,915
2039	0	1,000,940	0	1,000,940	2074	0	-4,918,053	0	-4,918,053
2040	0	833,370	0	833,370	2075	0	-4,203,111	0	-4,203,111
Total						**0**	**7,644,973**	**0**	**7,644,973**

4 MONITORING

4.1 Data and Parameters Available at Validation

Table 9. *Parameters available at validation*

Data Unit / Parameter:	A_i
Data unit:	ha
Description:	Area of stratum *i*
Source of data:	Monitoring of strata and stand boundaries is done using a Geographical Information System (GIS) which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data)
Value applied:	Variable according to stratum
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	$BEF_{2,j}$
Data unit:	Dimensionless
Description:	Biomass expansion factor for conversion of stem biomass to above-ground biomass for tree species or group of species j
Source of data:	IPCC default values (e.g. Table 3A.1.10 of IPCC GPG-LULUCF 2003)
Value applied:	From 1.15 to 3.4, depending on the tree age
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	BEFs in IPCC reports and national forest inventories are usually applicable to closed canopy forests. If applied to individual trees growing in open field.

Data Unit / Parameter:	CFj
Data unit:	t C t^{-1} d.m.
Description:	Carbon fraction of tree biomass for species or group of species j
Source of data:	The IPCC default value of 0.5 t C t^{-1} d.m.
Value applied:	0.5
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	D_j
Data unit:	t d.m. m^{-3}
Description:	Basic wood density for species or group of species j
Source of data:	National species-specific data from LATU: "*Evaluación de parámetros de calidad de Eucalyptus globulus y E. maidenii de plantaciones uruguayas para pulpa de celulosa*." and "*Densidad, Dureza y Color de Eucalyptus grandis de Uruguay Ing. Quím. Silvia Böthig Informe de Investigación N^o 5, Julio 2001*"
Value applied:	0.46 and 0.52
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	R_j
Data unit:	Dimensionless
Description:	Root-shoot ratio for species or group of species j
Source of data:	Calculated as B/A where B = exp[-1.085+0.9256*ln(A)], where A is aboveground biomass (t d.m. ha^{-1}) and B is below-ground biomass (t d.m. ha^{-1}) [Source: Table 4.A.4 of IPCC GPG-LULUCF 2003]
Value applied:	0.23 to 0.29 depending on the tree age
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	$V_{TREE\ j\ p\ i}$
Data unit:	m^3
Description:	Stem volume of trees of species or group of species j in plot p in stratum i
Source of data:	Existing local species-specific tree growth models. (SAG globulus and SAG grandis)
Value applied:	N/A
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	In case of ex ante calculation, growth was estimated based on average growth according to specific site conditions presented in the project site.

Data Unit / Parameter:	Bark volume
Data unit:	m^3/ha
Description:	Bark volume of trees of species
Source of data:	Methodological tool "Estimation of carbon stocks and change in carbon stocks of trees and shrubs"
Value applied:	15% of total stem volume
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	Stem volume estimations of local growth models are under bark, thus this factor is applied

Data Unit / Parameter:	$f_{IN,i}$
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline input regime (e.g. crop residue returns, manure) in stratum i of the areas of land
Source of data:	Tables 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied:	0.7
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	SOC_{REF}
Data unit:	t C ha^{-1}
Description:	Reference SOC stock corresponding to the reference condition in native lands (i.e. non-degraded, unimproved lands under native vegetation . normally forest) by climate region and soil type applicable to stratum *i* of the areas of land
Source of data:	Table 3 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied:	88
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	NA

Data Unit / Parameter:	$f_{MG,i}$
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline management regime in stratum *i* of the areas of land; dimensionless
Source of data:	Table 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied:	0.95
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

Data Unit / Parameter:	$f_{LU,i}$
Data unit:	Dimensionless
Description:	Relative stock change factor for baseline land-use in stratum i of the areas of land; dimensionless
Source of data:	Tables 6 of “Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM Project” activities.
Value applied:	1
Justification of choice of data or description of measurement methods and procedures applied:	N/A
Any comment:	N/A

4.2 Data and Parameters Monitored

Table 10. *Parameters monitored*

Data Unit / Parameter:	D_n
Data unit:	cm
Description:	Diameter of the n^{th} piece of lying dead wood intersecting a transect line
Source of data:	Field measurements along transect lines in sample plots
Description of measurement methods and procedures to be applied:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, may be applied
Frequency of monitoring/recording:	Before every verification event
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC) procedures prescribed under National forest inventory are applied. In absence of these, QA/QC procedures from published handbooks or from IPCC GPG LULUCF 2003, may be applied.
Calculation method:	N/A
Any comment:	N/A

Data Unit / Parameter:	DBH
Data unit:	cm
Description:	Diameter at breast height of tree
Source of data:	Field measurements in sample plots
Description of measurement methods and procedures to be applied:	Usually the diameter at breast height of the tree, but it could be any other diameter or dimensional measurement (e.g. basal diameter, root-collar diameter, basal area, etc.) applicable for the model or data source used. Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Frequency of monitoring/recording:	Before every verification event
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or

	from the IPCC GPG LULUCF 2003, are applied
Calculation method:	N/A
Any comment:	N/A

Data Unit / Parameter:	H
Data unit:	m
Description:	Height of trees
Source of data:	Field measurements in sample plots
Description of measurement methods and procedures to be applied:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Frequency of monitoring/recording:	Before every verification event
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Calculation method:	N/A
Any comment:	N/A

Data Unit / Parameter:	$DWR_{LI, p, i}$
Data unit:	Dimensionless
Description:	Dry-to-wet weight ratio of the litter sub-sample collected from plots
Source of data:	Laboratory measurement of field samples
Description of measurement methods and procedures to be applied:	Litter samples shall be collected and well mixed into one composite sample at the same time of the year in order to account for natural and anthropogenic influences on the litter accumulation and to eliminate seasonal effects. A subsample from the composite sample of litter is taken, oven dried and weighed to determine the dry weight.
Frequency of monitoring/recording:	Before every verification event
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	It is acceptable to determine this ratio for three randomly selected sample plots in a stratum and then apply the average ratio to all plots in that stratum

Data Unit / Parameter:	N
Data unit:	Dimensionless
Description:	Total number of wood pieces intersecting the transect
Source of data:	Field measurements
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	N/A
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	N/A

Data Unit / Parameter:	T
Data unit:	Year
Description:	Time period elapsed between two successive estimations of carbon stock in trees and shrubs
Source of data:	Recorded time
Description of measurement methods and procedures to be applied:	N/A
Frequency of monitoring/recording:	N/A
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	N/A
Calculation method:	N/A
Any comment:	If the two successive estimations of carbon stock in trees are carried out at different points of time in year t_2 and t_1, (e.g. in the month of April in year t_1 and in the month of September in year t_2), then a fractional value is assigned to T

Data Unit / Parameter:	$a_{p,i}$
Data unit:	m^2
Description:	Area of sampling frame
Source of data:	Area of litter sampling frame used in plot p in stratum *i*
Description of measurement methods and procedures to be applied:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, may be applied
Frequency of monitoring/recording:	N/A
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC)

	procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, may be applied
Calculation method:	N/A
Any comment:	Often a litter sampling frame of 0.50 m^2 is used

Data Unit / Parameter:	$A_{p,i}$
Data unit:	ha
Description:	Area of sample plot
Source of data:	Field measurement
Description of measurement methods and procedures to be applied:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Frequency of monitoring/recording:	Every five years since the year of the initial verification
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, are applied
Calculation method:	N/A
Any comment:	Sample plot location is registered with a GPS and marked on the project map

Data Unit / Parameter:	$B_{LI\_WET,p,i}$
Data unit:	kg
Description:	Wet weight of the composite litter sample collected from plot p of stratum i; kg
Source of data:	Field measurements in sample plots
Description of measurement methods and procedures to be applied:	Standard operating procedures (SOPs) prescribed under national forest inventory are applied. In the absence of these, SOPs from published handbooks, or from the IPCC GPG LULUCF 2003, may be applied
Frequency of monitoring/recording:	Every verification
Value applied:	N/A
Monitoring equipment:	N/A
QA/QC procedures to be applied:	Quality control/quality assurance (QA/QC) procedures prescribed under national forest inventory are applied. In the absence of these, QA/QC procedures from published handbooks, or from the IPCC GPG LULUCF 2003, may be

	applied
Calculation method:	N/A
Any comment:	N/A

4.3 Description of the Monitoring Plan

Monitoring will be done according to the consolidated methodology AR-ACM0001 "Afforestation and reforestation of degraded land" (version 05.1.0, EB 60). Analysis of its applicability conditions have been developed in section 2.2 of this PD.

Monitoring comprises gathering information, performing calculations and making estimations of GHG emissions and removals. It ensures that commonly established principles of forest inventory and management are put into practice. All data gathered as part of the monitoring plan is archived electronically and kept at least for two years after the end of the last crediting period.

Physical limits will be calculated and checked periodically. The project boundary and the boundaries of pre-defined strata will be adjusted after plantations are established. This is be done by using GPS technology, and the information will be organized in GIS format. Areas of each stratum will be recalculated and adjusted accordingly.

All activities performed in each stratum will be recorded and relevant parameters quantified. This includes the following:

- Site preparation: application of herbicides, tillage operations (date of operation, tools used, number of passes, width of operation in strip tillage, depth of operation, chemical weed control).
- Planting date, number of trees planted per unit area, tree species.
- Tree survival rate
- Fertilization date, application form, type and amount of fertilizer used.
- Harvesting date, volumes of wood removed by type of product.
- Disturbances: date, location, affected area (using GPS), type of disturbance, biomass lost.

<u>Sampling design and stratification</u>

Project boundaries will be defined at the beginning of project activity and updated along the crediting period. Boundaries may vary or new strata may be created after disturbances effects (pests, droughts, fire) and boundaries will be redefined. Geographic coordinates are established, recorded and archived. A Geographic Information System will be implemented with the following basic layers:

- project boundaries
- aerial photographs
- soils map
- projected land-use map
- roads, fences, firebreaks, wood stocking areas, buildings, etc.
- permanent sampling plots

Other layers will be added in the future. The layers will be linked to several databases.

With the purpose of developing the monitoring plan, the total area will be divided in 22 strata. Stratification was done considering region (as described in section 2.3); age class (plantation date); and species planted[16]. Current stratification could suffer subdivisions or merges in the case unexpected disturbances occur or insignificant intra-stratum variability is detected in the annual variation in carbon pools (e.g. forest management activities like thinning or harvesting). The size of the sample plot is a trade-off between accuracy, precision, and time (cost) of measurement. The size of the plot is also related to the number of trees, their diameter, and the carbon stock variance among plots. The plot should be large enough to contain an adequate number of trees per plot to be measured. IPCC Good Practice Guidance for LULUCF, chapter 4.3, recommends using a single plot varying between 100 m^2 to $600m^2$, increasing the size from densely planted stands of 1000 trees per hectare to sparsely planted stands of multi-purpose trees. Because of application of thinning, forest stands in this project, have a low number of trees per hectare, tending to have a few large trees per hectare as the stands get older, and uniformly distributed. Taking into consideration the guidance by IPCC and the project-specific conditions, circular plots of 500 m^2 have been selected for monitoring. Permanent sampling plots are selected, since these are considered to be more efficient for estimating changes in carbon stocks by filtering out any variance due to plot effect.

Estimation of the number of sample plots was done in accordance with the methodological tool "*Calculation of the number of sample plots for measurements within A/R CDM project activities*". Calculations are archived as part of project documentation. The monitoring plan will aim at an estimation of the mean carbon stocks with a precision level of 10% with 90% confidence. These are the values suggested by the selected methodology, and have also been chosen because they reach a compromise between precision in estimation of the population parameters and costs of the measurement and processing (section 4.3.3.4.1 IPCC GPG). The outcome of the estimation from the tool was a total of 119 plots for the whole project area. The distribution of permanent sampling plots per stratum is presented in Table 11.

The location of the plots will follow the guidance given by the corresponding methodological tool, as well as IPCC Good Practice Guidance for LULUCF (2002), chapter 4.3. An Arc-Map software (NAPA) developed by Pike & Co. will be used to randomly locate the permanent sampling plots (location is systematic, with random start). This software has a feature to enable the location of all plots on forest areas (i.e., it avoids plots from being located in firebreaks and other non-planted areas). The map with the location of the sampling plots is loaded on the GPS receptors used by forest inventory crews, so that they can reach the plots accurately. An example of the software output for two contiguous strata is shown in Fig. 21.

Data collection

The following steps are followed for identifying the sampling points:

1. Identify the plot to be measured in the paper map and in the GPS.
2. Steer to the plot with the help of a GPS navigator.
3. When the operator is approaching the point, make sure the GPS has the best possible signal. Stop at the first point that the GPS reads zero. If the GPS is kept at zero, that is the point indicated,

[16] Taking into account different species already includes both forest managements applied (22 and 16 years rotation length).

otherwise move the GPS to the zero mark a second time. That becomes the ultimate focal point, even whether the zero moves again.

Table 11. *Number of plots per stratum*

Region	Monitoring strata	N°plots/stratum	Area_hectares
Cerro Chato/Valentines	CCH/V 2006 globulus	3	939
	CCH/V 2006 dunnii	1	46
	CCH/V 2009 maidenii	1	110
	CCH/V 2009 globulus	1	335
	CCH/V 2010 maidenii	1	291
Las Cañas	Las cañas 2010 grandis	1	70
	Las cañas 2011 grandis	1	224
	Las cañas 2009 grandis	2	382
	Las cañas 2008 grandis	29	5,204
	Las cañas 2007 grandis	25	4,509
Regis/Garao	R/G 2007 taeda	1	59
	R/G 2009 taeda	1	82
	R/G 2009 tereticornis	1	39
	R/G 2006 grandis	2	353
	R/G 2007 grandis	4	772
	R/G 2011 grandis	4	704
	R/G 2008 grandis	5	879
	R/G 2009 grandis	18	3,139
Tupambaé	Tup 2009 grandis	5	849
	Tup 2011 grandis	1	180
	Tup 2008 grandis	2	331
	Tup 2007 grandis	10	1,802
Total		**119**	**21,298**

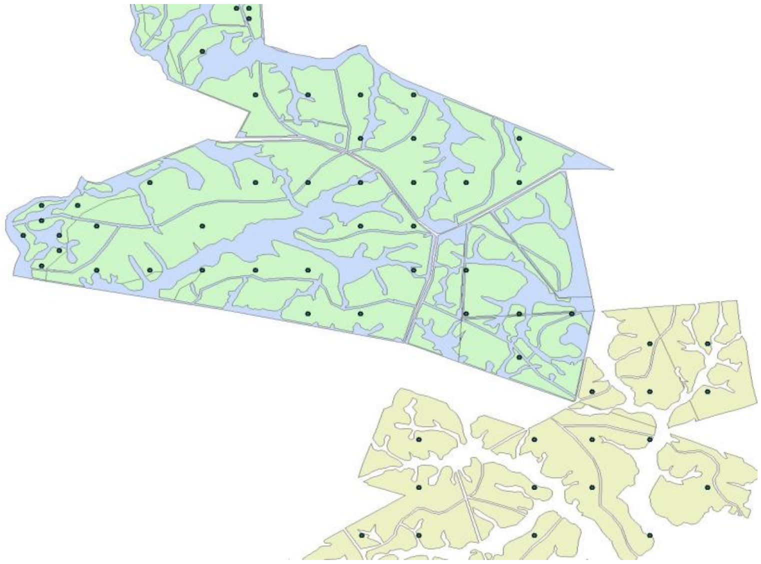


Figure 21. *Example of location of permanent sampling plots.*

4. Mark a new GPS point in the defined location.

5. Set the plot at that point, leaving a visible stake buried in the center of the plot (the stake is not intended to be permanent, but a mark for the control to be held a few weeks afterwards).

Each pool will be measured following the methodology procedures and IPCC Good Practice Guidance for LULUCF (2003). Carbon stocks in above and below ground biomass of trees are estimated by applying the BEF method. Stem volume, will be calculated applying a manual of procedures developed for local conditions, based on DBH and height measurement in each plot. Stem volume of trees is converted to above-ground and below-ground tree biomass using basic wood density (D), biomass expansion factor (BEF) and root-to-shoot ratio (R). Default carbon fraction (CF) value will be used in order to estimate the carbon stock.

Deadwood will be calculated according to the tool "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*". Two types of dead wood will be measured in the field: standing dead wood and lying dead wood. The former will be measured in the same sample plots used for estimating biomass stocks, and will be sub-divided into three categories. The carbon stock for the first two categories (dead standing trees and dead standing trees with fewer leaves and twigs) will be estimated in the same way as for living trees applying a reduction factor to account for lost biomass. The third category, which are standing trees with no leaves and branches, will be also divided into three types according to the rottenness level of the wood (a specific method will be applied in order to define rottenness). Each category will have a specific reduction factor. Laying dead wood will be estimated with the transect method. Two transect lines, intersecting and bisecting orthogonally each other in the center of the plot will be set. The length of the line should be of 100 meters in total. The diameter of wood pieces with diameter larger than 10 cm that are touched by the transect line are measured. The rottenness category is estimated as for standing dead wood. Then the methodological formula is applied.

Samples for measuring litter carbon stock shall be collected from the same plots used for living biomass estimations, using a sample frame to be laid on the ground on random locations. All litter on the area within the frame will be collected. A sub-sample shall be extracted and weighed. It shall be further oven-dried and weighed again. Dry to wet weight ratio shall be estimated, and the resulting value shall be applied to all samples in the plot. Then the methodological formula is applied.

In order to ensure that application of default data results conservative, the *"Guideline on conservative choice and application of default data in estimation of net anthropogenic GHG removals by sinks"* is applied.

Prior to the start of the inventory, all equipment used during the field work shall be checked and calibrated. This includes:

1. Measuring tapes: a. Verify correct display of the numbers b. Check if it is stretched. This is done by a comparison with all other tapes and the tape pattern (without use tape that is taken for backup). c. Verify that the tip of the tape is zero

2. Caliper: a. Verify correct display of the numbers b. Check for bent or mechanical problems c. In the case of digital caliper, verify the proper functioning of the electronic device, making successive comparisons with the scale of the same caliper or comparing with another caliper. d. Check the height for DBH measures obtained by each operator.

3. Height measurements disposals (Criterion): a. Verify correct display of the viewfinder (setting interior light intensity depending on environmental conditions) b. Check battery charge and the replacement ones c. Control measurements/calibration of them (measure height of 5 different trees with all the equipment to be used)

4. GPS: a. Verify correct display of the screen b. Check battery charge and the replacement ones c. Check the correct registration of the plots to measure d. Check the location of the plots with all GPS, ensuring that all team scores the same location.

5. Others: a. Equipment: In case there are other measuring pieces of equipment (such as Suunto, blumeneis and other), they should also be verified and calibrated. b. Safety Equipment: Helmet, Vest, Leggings

The project will manage the sampling uncertainties evaluating and trying to reduce the type of errors. For that, the project developer shall:

- produce a Measurement Protocol (MP) and run courses for all field personnel;
- double check 10 per cent of sampling measurements by an independent party team. If the difference between measurements is higher than 5%, a third definitive measurement will be run. If the difference is higher than 10% the sample plot will be eliminated;
- *minimize measurement errors*: special attention will be paid to systematic errors that could scale up to the total estimations and multiply the uncertainty. A number of quality assurance and quality control measures will be implemented, as explained elsewhere;
- *minimize model errors or static factors*: These errors were minimized in the design of the monitoring methodology, which makes minimal use of default values, and uses widely accepted equations or models;
- *minimize sampling errors:* The allocation of samples in the field will be random, so the differences between population and sample mean and variance will tend to neutralized, if the sample fraction is wide enough;
- *minimize data recording and calculation errors:* Usually hard to detect, they can be checked by controlling the range and variance of data of different measurement teams. Use of data loggers, software, automatic data recording field equipment, etc., will minimize errors in data handling.

Managing data quality

A Quality Control System will be implemented for routinely checking for data consistency, correctness and completeness; for identifying and correcting errors and omissions; and for properly documenting and archiving data and documentation related with the monitoring activities. Quality Assurance measures will be implemented, in order to verify that data quality objectives are met, and in general, to support the effectiveness of the QC system.

QA/QC plan includes a number of activities aiming at achieving accuracy and precision of data, and transparency of procedures, such as:

✓ *development of Standard Operating Procedures for field measurements,* clearly defining all staff responsibilities and raising awareness about the importance of each tasks for producing reliable results;

✓ *proper training of field measuring teams*;

✓ *periodical check and maintenance of measuring instruments; all mechanical, optical and electronic instruments will be periodically checked by qualified personnel. In addition, consistency on field data will be permanently monitored, in order to detect any malfunctioning.*

✓ *perform area measurements using different methods (e.g., aerial photograph, cadastral data, satellite images, ground measurements), and check for accuracy and consistency.*

✓ *development of electronic worksheets for data processing; special software may be designed for the monitoring process, with graphical capabilities and data consistency checking functions.*

✓ *fully document and archive field and processed data, as well as all procedures used; to ensure data preservation, all relevant data, data analyses, static factors, photos, images, GIS output and other data shall be stored in electronic and paper format.*

✓ *establish procedures for eliminating inconsistent or erroneous field data; perform random checks of field measurements in order to detect measurement errors or systematic biases; some of such measures are: 1) use field computers and automatic data loggers (e.g., electronic recording caliper), and hire independent workers for transferring field data to digital media. (IPCC GPG 5.3.6.1); 2) during field work, double check 10% of sampling measurements with an independent party team or with a team different from the one that performed the measurement or sampling; if the difference between measurements is higher than 5%, a third definitive measurement will be run. If the difference is higher than 10%, the data or the plot will be eliminated;*

✓ *establish procedures to ensure representativeness of PSPs (i.e., to avoid biased estimates due to differential management of PSPs); The allocation of samples in the field will be systematic with random start, so, the differences between population and sample mean and variance will tend to neutralized, as the sample fraction is wide enough; identification of plots in the field should be coded and apparent only to the monitoring team; periodical checks will be performed on simple measurements (e.g., DBH) outside PSPs, in order to correlate these values with plot measurements;*

✓ *development of allometric equations and emission/C-stock-change factors; project-specific equations and stock change factors would minimize errors, as compared to the use of default factors.*

✓ *check project data with benchmarks; this will help detecting possible inconsistencies in data collection or processing.*

<u>Operational and management structure</u>

The monitoring will be coordinated by the property manager (Forestal Atlántico Sur) and implemented by a qualified contractor. One staff member of Forestal Atlántico Sur will be identified as the focal point.

Entity applying monitoring plan

- **Forestal Atlántico Sur S.A.**
- Rincón 487/201
- Montevideo 11.000, Uruguay

5 ENVIRONMENTAL IMPACT

An Environmental Impact Assessment of the project has been prepared for each estate by Pike & Co. An analysis of possible environmental impacts of the proposed project activity leads to the following main conclusions:

Climate change mitigation

This is achieved mainly through carbon sequestration as shown in this PD.

Biodiversity preservation

The establishment of forest plantations designed to preserve high biodiversity value areas (such as native forests, wetlands and low areas under grassland) has proved to be effective in Uruguay. Since large-scale forest planting started in the 1990s, several surveys (mostly conducted by independent scientists on behalf of forest companies) have found a proliferation of birds, frogs, and mammals, some of which had been considered as extinct or endangered. These studies also allowed finding at least three new species (two birds and one frog) which had never been reported before in the country. One of them is a case of a completely new species. The project activity would produce similar impacts.

Hydrological cycle

It is well known that planting trees on a grassland site usually causes a reduction in the runoff and an increase in the evapotranspiration. This might cause some competition for water with other users (e.g. cattle farms located downstream in the watersheds, hydroelectric power generation, and water for human consumption). Some studies (e.g., Silveira et al., 2006[17]) have shown that this effect is not significant in Uruguay at the medium-size watershed scale (due to high precipitation). At the micro-watershed level, there might be some problems, which can be minimized by plantation design (e.g. by limiting the extent of forest plantations in a watershed). The proposed project will leave at least 35% to 40% of the land area unplanted, which would greatly reduce the hydrological effects, as compared with a more common 25-30% of unplanted area. In addition, since most of the project area flows into rivers with relatively high flow rate, no significant downstream effects are expected.

Any potential impacts on the hydrological cycle processes will be minimized by:

- the design of plantations, which will occupy only approximately 60% of the land area owned by *Guanaré*, avoiding sensitive areas; and
- the fact that the annual rainfall, and in particular during the spring-summer period, when usually water deficits occur, has been increasing over recent decades, and is expected to continue in the future, thus offsetting the expected decrease in runoff.

Given the fact that soil erosion will be controlled and that a minimal amount of agro chemicals will be used every 22 years; no negative impacts on water quality is expected. All watercourses in the project site will be continuously monitored. Proper corrective measures will be taken in the case of detection of pollutants above pre-project levels.

Soils

The area where the project will be implemented has an incipient process of soil erosion caused by overgrazing. This process may be accelerated due to climate change through the effects of an increased

[17] Silveira, L., Alonso, J., y Martínez, L. 2006. Efecto de las plantaciones forestales sobre el recurso agua en el Uruguay. Agrociencia (2006) Vol. X N°2 pág. 75-93

frequency of both droughts (and, in consequence, of overgrazing) and intense rainfall (leading to higher water erosion). In addition, the site has suffered from degradation due to nearly 300 years of extensive grazing by beef cattle and sheep, evidenced by a decrease in the content of organic carbon in the soils.

The implementation of the project activity will result in an effective protection of the soil against erosion and in a reversion of the degradation by building up soil organic carbon. Soils will be disrupted only once each rotation cycle and site preparation will be based on strip tillage, with strips oriented perpendicularly to slope direction, and use of glyphosate herbicide to minimize the exposure the soil to erosion agents. The tree vegetation will completely protect the soil and at harvest, bark, leaves and branches will be left on the ground, thus minimizing any negative impacts of erosion by rainfall and soil degradation by harvesting machinery.

Use of chemicals

The project will use a limited amount of certain chemicals during site preparation for plantation; this is, only once every 22 years. These products include:

- herbicides for site preparation. Including glyphosate, oxifluorfen and others, all of them properly registered and allowed by law in Uruguay. All these products will only be applied selectively (only when and where they are needed) and avoiding excessive rates. Adoption of safety procedures will minimize problems related with herbicide handling and spraying.

- insecticides for ant control: ants are a major problem in newly established plantations in Uruguay, and they must be controlled in order to obtain a successful plantation. The project will use fipronil and eventually other products recommended by the Ministry of Agriculture (MGAP). These products are used in localized applications (e.g. they are not overcast) and in small rates, and only during site preparation and the first weeks after plantation. Adoption of safety procedures will minimize problems related with insecticide handling.

- fertilizers: only limited amounts of starter fertilizers will be applied. Phosphorus is highly deficient in the project site soils, and application of phosphate localized at one side of each seedling ensures proper establishment. Average rate will be 100-150 g of P-rich fertilizer per seedling (between 1000 and 1100 seedlings/ha). Fertilizer will also have small amounts of nitrogen. In some cases, and according to soil analysis, small rates of potassium could be added, as well as some micro-nutrients needed to correct deficiencies.

Risk of forest fires

In compliance with national regulations, *Guanaré* has implemented an extensive plan to prevent forest fires. There are many preventive activities such as: i) establishment of a network of firebreaks surrounding forests blocks with an area not larger than 50 ha; ii) the introduction of cattle in early stages of the forestation for maintaining pastures short and green, thus reducing the volumes of fuel; iii) permanent surveillance of the project area, particularly at times of medium to high risk of fire; iv) burning as possible technique for cleaning fields is particularly excluded; vi) warning signs with risk of fire are placed next to forest sites; vii) transit of non-authorized hunters, hikers or campers is forbidden; viii) fire extinguishers must set in vehicles (including tractors) that circulate in the property.

The risk of fires in commercial forests plantations in Uruguay is very low due to reduced population density and a very humid climate. Normally forest fires in Uruguay only occur in summer in the coastal areas of the South and Southeast of the country, associated with the tourism activity.

In spite of prevention activities, fires can happen. In that case, equipment and staff (own and contracted) is ready and trained for fire fighting.

Socio-economic impacts

The project activity is expected to produce numerous socio-economic benefits, summarized as follows:

as a result of the project activity there would be an increase in the creation of jobs in an area with high unemployment and high poverty rates. The forestry activity in Uruguay causes an 8 to 10 fold increase in the number of jobs per unit area of land, as compared to extensive livestock production activity. Job quality is also improved, since forestry wages are typically higher than those of other activities in rural areas. The project activity makes a contribution to the attenuation or reversal of the phenomenon of population migration from the project zone to urban and other areas of the country. This phenomenon of migration from rural areas is one of the leading causes of the main social problems affecting the country.

In addition, there is also an increase (in relation to cattle production) in the number of job opportunities for women, in activities such as nurseries, planting, pruning and others. This would help to improve the stability of rural families. Forestry workers in Uruguay normally return home after each workday, which is a big improvement over the situation of the livestock sector, which strongly depends on workers residing on farms, away from their families.

The development of services in the towns next to project area is boosted due to the project activity. The gross value of production per unit land area will increase between 6 to 8 times as compared to extensive livestock farming, and this triggers an increase in the demand for various services.

Forestry also produces an increase in tax revenues as compared to the previous land use, associated with the higher gross value of production and increased number of workers and demand or services.

Biomass production is an energy resource of high strategic value for Uruguay, given the fact that the country completely lacks fossil fuel resources. Nearly 25 per cent of the energy consumed in the country in 2010 was in the form of biomass, and the government has implemented a policy for promoting the generation of electricity from biomass, which will increase that share during the coming years. The project activity will increase the supply of biomass in the forms of thinning wood and forest harvest residues, thus contributing to the energy security of the country.

6 STAKEHOLDER COMMENTS

There are no stakeholder’s comments.