CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) Version 04

CONTENTS

Annexes

SECTION A. General description of the proposed A/R CDM project activity:

A.1. Title of the proposed A/R CDM project activity:

Title of the A/R CDM project activity: Reforestation of grazing Lands in Santo Domingo, Argentina
The version number of the document: 06
The date of the revised document: 01/05/2013

A.2. Description of the proposed A/R CDM project activity:

The proposed A/R CDM project activity, Reforestation of Grazing Lands in Santo Domingo, Argentina, is a FSC[1] certified reforestation project using native and exotic species aiming at credible carbon sequestration and generating high value forestry products. The proposed A/R CDM project activity fosters application of native species in northern Argentina forestry plantations and hence contributes to environmental and social benefits in the region. The proposed A/R CDM project activity is located in a property of 2,927 ha with a project area of 2,292 ha, within the Santo Domingo Estate, located in the Department of Ituzaingó Province of Corrientes, in northern Argentina.

The specific project objectives include:

(1) To sequester CO_2 through forest planting in grassland areas, generating net anthropogenic removals by sinks that can be measured; monitored and verified. The net anthropogenic removals by sinks in the proposed A/R CDM project activity will help the project participant to achieve a voluntary emission reduction target. Being part of this voluntary emission reduction strategy, the generation of carbon credits is the main driver of the proposed A/R CDM project activity.
(2) To establish sustainable FSC certified forest plantation using native species, aiming at high quality forestry products generating local and regional value added and fostering the demand of native species products from northern Argentina. The high value added of products is in line with the sustainable management of the project activity since this leads to higher economic revenues in the region.
(3) The innovative native species plantation will bring along environmental benefits such as soil protection, water runoff regulation and biodiversity benefits. The environmental impacts have been assessed and will be monitored in accordance with CDM rules and procedures and FSC Principles and Criteria. In addition, the plantation connects the few native forest patches on the property, adjacent to the project area, that are kept in order to protect water resources and habitats of local fauna and flora.
(4) The project generates long term and seasonal employment opportunities on-site, and will lead to employment in the wood products industry where the wood will be processed. High value timber products of native species and *Grevillea robusta* will be sold to the local joinery and furniture industry. The Pinus sp products will be sent to the local pulp and paper industry (e.g. Alto Parana). A social impact assessment with local people has been conducted and will be subject to monitoring in line with CDM rules and procedures and FSC Principles and Criteria.

[1] FSC-Certification done by Smartwood in August 2009. Certificate SW-FM/CoC-003027

To achieve these objectives the proposed A/R CDM project activity consists of setting-up a mixed forest plantation targeting at 75% of native species and 25% of fast-growing exotic species with an excellent adaptation in the zone, like *Pinus elliottii*, *Pinus taeda* and *Grevillea robusta*. These species will be used in the beginning phase to support native species plantations especially on areas with more difficult growing conditions. The plantation will cover the whole project area. The native species were chosen after screening the existing natural forest patches adjacent to the project boundary to assure that mostly species with local adaptation are used. The planting of tress began in June 2007 and the last native species trees will be planted during 2009.

Table 1: Native species to be planted

Cabralea canjerana
Jacarandá micantha
Cedrela fissilis
Apidosperma australe
Myrocarpus frondosus
Nectandra megapotamica
Cordia trichotoma
Pterogyne nitens
Parapiptadenia rigida
Patagonula americana
Tabebuia heptaphylla
Ruprechtia laxiflora
Enterolobium contortisiliquum
Araucaria angustifolia
Peltophorum dubium
Inga uruguensis
Tabebuia pulcherrima
Tabebuia ochracea

The project uses nurseries located in the region (Misiones and Corrientes). A list and description of the nurseries is found in section A.5.4. (Table 5). The project activity supports the nurseries in gaining experience with native species. This contributes to the development of further native species plantations in northern Argentina.
The main plantation management technology which is applied under the proposed A/R CDM project activity is reforestation through direct planting with environmental-friendly, low impact techniques on grassland. The following technical standards are strictly followed:

- Forest Management Plan
- Forest Stewardship Council`s Principles and Criteria
- Any requirement under the CDM as detailed in this PDD

Geographical Information System (GIS) and Geographical Positioning System (GPS) are and will be applied for determination of project location, baseline and project stratification, monitoring and the verification of the proposed A/R CDM project activity.

The application of native species mix in combination with FSC certification makes the proposed A/R CDM project activity an innovative one among northern Argentine forestry projects. Currently knowledge concerning native species plantation management, biomass growth performance and seeding preparation in nurseries is rather limited. Most forestry plantations in northern Argentina apply fast growing exotic species like *Pinus* spp. and *Eucaliptus* spp. with a rather limited value added. The proposed A/R CDM project activity therefore can be seen as a pioneer project that helps to generate knowledge on native species nurseries, plantation management or biomass growth models. In addition, the proposed A/R CDM project activity may foster demand for high value native species products from northern Argentina, which may help other forestry activities to work with native species in future.

The land of the project activity was purchased from a family active in grazing land management. Meanwhile, the original land owners have left the place and quit livestock farming activities. Since 2007 and until May 2009 all cattle were sold and displaced, partly directly to slaughterhouses partly to other livestock farmers in the vicinity who feed the cattle for meat production. The cattle density on grazing lands of the buyers will not surpass one animal per hectare which is the sustainable grazing threshold value in northern Argentina. The project does not cause further shift of people or job dismissals because the grazing lands were managed by the owners (a family) themselves. In contrary, the project leads to new employment.

The proposed A/R CDM project activity is a reforestation project because project participant were not able to provide hard evidence that the project region was without forest cover for the last 50 years. According to former land owner and interviews with local people, the land has been used as grazing land for more than 50 years, but there is no hard evidence for that. The oldest document found describing the land as grazing land was published in 1967.

A.3. Project participants:

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Argentina (host)	• Novartis Argentina S.A.	No
Switzerland	• Novartis Pharma AG	No
(*) In accordance with the CDM A/R modalities and procedures, at the time of making the CDM-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: When the CDM-AR-PDD is prepared to support a proposed new baseline and monitoring methodology (form CDM-AR-NM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

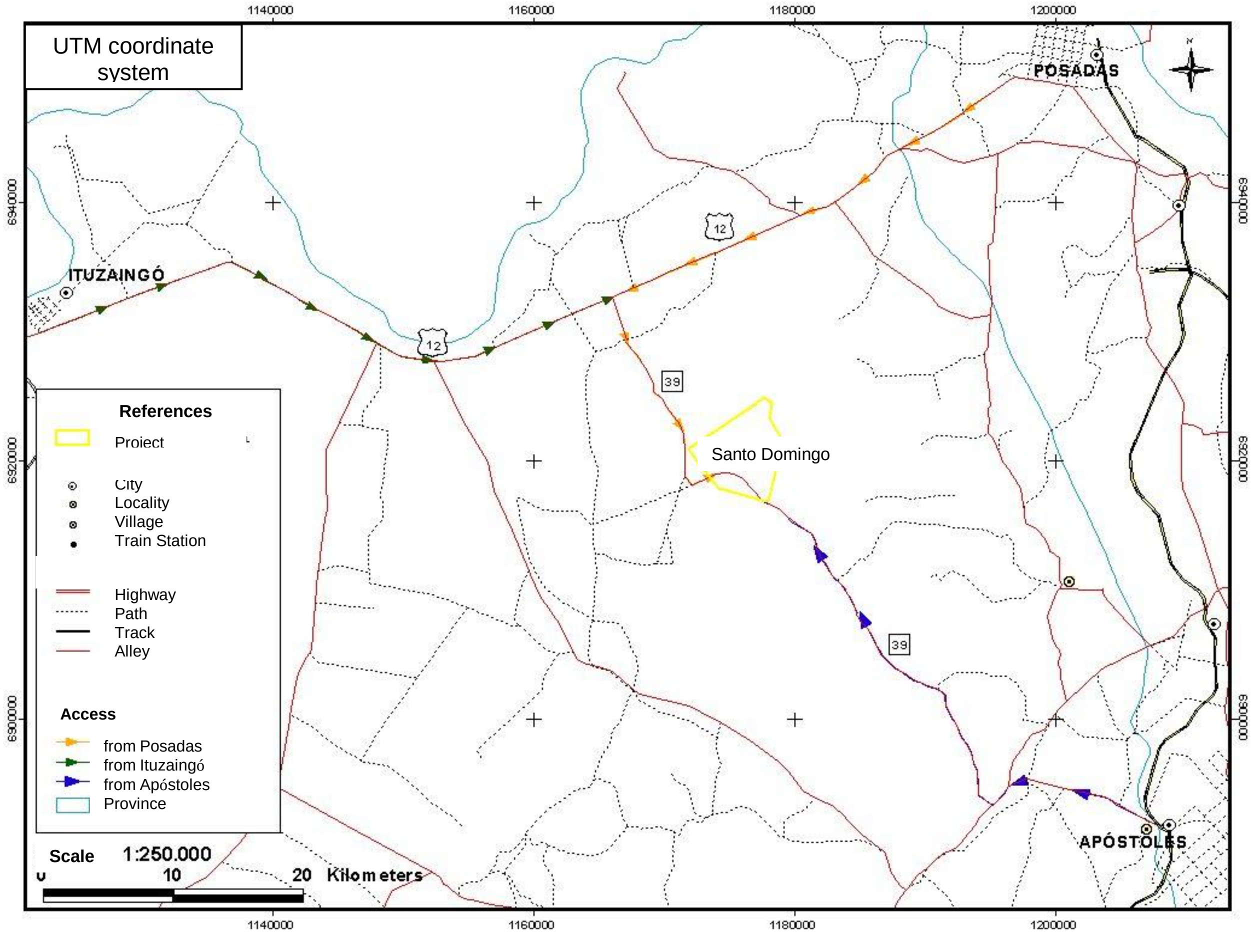
A.4. Description of location and boundaries of the A/R CDM project activity:

A.4.1. Location of the proposed A/R CDM project activity:

The proposed A/R CDM project activity is located in Ituzaingó Department of the Province of Corrientes (Figure 2), in northern Argentina (Figure 1).

Figure 1: Map of Argentina showing the project location

Figure 2: Location of the proposed AR CDM project activity



A.4.1.1.	**Host Party(ies):**

Argentina

A.4.1.2.	**Region/State/Province etc.:**

Region: Ituzaingó (Department); Province: Corrientes

A.4.1.3.	**City/Town/Community etc:**

Santo Domingo

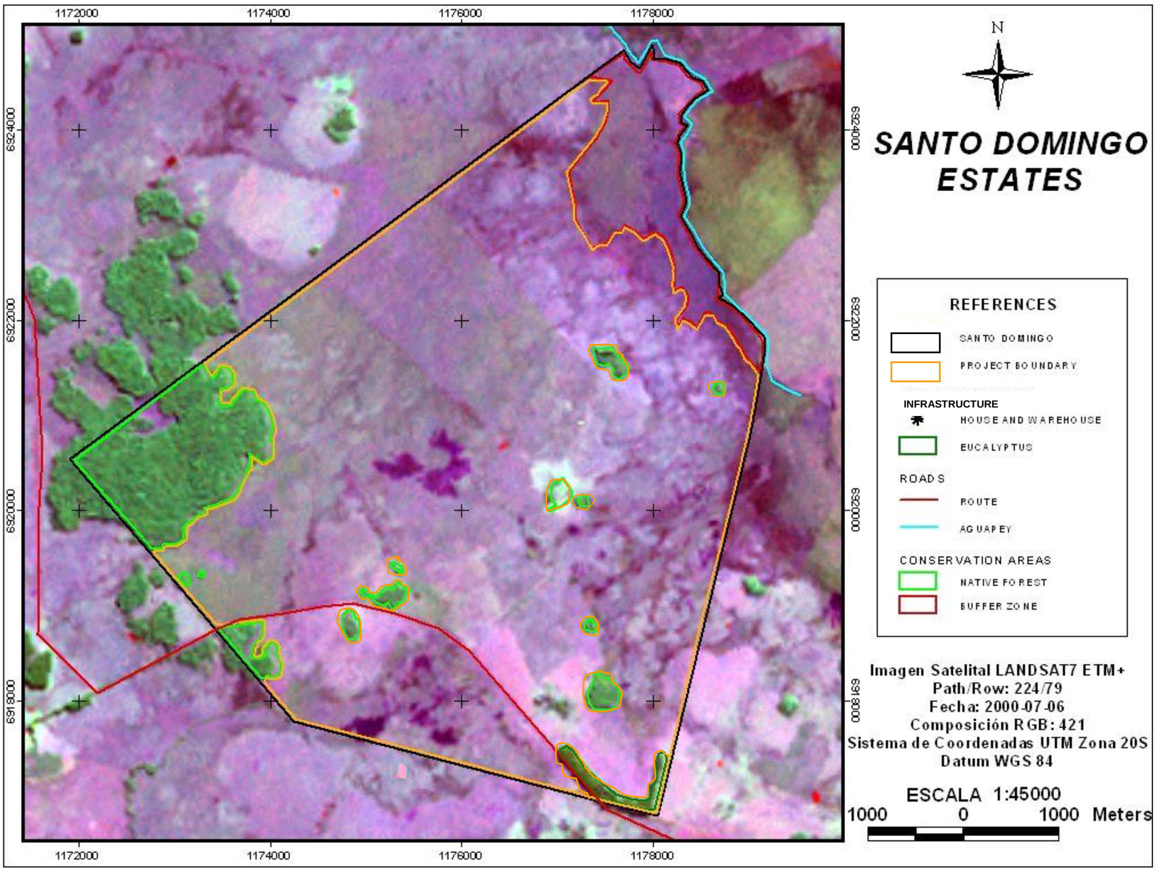
A.4.2 Detailed geographic delineation of the project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

The proposed A/R CDM project activity is located in one discrete area of land. The project boundaries and geographical locations are indicated in the figure below (Figure 3) and the specific geographical positions (longitude/latitude) at each corner have been determined using GPS.

Project Boundary: This discrete area of land (project area of 2,292 ha) is confined within a property of 2,927 ha of land, between latitudes 27°37'25'' S and 27°42'12" S and longitudes 56°12'10'' W and 56°07'40'' W, in an altitude between 100 m and 130 m above sea level. The area consists of pastures with native grass species. There are few trees on the area. On the property itself, adjacent to the project area there are some small natural forest patches kept for protection of water resources and habitats of local flora and fauna. The forest patches are outside of project boundary and will be left unmanaged.

Title Deed: Currently the property is owned on behalf of Novartis Argentina S.A. by a fiduciary located in Buenos Aires. This fiduciary is the owner of the land until an approval of the border zone commission is issued for owner rights transfer. Novartis Argentina S.A. will take over the property as soon as the National Border Zone Commission will have cleared the application of Novartis Argentina S.A.. The original land owners have left the place and quit livestock farming activities. The transfer of the land is in the legal process according to Argentina laws. The transfer of the carbon rights from Novartis Argentina S.A. to Novartis Pharma AG is regulated via a Purchase Agreement.

Figure 3: Project boundary overlaid on Landsat 7 ETM+ Image



A.5. Technical description of the A/R CDM project activity:

A.5.1. Description of the present environmental conditions of the area planned for the proposed A/R CDM project activity, including a concise description of climate, hydrology, soils, ecosystems (including land use):

The proposed A/R CDM project activity was implemented in an area of extensively managed grassland with scattered trees. The present environmental conditions have not changed from conditions before the project started. The environmental conditions of the land before the project started are described as follows:

Climate:
The climate of the project area in the northeast of the province of Corrientes belongs to the subtropical humid without dry station climate at the border to the tropical climate zone. The mean annual frost-free period is 344 days. The annual mean precipitation is 1,800 mm. The annual mean temperature in the region is 21.4 °C, with the extreme temperature of 45 °C in the summer and –5,5 °C in the winter, nevertheless frosts are not frequent. The annual mean evaporation is 1050 - 1100 mm. The annual mean humidity is 77%.

Hydrology:
In the Province of Corrientes approximately six hundred water bodies exist (among the rivers, streams, lagoons, marsh-lands, swamplands, etc), which occupy between 10 and 20% of the provincial surface, the variation due to the fluctuations in the water levels. The 65% of the provincial surface discharge towards the Paraná River, whereas 35% drain towards the Uruguay River. The hydrology of the project area is represented by the Agapey River at northeast with a permanent watercourse.

Soils:
There are four soil orders within the project area, including Inceptisols, Ultisols, Mollisols and Histosols (according to Soil Taxonomy). The soils in the highest sites are deep red associated with yellowish brown soil and the soils with hydromorphic characteristics at the base of the hills. Contrasting with these the soils of the area of influence of the Aguapéy River, are of dark colors, moderate depth, with the water table at or near the surface for much of the year (Inceptisols) and characteristics related to excess of humidity. Limiting factors are the risk or the susceptibility to water erosion and floods.

Ecosystems and Land use:
Within the boundary of the project area there are 290 single standing trees. The single trees will not be felled but will be integrated to the plantations. They are subject to baseline emissions and monitoring. The natural forest patches and buffer zone adjacent to the project area will be preserved among others for protection of water sources and habitats for local fauna and flora. Their area and development is subject to monitoring. For the last 50 years at least the land has been used as extensively managed grassland for cattle dedicated to meat production (this is evident from interviews, but no hard evidence, e.g. pictures or peer reviewed literature, has been found). Accordingly, the area consists mainly of pastures with native grass species (e.g Cyperaceae).

A.5.2. Description of the presence, if any, of rare or endangered species and their habitats:

The project area is characterized by the presence of grassland-Steppe savannah on the hills; grassland and meadow on hydromorphic soils on of valleys and alluvial plains. Within the project area no rare or endangered vegetal species has been observed[2].

Specialists have registered the presence of 23 species of mammals, 427 species of birds and 106 species of amphibians and reptilians in the northeast region of the province of Corrientes. Some of these species are in danger, like pampas deer (*Ozotoceros bezoarticus leucogaster*), aguara-guazú or maned wolf (*Chrysocyon brachyurus*), marsh deer (*Blastoceros dichotomus*), neotropical otter (*Lontra longicaudis*), yellow anaconda (*Eunectes notaeus*), in addition to saffron-cowled blackbird (*Xanthopsar flavus*) and golden pipit (*Anthus nattereri*). Please note that these species have been recorded to occur in the northern Corrientes region. For that reason they may appear in the project region. Investigations on fauna and flora on the project area have been conducted in 2008 and all species have been recorded. [3]Some of the species, especially birds, appear on IUCN list of endangered species.

[2] Cecilia Domecq (2009); Categorizacion de la Fauna y Flora del Establecimiento “Santo Domingo” Ituzaingo,Ctes., Argentina, p.3.

[3] Krauczuk Ernesto Rubén, 2008; Los Anfibios de la Estancia Santo Domingo Corrientes, Argentina

Table 2: List of Birds found in Santo Domingo under IUCN List BirdLife International. Categories; EC: Critically Endangered; EN: Endangered; TH: Threatened; VL: Vulnerable; LC: Least Concern

FAUNA

List of Birds found in Santo Domingo
by Ernesto Krauczuk

Familia	Species	Aves Arg/AOP-Sec Ambiente y Desarrollo categoria				
		EC	EN	TH	VL	LC
Familia RHEIDAE Bonaparte, 1849						
	Rhea americana (Linnaeus, 1758)			X		
Familia CRACIDAE Rafinesque, 1815						
	Penelope obscura Temminck, 1815			X		
Familia ACCIPITRIDAE						
	Percnohierax leucorrhous			X		
Familia FALCONIDAE Leach, 1820						
	Micrastur semitorquatus (Vieillot, 1817)				X	
Familia STRIGIDAE Leach, 1820						
	Megascops atricapillus				X	
Familia CAPRIMULGIDAE Vigors, 1825						
	Lurocalis semitorquatus (Gmelin, 1789)				X	
	Eleothreptus anomalus		X			
Familia RAMPHASTIDAE Vigors, 1825						
	Ramphastos toco Statius Muller, 1776					
Familia TYRANNIDAE Vigors, 1825						
	Culicivora caudacuta (Vieillot, 1818)		X			
	Gubernetes yetapa (Vieillot, 1818)				X	
	Alectrurus risora (Vieillot, 1824)		X			
Familia EMBERIZIDAE Vigors, 1825						
	Emberizoides ypiranganus Ihering & Ihering, 1907				X	
	Sporophila bouvreuil (Statius Muller, 1776)			X		
	Sporophila palustris (Barrows, 1883)		X			
	Sporophila hypochroma Todd, 1915		X			

Héctor A. Keller, Luis Ritter & Marcelo Franco, 2008; Estudio de Biodiversidad Vegetal en Fragmentos de Selvas y Bosques Marginales del Predio Santo Domingo, Departamento Ituzaingó, Corrientes, Argentina. Facultad de Ciencias Forestales . Universidad Nacional de Misiones

Krauczuk Ernesto Rubén, 2008; Las Aves de la Estancia Santo Domingo Corrientes, Argentina

Krauczuk Ernesto Rubén, 2008; Identificación y Caracterización de los pastizales Ea. Santo Domingo S.A. Ituzaingó. Corrientes

Cecilia Domecq (2009); Categorizacion de la Fauna y Flora del Establecimiento “Santo Domingo” Ituzaingo,Ctes., Argentina,

Table 3: List of mammals found in Santo Domingo in 2007 under Red List of mammals of Argentina (SAREM). Categories: CR: Critically Endangered; EN: Endangered; VU:Vulnerable; NT: Near Threatened; LC: Least Concern; EX: Extinct; DD: Insuficient Data

lista de especies de Mamiferos avistados en Sto Domingo 2007 a la fecha por personal del Establecimiento	LIBRO ROJO de Mamiferos amenazados de la Argentina - SAREM						
especies de mamiferos							
Familia Cibidae	CR	EN	VU	NT	LC	EX	DD
Alouata caraya							
Cebus apella					X		
Familia Canidae				X			
Chrysocyon brachyurus							
Pseudalopes culpaeus		X					
Cerdocyon thous							
Familia Hydrochaeridae				X			
Hydrochaeris hydrochaeris							
Familia Cervidae				X			
Ozotoceros *bezoarticus*							
Mazama americana		X					
Blastoceus dichotomus					X		
		X					

The FSC report of 2009[4] provided by Smartwood states that adequate and necessary measures are taken by project activity to protect endemic species and their habitats. This is mainly done through protection of existing natural forest patches and a sufficient buffer zone along the river, both adjacent to the project area. In addition, the project works largely with a mix of native broadleaf species that occur in the natural forest patches.

A.5.3. Species and varieties selected for the proposed A/R CDM project activity:

Tree species applied have been determined taking into consideration carbon sequestration rates, biodiversity enhancement, soil erosion control and the value of associated forest products. These species include exotic species with recognized development in the region (*Pinus elliottii*, *Pinus taeda and Grevillea robusta*). These fast-growing exotic species with an excellent adaptation in this region generate environmental conditions that protect the native species in the initial growing phase.

All native species planted in the project appear in the natural forest patches adjacent to the project area, except *Araucaria angustifolia*. However, *Araucaria angustifolia* is native in the region, therefore it is considered native to the project. The native species used are the following:

[4] FSC report 2009: Manejo Forestal – Auditoria annual 2009. Informe para: Fidecoismo Santo Domingo. Rainforest Alliance.

Table 4: Trees selected for the proposed A/R CDM project activity

Cabralea canjerana
Jacarandá micantha
Cedrela fissilis
Apidosperma australe
Myrocarpus frondosus
Nectandra megapotamica
Cordia trichotoma
Pterogyne nitens
Parapiptadenia rigida
Patagonula americana
Tabebuia heptaphylla
Ruprechtia laxiflora
Enterolobium contortisiliquum
Araucaria angustifolia
Peltophorum dubium
Inga uruguensis
Tabebuia pulcherrima
Tabebuia ochracea

The spacing of the exotic species is standard and is adopted to soil conditions and planting techniques. There is little or no experience with some of the native species planted. Native species are inter-planted with *Pinus eliotti/taeda* in rows or with *Grevillea robusta* in groups (enrichment planting in groups). The two models are applied in order to diversify performance risks of native species. If one species fails, the area will be replanted with native species that have grown successfully. In general, failed plantations of native species are replanted with native species. Reference to these models is made in section A.5.4

A.5.4. Technology to be employed by the proposed A/R CDM project activity:

The main technology which is applied under this A/R CDM project activity is reforestation through direct planting with environmental-friendly techniques on grassland. Successful national and international technologies are adopted. The following technical standards will be strictly followed:

- Forest Management Plan
- Forest Stewardship Council`s Principles and Criteria[5]
- Any requirement under the CDM as detailed in this PDD

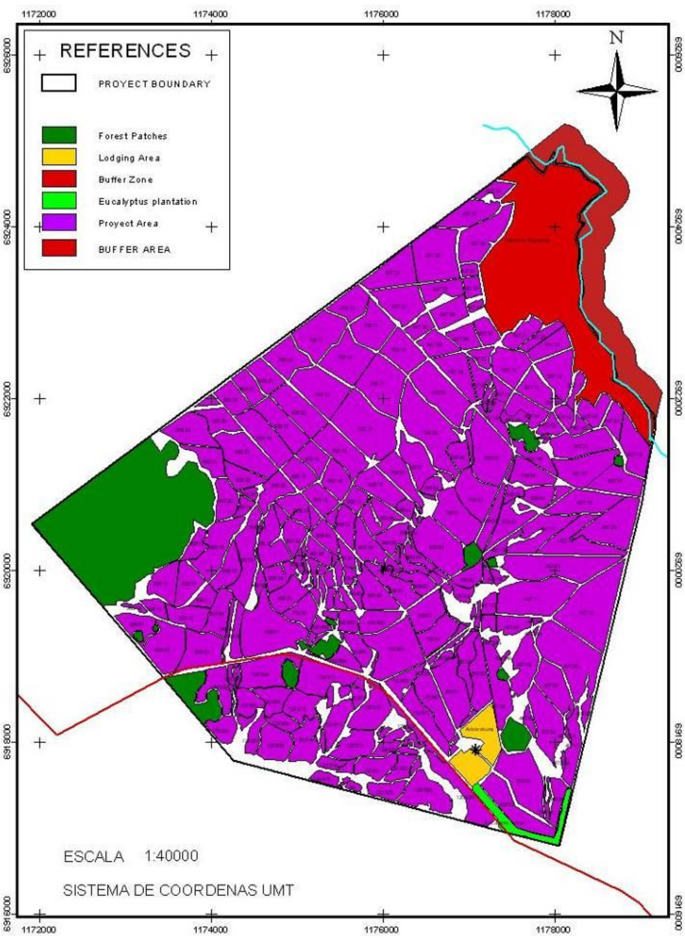
Geographical Information System (GIS) and Geographical Positioning System (GPS) are applied for stratification, monitoring and verification of the proposed A/R CDM project activity.

[5] FSC Certificate from 24. February 2008, SW-FM/COC-003026

Site and Soil preparation

To prevent soil erosion, reduce GHG emissions and protect existing carbon stocks, site burning will not be applied during site preparation. Traditionally in northern Argentina, grassland burning is used as a management tool for the renewal of the sites, which results in carbon and non-CO_2 GHG being released into the atmosphere.

Figure 4: Land use of the A/R project area



In the proposed A/R CDM project activity, the planting site was determined and mapped using GIS application before planting. The map indicates all plantable areas, buffer zones (adjacent to project boundary) and conservation areas (natural forest patches outside project boundary) and rivers (Figure 4). Depending on monitoring requirements and purpose, additional variables can be included ex post in the GIS system.

In the proposed A/R CDM project activity site preparation is executed taking into account special site characteristics (low lands and hillock) and most of the original vegetation will be kept. The soil preparation in the low lands includes drilling of narrow drills and application of a role that leads to a small heap (ridges; 50 cm height and 1.8 m width) of soil in which seeds are planted. Distance between

plants depend on five different planting scenarios and vary between 3, 4 and 5 meters between the lines and 2 and 2.5 meters within lines (see Table 6). These ridges are oriented in a way that permits the excess water to evacuate contributing to a natural runoff. This site preparation helps to improve better development of the roots avoiding floods and surface runoff of the water. In the hillocks, tillage was performed with subsoiler at 30 cm depth that removed the soil vertically without causing superficial accumulation, permitting the water caption and the root development in depth. Afterwards a disk harrows was used in line with the tilled soil.
Site preparation is not expected to cause significant longer term net emissions from soil carbon. Soil drainage and disturbance are negligible. Weeds and leave cutter ants are treated with common chemicals in line with FSC principles and indicators.

Figure 5: Soil preparation

Genetic Sources and Nursery Practices

A total number of 2’128’000 Pinus sp. seedlings 670’000 native species seedlings and 145’000 Grevillea robusta seedlings will be purchased from different nurseries of the provinces of Misiones and Corrientes (Table 5).

Table 5: Production of nurseries in Misiones and Corrientes

Nursery	Species	Location	Province	Production
San Miguel	Native	Garuhape	Misiones	200'000
Chajaikoski	Native	Apostoles	Misiones	100'000
Hut	Native	Cerro Moreno	Misiones	200'000
Carlos Lange	Native	Montecarlo	Misiones	25'000
Forestal Maria Silvia	Native	Jardin America	Misiones	30'000
Huagro	Exotic	Virasoro	Corrientes	3'000'000
Ruben Kolln	Exotic	Eldorado	Misiones	1'000'000
Cham	Exotic	Capiovo	Misiones	5'000'000
Pomera	Exotic	Ituzaingo	Corrientes	4'000'000
Loreto Forestal	Exotic	Loreto	Corrientes	2'000'000

PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

The transfer from the nurseries to the plating area of the seedlings in small tubes is carried out in air-conditioned trucks to protect the seedling from heat and wind. The seedlings are in tubes with holding bags filled with a moistening gel to avoid dehydration of the seedlings.

Forest Establishment

The planting activities will last three years, starting in 2007 as in the following planting plan:

Table 6: Planting Plan

CASE	SPECIES	YEAR	HA	CONFIG. PINUS	CONFIG. NATIVE	NAT. INTERPL.	CINFIG. GREVILLEA	PINUS (TREE/HA)	NATIVE (TREE/HA)	INTERPL (TREE/HA)	GREVILLEA (TREE/HA)	TREE/HA
1	Pinus	2007	142.80	5 x 2.5				800				800
2	Pinus	2008	465.19	4 x 2				1250				1250
3	Pinus	2008	278.34	5 x 2				1000				1000
4	Mixed Loma	2007	65.23	5 x 2.5	5 x 7.5			800	267			1067
5	Mixed Loma	2008	273.51	3 x 2	3 x 8			1667	417			2083
6	Mixed Loma	2008	76.98	5 x 2	5 x 6	5 x 3		800	333	667		1800
7	Mixed Bajos	2007 -08	505.47	5 x 2.5	5 x 7.5			800	267			1067
8	Mixed Bajos	2008	30.99	4 x 2	4 x 8			1250	313			1563
9	Mixed Bajos	2008	8.17	5 x 2	5 x 8			1000	250			1250
10	Grevillea/Native	2009	100		3 x 2		3 x 2		833		833	1667
11	Grevillea/Native	2009	184.7		3 x 2,5		3 x 2,5		1000		333	1333
12	Pinus	2009	86.3	4 x 2,5				1000				1000
13	Mixed media loma	2009	74.2	4 x 2	4 x 2			625	625			1250

Since the knowledge-base on native species plantations in northern Argentina is rather underdeveloped, it was decided to carry out different plantation patterns (13 cases) with different tree densities, spacing and mixes of *Pinus eliottii*, *Pinus taeda*, *Grevillea robusta* and native species.
Tree density of the different cases are between 800 and 2083 plants per hectare, depending on the plantation scenarios described in Table 6. Table 6 also describes distances within and between the rows. In 2007 and 2008 native species were planted in the same rows with *Pinus eliottii*, *Pinus taeda.* In 2009 different patterns are applied. Besides plantings of native species with *Pinus eliottii*, *Pinus taeda* in rows there are cases (10 and 11) where native species and *Grevillea robusta* are planted in alternating homogenous groups[6]. The two distinct models are applied to diversify performance risk of native species. At the beginning 25% of the area will be native species and 75% exotic species. The mid term goal, with successful thinning is to have 75% of the project area planted with native species mix and 25% planted with Pine and *Grevillea robusta*.
No nitrogenous fertilizer will be applied. Ant control will be carried out until the second year of planting with the use of chemical pesticide.

Forest management

Forest maintenance operations include weeding, pruning and thinning, according to the forest management plan. The first year following planting, weeding is done with Glyphosphate with two or three applications. The pruning aims to remove dead or low branches of the stem in order to improve wood quality from *Pinus elliottii*, *Pinus taeda* and *Grevillea robusta* and is carried out with saws or scissors, and is performed in gradual form taking into consideration the development of the trees. The first pruning will be carried out when the DBH is not greater than 0,10 m.

[6] Griselda Guarino (2009):Manual de Diseño de Plantación, Año 2009-Estabelicimiento Santo Domingo, GMF.

In case of the *Pinus elliottii, Pinus taeda* stands two thinnings will be realized. The first thinning will be carried out at the age of 8 and the second at the age of 13. Thinnings will be executed in order to gradually reduce the density of fast-growing exotic species to permit the better development of the native species. The management of the native species will be done in function of the growth. Currently, thinning of native species and Grevillea robusta (in Case 10 and 11) is planned to be conducted at the age of 12 and 17. In the other cases (4-9) no thinnings on native species will be realised. The remaining *Pinus elliotti, Pinus taeda* trees will be harvested after the age of 20 years. *Grevillea robusta* and native species are expected to be harvested between 25 and 30 years after planting year. In the cases 5 and 6 due to forest management optimisation it is possible that thinnings will be advanced approximately one year or that one further thinning will be introduced.

A.5.5. Transfer of technology/know-how,if applicable:

There will be no technology transfer from Annex-1 countries to the Host Country related to the project activity.

A.5.6. Proposed measures to be implemented to minimize potential leakage:

The approved methodology assumes leakage to be occurring from fossil fuel combustion and activity displacement. The use of fossil fuel in project activities will be minimized and optimized by using machinery only where necessary and using cars and vehicles strictly for project purposes. Land preparation method will not involve ploughing, nor slash and burn practice. The project will cause a land use shift from livestock to forest plantations. The shift occurred stepwise in such a way that by May 2009 all cattle was displaced. Cattle was either slaughtered or sold and displaced to pastures of other land owners in the region. The pastures of these other land owners hence serve as temporary substitute to provide the foregone goods from the project. The cattle density in pastures of the land owners in the region will not surpass the limit of one animal per hectare, which is considered to be the threshold value for sustainable grazing land management in the region[7]. The area of cattle farming of land owners who bought cattle from the project area will not increase due to the project activity. According to this, the activity displacement will not cause any land use changes or biomass loss outside the project boundary. Currently in Corrienntes 4.382 mio cattle lives on 6.860 mio ha of grasslands[8]. This provides further evidence that the shift of cattle caused by project activity is negligible. The project activity leads to an overall decrease of cattle number in the region, due to increased slaughtering. Since the displaced cattle was bought for meat production and density threshold values will not be surpassed on the existing cattle farming areas no leakage will occur. The cattle density will be monitored in first year of monitoring. As of per August 2008 approximately 400 animals were sold to slaughterhouses and 2000 animals to regional grazing lands. The rest of the cattle was displaced until May 2009.

[7] See for instance:

Guillermo Chiossone 2006: Sistemas de produccion ganaderos del noreste de Argentina, INTA.
Kurtz, Dietmar; Ligier, Daniel (INTA 2008): La carga ganadera “real” en la provincia de Corrientes.

The animal densities lie, depending on the pastures, between 0.3 and 0.71 animals per ha. These densities are calculated including unmanageable land like forests, rivers, swamps etc. If these areas are deducted around 1 animal per hectare results, which is considered to be the sustainable threshold value in the region.

[8] Guillermo Chiossone 2006: Sistemas de producción ganaderos del noreste de Argentina, INTA

A.6. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

Currently the property is owned on behalf of Novartis Argentina S.A. via Operating and Forestry Rights Agreement by a fiduciary located in Salta. Novartis Argentina S.A. will take over the property as soon as the National Border Zone Commission will have cleared the application of Novartis Argentina S.A.. The original owners have left the area and quit livestock farming activities.

Rights to lCERs: Novartis Argentina S.A. has transferred exclusive rights to all accumulated lCERs issued for the proposed A/R CDM project activity to Novatis Pharma AG via a Purchase Agreement. Novartis Pharma AG uses the lCERs within their voluntary GHG emission offsetting strategy and will not sell the lCERs but retire them. The ownership of carbon credits is clarified in the Operating and Forestry Rights Agreement. The Agreement is governed by law of Argentina.

A.7. Assessment of the eligibility of the land:

The Argentinean Government defines forests as land having growing trees with:

- A minimum area of 1 hectare;
- A minimum tree crown cover of 22.5%; and
- A minimum height of 3 meters.

Therefore, the threshold values of the forest definition of Argentinean government complies with the UNFCCC definition and are to be used for the purposes of the Kyoto Protocol.

The assessment of the eligibility of land has been conducted based on the decision by the EB35-Annex 18 that provides "Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities". These procedures require a demonstration of two issues, first the land is not forest at the time the project starts and secondly, that the activity is a reforestation or afforestation project activity. The project participants have assessed the land eligibility as follows:

a) The land does not contain forest at the moment the project starts:

i. *Vegetation on the land is below the forest threshold (tree crown cover or equivalent stocking level, tree height at maturity in situ, minimum land area) adopted for the definition of forest by the host country under decisions 16/CMP.1 and 5/CMP.1 as communicated by the respective DNA;*

The land eligibility is demonstrated by Landsat imagery from 2000 and 2003. Field tour studies also indicate that the lands to be planted in the proposed A/R CDM project activity are extensively managed grasslands covered mostly with grasses and a few scattered trees, rather than forests or temporarily unstocked lands (Figure 6). Regarding the few growing trees (a census has been conducted in 2008 and 290 single standing trees were counted) on the project area, the tree crown cover of the land is still far below 20% of the threshold value of forests in Argentina, and would remain so under continuation of

current management. The various images are presented on the next pages (Figure 7, Figure 8, Figure 9) and they indicate that there was not any forest at the time the project starts.

Figure 6: View of the project area with a forest patch to be conserved and single standing trees

ii. *All young natural stands and all plantations on the land are not expected to reach the minimum crown cover and minimum height chosen by the host country to define forest;*

There were no plantations or young natural stands within the project activity boundary at the start of the project.

iii. *The land is not temporarily unstocked, as a result of human intervention such as harvesting or natural causes.*

For the last 50 years (see next section) the land has been used as extensively managed grassland for cattle dedicated to meat production. Accordingly, there have not been any unstocking activities.

b) Demonstrate that the activity is a reforestation or afforestation project activity

i. *For reforestation project activities demonstrate that the land was not forest by demonstrating that the conditions outlined under (a) above also applied to the land on 31 December 1989.*

Interviewing with local farmers/communities on land use/cover history indicates that the lands to be planted in the proposed A/R CDM project activity have been non-forested grassland for the last 50 years. However, the project participants were not able to provide hard evidence on this and the oldest publication found that describes the land area dates back only to 1967. Accordingly the project activity was defined as a reforestation project activity.

Land use/cover satellite images from 1988 (Figure 7), 2000 (Figure 8) and 2003 (Figure 9) demonstrate that the lands to be planted were extensively managed grassland since at least 1989.

Figure 7: Satellite picture of project area: 1988

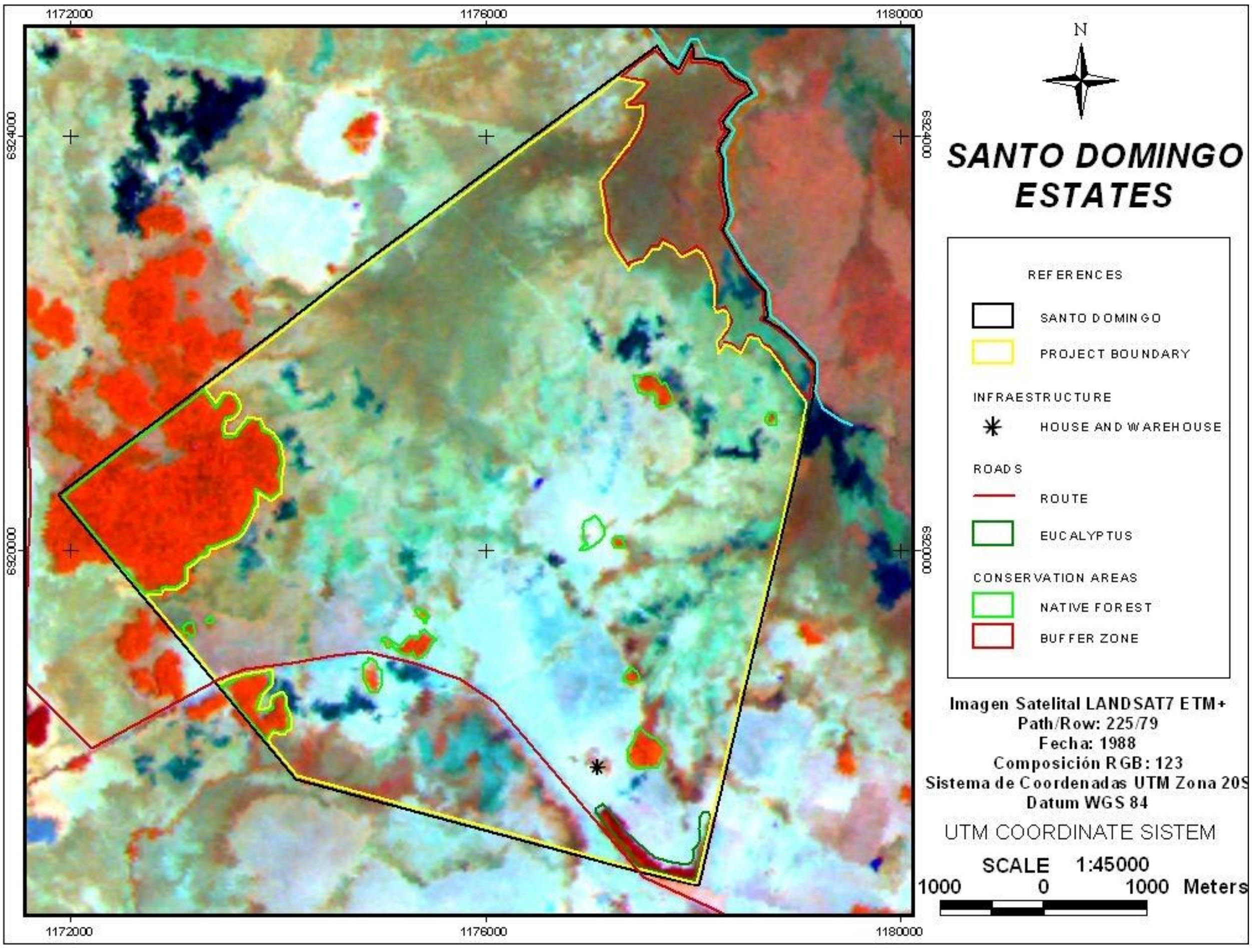


Figure 8: Satellite picture of project area: 2000

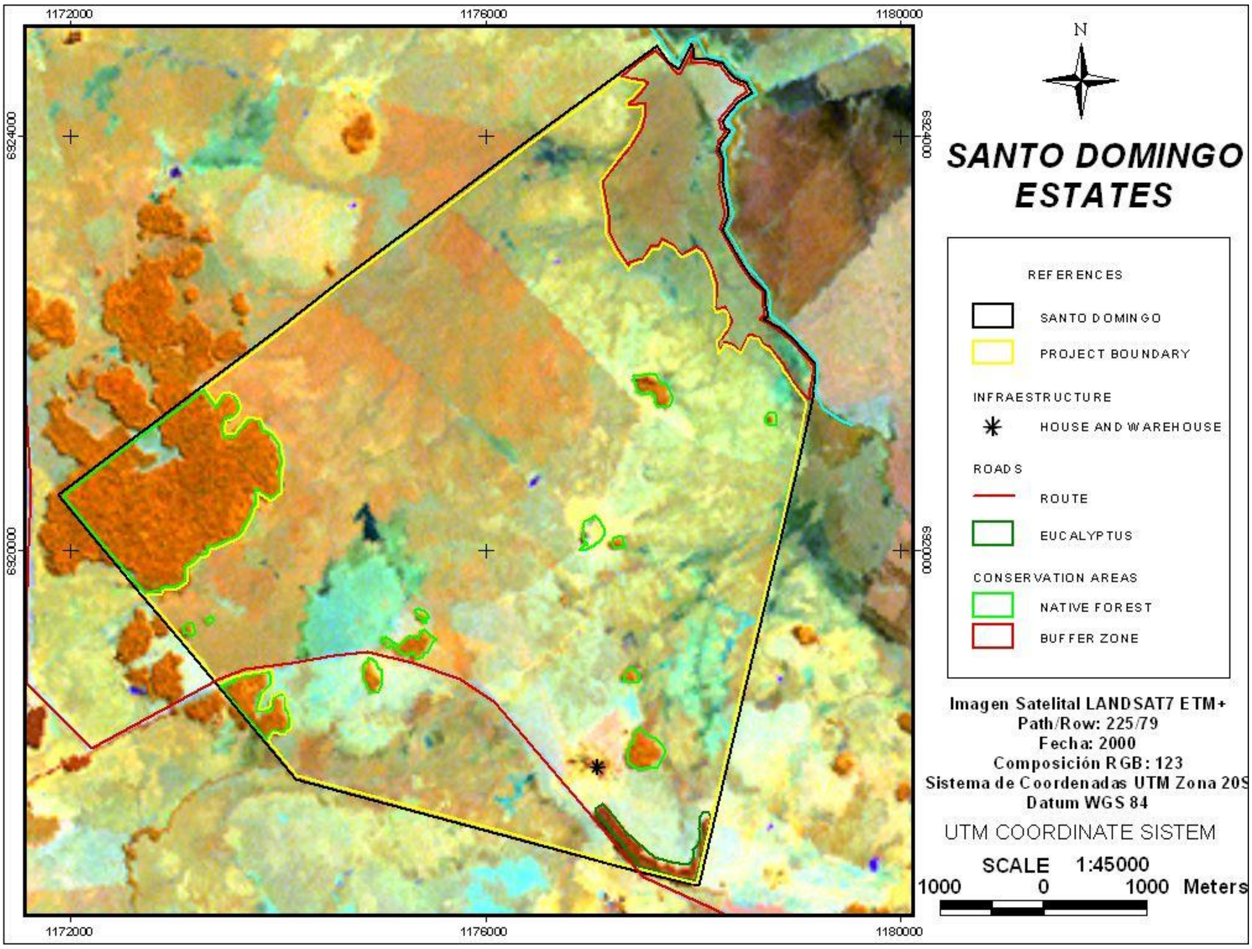
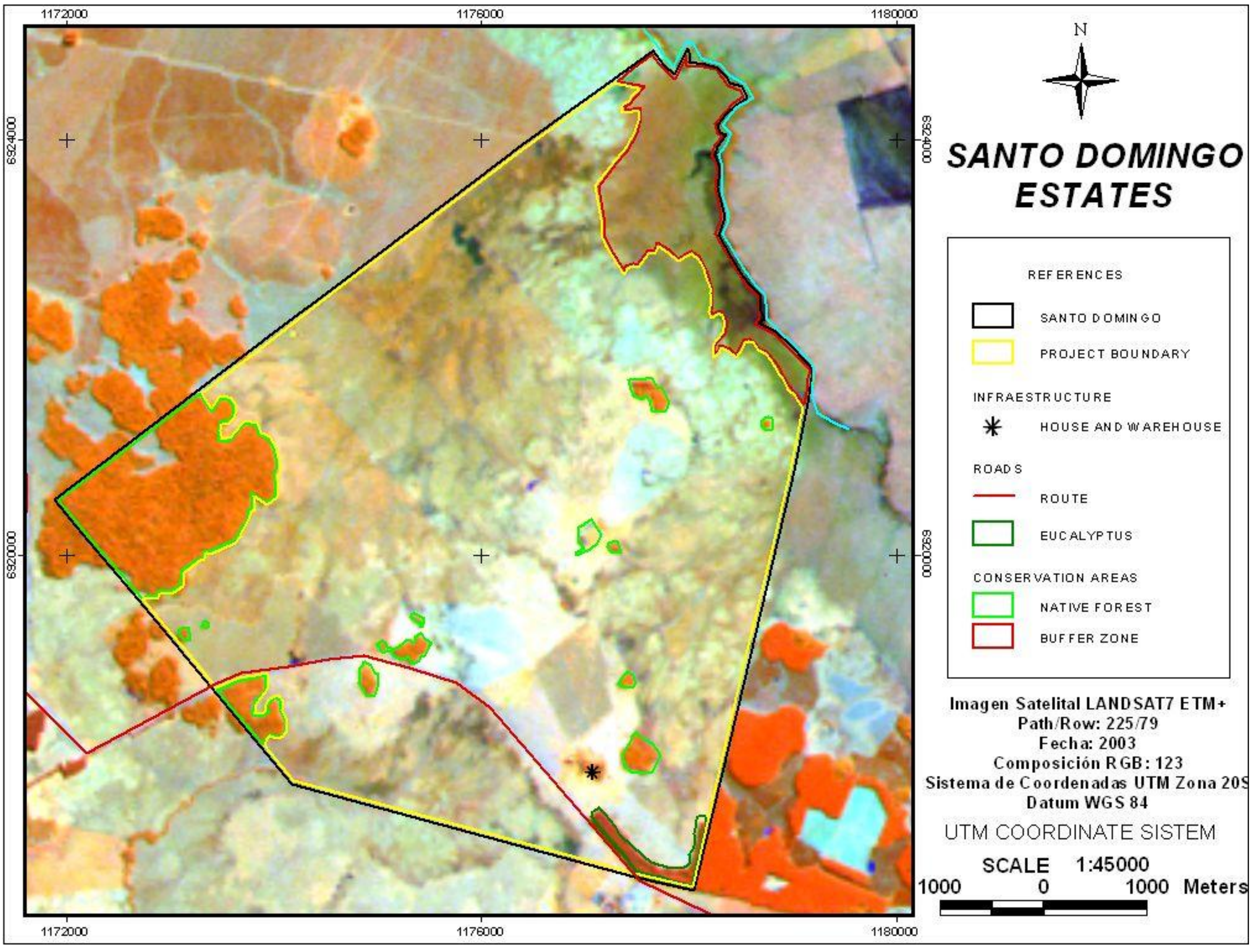


Figure 9: Satellite picture of project area: 2003



A.8. Approach for addressing non-permanence:

The issuance of lCERs for the net anthropogenic greenhouse gas removals by sinks achieved by the proposed A/R CDM project activity is chosen.

A.9. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>

The table below shows the results of the estimation of anthropogenic GHG removals by sinks over the crediting period. Since verifications are planned in the years 2012, 2017, 2022 and 2027 it becomes evident that verifications do not coincide with peaks in carbon accumulation (see also table 17 in section E.2.)

Summary of results obtained in Sections C.7., D.1., and D.2.

Year	Estimation of baseline net GHG removals by sinks (tonnes of CO_2 e)	Estimation of actual net GHG removals by sinks (tonnes of CO_2 e)	Estimation of leakage (tonnes of CO_2 e)	Estimation of net anthropogenic GHG removals by sinks (tonnes of CO_2 e)
2007	5	876	0	871
2008	22	4,853	0	4,831
2009	35	9,623	0	9,588
2010	85	23,187	0	23,102
2011	180	49,984	0	49,804
2012	323	77,625	0	77,301
2013	513	105,161	0	104,648
2014	744	131,521	0	130,776
2015	764	132,796	0	132,032
2016	971	96,902	0	95,932
2017	1,207	73,983	0	72,777
2018	1,466	156,193	0	154,727
2019	1,747	144,798	0	143,051
2020	1,125	4,516	0	3,392
2021	1,356	-135,603	0	-136,960
2022	1,608	150,894	0	149,286
2023	1,876	159,609	0	157,734
2024	2,155	54,172	0	52,018
2025	2,443	-41,757	0	-44,201
2026	2,740	142,803	0	140,064
Total (tonnes of CO2 e)	21,366	1,342,140	0	1,320,775

A.10. Public funding of the proposed A/R CDM project activity:

No public funding has been used for the proposed A/R CDM project activity.
The project activity has chosen to apply for the size-independent tax benefits as described in Section C.5.1 (Step 2). These benefits do not impact any tenure rights or carbon rights. Being tax benefits they do not directly impact initial investment risks taken by project owner.

SECTION B. Duration of the project activity / crediting period

B.1 Starting date of the proposed A/R CDM project activity and of the crediting period:

02/ 05/2007 is the starting date of the proposed A/R CDM project activity and the crediting period.

B. 2. Expected operational lifetime of the proposed A/R CDM project activity:

At least 60 years

B.3 Choice of crediting period:

The proposed **A/R CDM project activity** will use a **renewable** crediting period.

B.3.1. Length of the renewable crediting period (in years and months), if selected:

20-years, 0 months (2 times renewable, making a total crediting period of 60 years).

B.3.2. Length of the fixed crediting period (in years and months), if selected:

N/A

SECTION C. Application of an approved baseline and monitoring methodology

C.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed A/R CDM project activity:

The revised approved A/R baseline methodology "Afforestation and reforestation project activities implemented for industrial and/or commercial uses" (AR-AM0005 Version 3) is applied.
This methodology further uses:
The "Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02)[9]
The Tool "Estimation of GHG emissions to displacement of grazing activities in A/R CDM project activity" (Version 2)[10]
The "Tool for testing significance of GHG emissions in A/R CDM project activities" (Version 01)[11]

C.2. Assessment of the applicability of the selected approved methodology to the proposed A/R CDM project activity and justification of the choice of the methodology:

The selected approved methodology is applicable to the proposed A/R CDM project activity as it complies with and is applicable under the conditions provided in the methodology. The conditions under which this methodology is applicable to the proposed A/R CDM project activity are:

- The land cover within the project boundary is in steady state. For the last 50 years the land has been used as extensively managed grassland for cattle dedicated to meat production.

[9] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-01-v2.pdf

[10] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-09-v2.pdf

[11] http://cdm.unfccc.int/methodologies/ARmethodologies/tools/ar-am-tool-04-v1.pdf

- Natural regeneration is not expected to occur in the project area because of the seed bank stored in the soil may be minimal by now. The historical information of the lands, based on interviews with the former owner and historical information (described in Section A.7.) shows that the lands have been extensively managed grassland for cattle dedicated to meat production with scattered trees already for the last approximately 50 years and no forest has established spontaneously in all those years

- In the absence of the project activity, the baseline is expected to remain extensively managed grassland. Grasslands under tropical conditions have less soil carbon compared to forest plantations. The project area lies at the border between the tropical and moist subtropical zone. Evidence that a shift from pasture to forest plantations leads to significant carbon storage in soils especially in wet or moist tropical regions is e.g. given in Silver et al. (2009)[12]and in the Environmental Impact Assessment (p.43). In addition the plantation contains large amounts native broadleaf species managed in long rotations which provides a long term continuous cover of the soil. Therefore not accounting of the soil organic carbon is a conservative approach for the project case. This holds especially true because in case of the grasslands some areas that tend to have surface water in case of heavy rains because of their low permeability do not have any grass cover (Figure 10). These areas, in case of the forest plantation will be better drained and have more vegetation cover. The areas are described in more detail in Annex 3.

Figure 10: Soils with low permeability on the A/R project area

- There will be no flooding irrigation.

- Site preparation includes drilling of narrow drills and application of a role that leads to a small heap of soil in which plants are put. Site preparation is not expected to cause significant longer term net emissions from soil carbon. The planting process follows a cultivation technique which minimizes soil impact and optimizes the use of water[13]. These procedures are in conformance with according

[12] Silver W.L. et al 2001; The Potential for Carbon Sequestration Through Reforestation of Abandoned Tropical Agricultural and Pasture Lands; Restoration Ecology, Vol 4 Issue 4; 394-407.

[13] Environmental Impact Assessment, ECO-Consulting S.R.L, Corrientes 2007.

FSC requirements, which include among others adoption of soil conservation techniques, monitoring of water quality and quantity and preservation of reserve areas.[14]. As such, soil drainage and disturbance are insignificant.

- Nitrogen-fixing species (NFS) will be planted in the A/R CDM project activity (25%). The greenhouse gas emissions from denitrification are not accounted in the estimation of the actual net greenhouse gas removals by sinks. As per decision by CDM EB 44 Nitrous oxide (N2O) emissions from decomposition of litter and fine roots from N-fixing trees are insignificant in A/R CDM project activities and may therefore be neglected in A/R baseline and monitoring methodologies.[15].

This assessment based on the conditions outlined in the approved methodology coupled with the information provided in Section A of the PDD, shows that the approved methodology is applicable to the proposed A/R CDM project activity.

Justification of the choice of the methodology:

The approved methodology outlines methods for measuring, monitoring and estimating the net anthropogenic GHG removals by sinks for A/R CDM projects undertaken for industrial or commercial purposes. In addition the methodology assumes the A/R CDM project activity is implemented on unmanaged or extensively managed grasslands.

C.3. Assessment of the selected carbon pools and emission sources of the approved methodology to the proposed CDM project activity:

Carbon pool selected

Carbon stocks in the pools of soil organic carbon, dead wood and litter will not decrease more, nor increase less, as a result of the proposed A/R CDM project activity than in the baseline, since planting trees will be on extensively managed grasslands that have lower soil organic matter content, and little, if any, dead wood and litter. Therefore, planting trees on extensively managed grass lands will improve the carbon balance in these other pools relative to the baseline scenario. As a consequence, to be conservative, we choose to account only for the aboveground biomass and belowground biomass in the proposed A/R CDM project activity. Other non-tree vegetation will be treated in a conservative manner by deducting any such pre-existing vegetation as a carbon stock decrease at the beginning of the project.

[14] FSC report 2009: Manejo Forestal – Auditoria annual 2009. Informe para: Fidecoismo Santo Domingo. Rainforest Alliance.

[15] http://cdm.unfccc.int/EB/044/eb44rep.pdf

Table 7: Selection and justification of carbon pools

Carbon Pools	Selected (answer with yes or no)	JUSTIFICATION / EXPLANATION
Above ground	Yes	Major carbon pool subjected to the project activity
Below ground	Yes	Major carbon pool subjected to the project activity
Dead wood	No	Conservative approach under applicability condition based on AR-AM0005/Version 3, see also justification in paragraph above
Litter	No	Conservative approach under applicability condition based on AR-AM0005/Version 3, see also justification in paragraph above
Soil organic carbon	No	Conservative approach under applicability condition based on A/R-AM0005/Version 3, see also justification in paragraph above

Emission source

The greenhouse gas (GHG) expected to be emitted as a result of the implementation of the proposed A/R CDM project activity is CO_2. The emissions result from:

- Vehicle and machinery use in nursery, site preparation, thinning, harvesting, etc. resulting in CO_2 emissions; As per EB44 emissions from fossil fuel combustion are insignificant and will therefore be neglected.
- Biomass loss due to conversion of extensively managed grassland to forest, resulting in CO_2 emissions; As per EB42 emissions from the removal of herbaceous can be neglected in accounting GHG emissions and will therefore be accounted for as zero.

No nitrogenous fertilizer will be applied and no slash and burn and overall tillage will be used in the site and soil preparation, therefore no greenhouse gas (GHG) emissions from this sources are expected to occur.

Table 8: Gases considered from emissions by sources other than resulting from change in carbon pools

Source	Gas	Included/ excluded	Justification /Explanation
Combustion of fossil fuels, e.g., on-site and/or off-site use of vehicle	CO_2	Included	As per EB44 emissions from fossil fuel combustion are insignificant and will therefore be neglected.
	CH_4	Excluded	Potential emission is negligibly small based on AR-AM0005 / Version 3
	N_20	Excluded	Potential emission is negligibly small based on AR-AM0005 / Version 3
Biomass burning (Fires)	CO_2	Included	However, no biomass burning will occur
	CH_4	Included	However, no biomass burning will occur
	N_20	Included	However, no biomass burning will occur
Removal of pre-existing non-tree vegetation	CO_2	Included	As per EB42 emissions from the removal of herbaceous can be neglected in accounting GHG emissions
	CH_4	Excluded	Not applicable
	N_20	Excluded	Not applicable

As shown in Table 8, no gaseous emissions from sources other than those resulting from changes in carbon pools are included in this AR CDM project activity.

C.4. Description of strata identified using the *ex ante* stratification:

The selected approved methodology recommends a hierarchical approach to stratification. The results of application of the ex ante stratification procedure as provided in Section II.3 are described below.

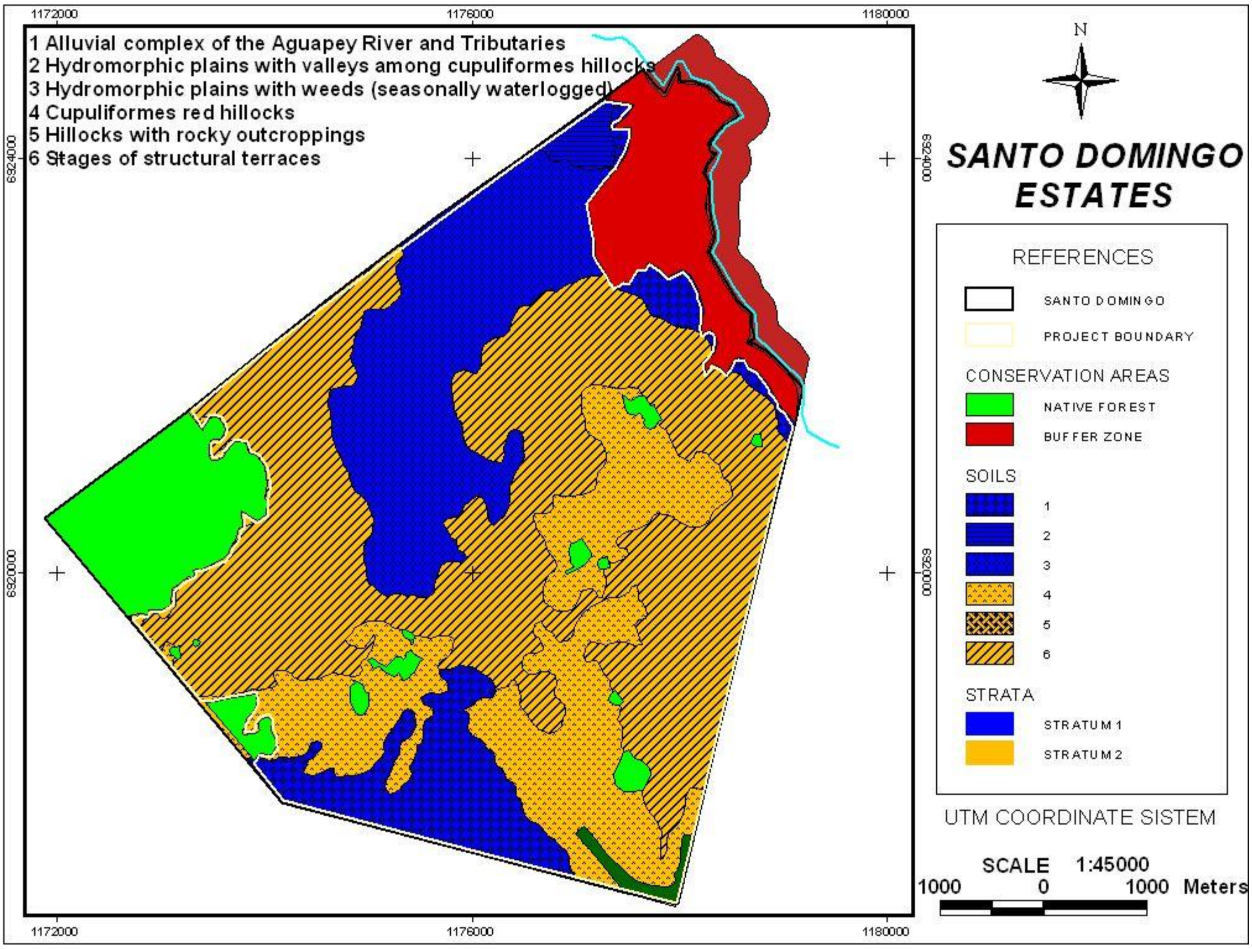
Step 1: Stratification taking into account pre-existing conditions and likely evolution of baseline

- The whole land areas of the project are characterized by six different landscapes, as described in Annex 3. The ex-ante baseline stratification has been established based on soil types, topography and vegetation cover and assuming that the current grassland use to be the baseline land use. The project area lies within one climatic region.
- The baseline information was collected during the baseline study in August 2007. Based on this study, 8 soil types were identified. Based on the collected information, in combination with landform, soil types and vegetation cover, the lands to be planted have been classified into 6 landscapes that are described in Annex 3.
- Interviews with local farmers/communities on land use/cover history indicates that the lands that are planted in the proposed A/R CDM project activity have been non-forested grassland for the last 50 years at least. Land use/cover LANDSAT satellite images from 1988, 2000 and 2003 demonstrate that the lands to be planted were extensively managed grassland since at least 1989. The information was ground-truthed with field surveys.
- Land use/cover satellite images from 1988 (Figure 7), 2000 (Figure 8) and 2003 (Figure 9) demonstrate that the lands to be planted were extensively managed grassland since at least 1989.
- In a field-survey of the 20th of November 2008 290 single trees were counted on the parcels described in Table 9 (see also Appendix 3). The single growing trees appear on three landscapes

(IV, V and VI). On landscape I, II and III there are no single growing trees. Based on the site investigation and assessment, the project area is categorized in 2 strata (see Figure 12).

1. Hydromorphic plains and alluvial complex: Landscape 1-3 (without growing trees)
2. Hillocks and structural terraces: Landscapes 4-6 (with growing trees)

Figure 11: Soil types on the A/R project activity

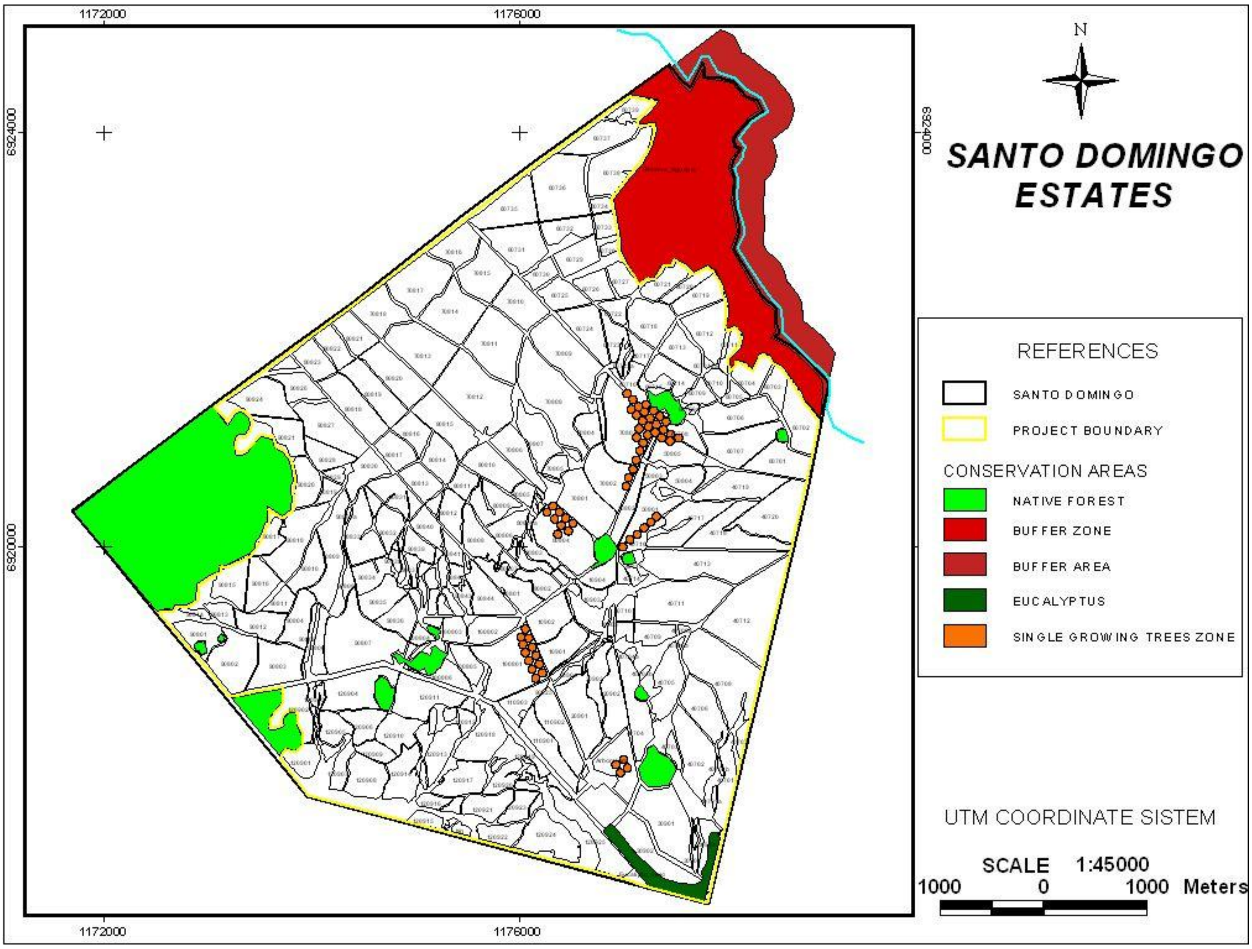


- The original vegetation will be kept.

Table 9: Single growing trees

Sectors	Potreros	Number of trees
1	10	130
2	7-8	45
3	5-6-7	70
4	4-5	20
5	2	25
Total		290

Figure 12: Sectors with single growing trees



- For the calculation of baseline removals by sinks the two strata were combined in one baseline strata representing extensively managed grassland with scattered trees in steady state. This is due to rather homogenous cover by extensively managed grassland with few scattered trees as described above.

- A study was conducted in December 2008 by GMF identifying the dominant species of grassland vegetation. As per EB 42 decision, emissions from the removal of herbaceous vegetation can be neglected in accounting GHG emissions.

Step 2: Criteria of stratification to be considered in the proposed CDM A/R project activity:

The stratification of the project scenario takes into consideration planting year, tree densities, spacing and mixes of *Pinus eliottii*, *Pinus taeda, Grevillea robusta* and native species. With regard to growth characteristics pure *Pinus* ssp., mixes of *Pinus* ssp. with native species and mixes with *Grevillea robusta* and native species were distinguished. This approach has been chosen because of the different growth charateristics of *Pinus* ssp[16], *Grevillea robusta*[17] and native species mixes[18]. For further details concerning growths characteristics please see also section D.1. Tree density is between 800 and 2083 plants per hectare, depending on the 13 plantation scenarios described in Table 10.

Table 10: Planting year and planting density of the different cases

CASE	SPECIES	YEAR	HA	CONFIG. PINUS	CONFIG. NATIVE	NAT. INTERPL.	CINFIG. GREVILLEA	PINUS (TREE/HA)	NATIVE (TREE/HA)	INTERPL (TREE/HA)	GREVILLEA (TREE/HA)	TREE/HA
1	Pinus	2007	142.80	5 x 2.5				800				800
2	Pinus	2008	465.19	4 x 2				1250				1250
3	Pinus	2008	278.34	5 x 2				1000				1000
4	Mixed Loma	2007	65.23	5 x 2.5	5 x 7.5			800	267			1067
5	Mixed Loma	2008	273.51	3 x 2	3 x 8			1667	417			2083
6	Mixed Loma	2008	76.98	5 x 2	5 x 6	5 x 3		800	333	667		1800
7	Mixed Bajos	2007 -08	505.47	5 x 2.5	5 x 7.5			800	267			1067
8	Mixed Bajos	2008	30.99	4 x 2	4 x 8			1250	313			1563
9	Mixed Bajos	2008	8.17	5 x 2	5 x 8			1000	250			1250
10	Grevillea/Native	2009	100		3 x 2		3 x 2		833		833	1667
11	Grevillea/Native	2009	184.7		3 x 2,5		3 x 2,5		1000		333	1333
12	Pinus	2009	86.3	4 x 2,5				1000				1000
13	Mixed media loma	2009	74.2	4 x 2	4 x 2			625	625			1250

For biomass calculations and monitoring we reduced the 13 strata to 5 strata as described in Table 11. The breakdown of the 13 cases to the 5 strata is based on cases with similar tree species and planting year. The first stratum is equal to case 1 (planting year 2007, only *Pinus*). The cases 2, 3 and 12 are

[16] Batista de Oliveira, Edilson (2002): V.SISEUCALIPTO-SISPINUS: Softwares para el manejo de plantaciones de Pinos y Eucaliptos. EMBRAPA-Floresta. Paraná, Brasil.

[17] CRECHI, E.; MOSCOVICH, F.; FASSOLA, H.; HENNIG, A.; HAMPEL, H.; DOMECQ, C.; MALETTI, C. 2003. TVHAla de volumen para Grevillea robusta A. en Misiones, Argentina. 10°Jornadas Técnicas Forestales y Ambientales - Facultad de Ciencias Forestales -UNaM y EEA Montecarlo - INTA. Eldorado, Misiones, Argentina.

MOSCOVICH, F.; CRECHI, E.; FASSOLA, H.; HENNIG, A.; HAMPEL, H.; DOMECQ, C.; MALETTI, C. 2004a. Funciones de volumen y forma para Grevillea robusta A. en Misiones, Argentina. 11°Jornadas Técnicas Forestales y Ambientales - Facultad de Ciencias Forestales - UNaM y EEA Montecarlo - INTA. Eldorado, Misiones, Argentina.

MOSCOVICH, F.; FASSOLA, H.; CRECHI, E.; COLCOMBET, L.; LACORTE, S.; DOMECQ, C.; HAMPEL, H. 2004b. Silvicultura y manejo de Grevillea robusta. 3° Simpósio Latino-americano sobre Manejo Florestal. Brasil.

[18] Korth, Silvia Marisel (2009): MODELO DE PRODUCCIÓN PARA “Peltophorum dubium” CAÑA FÍSTOLA.

purely *Pinus* plantations with planting year 2008 and therefore they have been merged to stratum 2. The stratum 3 consists of the cases 4 and 7, which both contain mixes of *Pinus eliotti*, *Pinus taeda* and native species with the same planting year. The cases mixed with *Grevillea robusta* and native species (case 10 and 11) and planting year 2009 have been merged to stratum 5. In case there are two planting years within one stratum (e.g. strata 2, 3 and 4) the earlier date has been considered as planting year for the biomass calculations.
The new planting densities of the strata have been calculated for each strata species wise and considering the areas of each case. The planting densities of the new strata have been calculated by combining planting area with planting densities of the according cases forming the respective stratum.

Table 11: Stratification

STRATA	CASE	AREA (ha)	YEAR	PINUS	NATIVE	CONFIG GREVILLEA	Total
1	1	142.8	2007	800	-	-	800
2	2,3,12	829.83	2008/2009	1140	-	-	1'140
3	4,7	570.70	2007/2008	800	267	-	1'067
4	5,6,8,9,13	463.85	2008/2009	1317	537	-	1'854
5	10,11	284.7	2009	-	941	509	1'450
TOTAL		2291.88		-	-	-	

Step 3: Ex ante stratification of A/R CDM project activity taking into account the stratification criteria and land use within the project boundary

All discrete areas in the project area were GPS located and geo-referenced. These data were incorporated to the project GIS platform. The changes that occur to the project activity implementation after the ex ante stratification shall be recorded so that these can be taken into account during the ex post stratification at the monitoring stage of the project.

Step 4: Preparation of ex ante stratification map:

A geo-referenced map with ex-ante stratification including sub-strata information was prepared with the defined strata (Figure 11)

Figure 13: Project cases (Case 1 – 13)

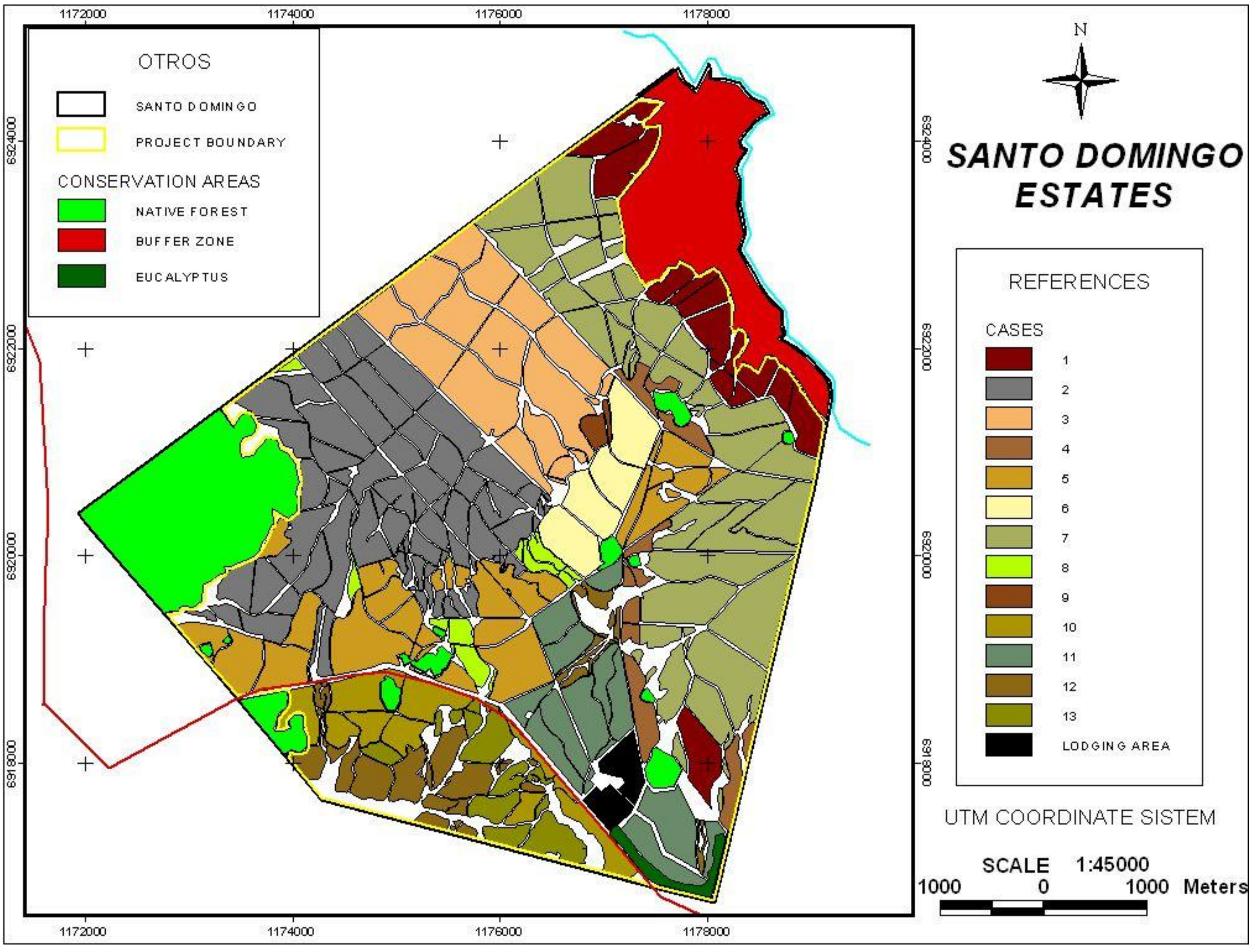
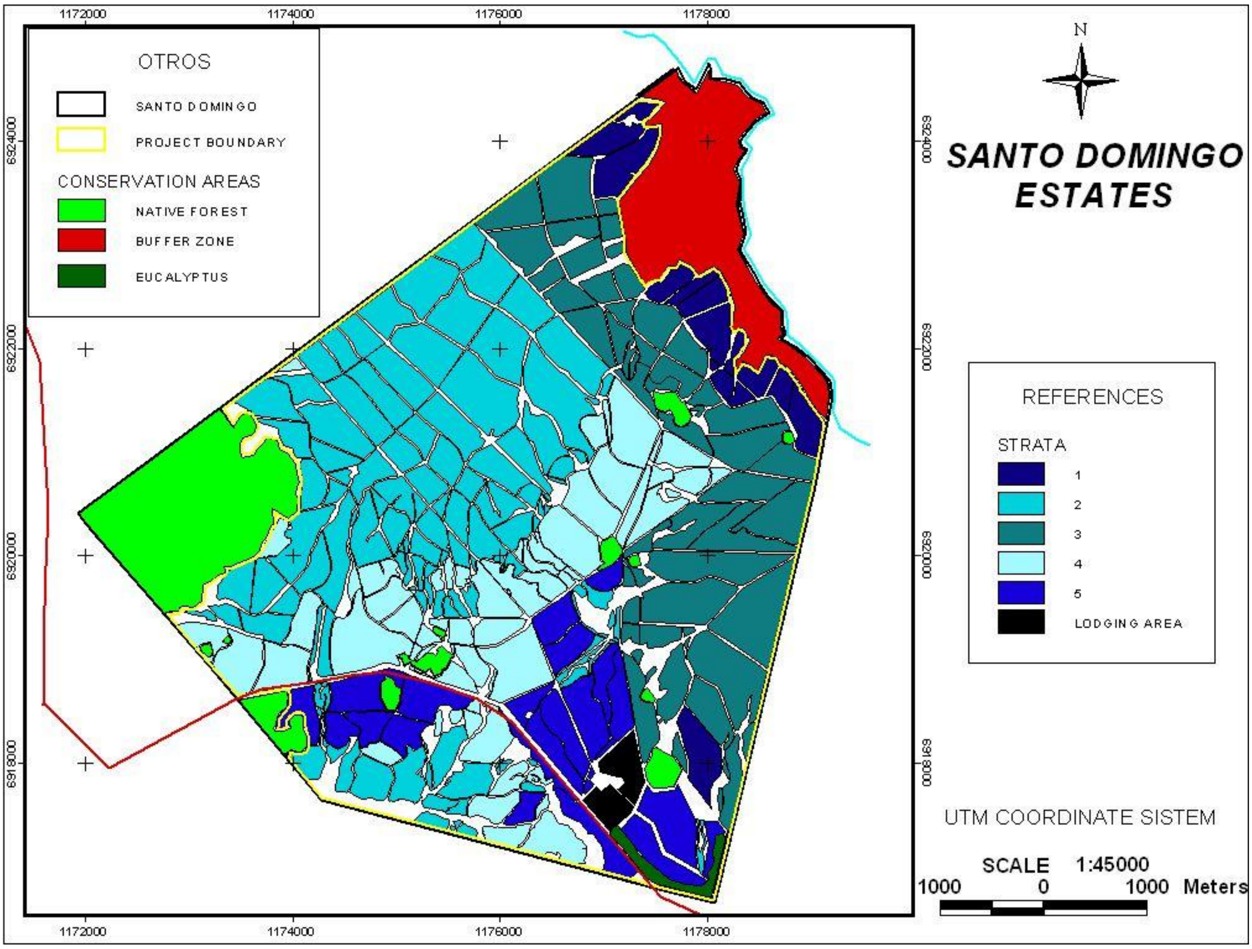


Figure 14: Project strata defined: breakdown of the 13 cases to the 5 strata used for biomass calculation and monitoring



Step 5: The changes to the A/R project after the adoption of ex ante stratification shall be Recorded

Any relevant changes that occur to the A/R project activity implementation after the adoption of ex ante stratification will be recorded and taken into account as and when unexpected events occur.

C.5. Identification of the baseline scenario:

>>

C.5.1. Description of the application of the procedure to identify the most plausible baseline scenario (separately for each stratum defined in C.4.):

The most plausible baseline scenario has been determined with steps presented in Section II.4 of the approved methodology AR-AM0005/version 03, "Procedure for selection of most plausible baseline scenario", as follows:

Step 1: Demonstration of the most likely land use at the time the project starts

The most likely land use and land cover within the project boundary in the absence of the project is the continuation of extensive grassland management for cattle meat production. The lands have been used in the last 50 years as extensively managed grasslands, according to statements of former owners and local people.

In the following we describe underlying reasons for the above stated from general, forestry and other alternatives perspectives:

- General: The predominant land use in Corrientes is grazing lands. Forestry plantations and other agricultural uses (e.g. soy production) are less[19]. Overall soy production area in Corrientes is 5,800 ha[20], forest plantation area is 420,000ha (thereof 370,000 are *Pinus* and *Eucaliptus* plantations)[21] and grazing land area is 6,860,000 ha (see Table 12). Grazing land is also the traditional land use and often large areas are managed by few people or single families. The setup and management of more labour-intense land uses like forestry or agricultural production is rarely an option for local people traditionally involved in grassland management.

- Specifically for a forest as alternative land use: There is no indication that a shift to forest management would have occurred in the absence of the project activity. Looking at project level, similar lands in the vicinity are under similar grazing land use and are not expected to be used for alternative land uses. Forest plantations are possible on the land. Some areas in the vicinity contain forest plantations. However, these forest plantations apply fast growing exotic species (usually *Pinus* spp. and *Eucaliptus* spp.) and not native species. In addition, forest plantations require high long term investments and usually are characterized by long pay back periods. Therefore, it is unlikely that the former land owners would have started forest plantations in the absence of the project activity. For further evidence see section C 6, Step 3 in additionality assessment.

[19] Corrientes en Cifras 2008 (Direccion de Estadistica y censos; Secretaria General de Gobernacion)

INDEC, 2002, Censo Nacional Agropecuario 2002. Dirección de Estadística de la Provincia de Corrientes.: http://www.indec.gov.ar/agropecuario/cna_defini.asp

Chiossone, Guillermo (2006): Sistemas de produccion ganaderos del noreste de Argentina, INTA.

Kurtz, Dietmar; Ligier, Daniel (INTA 2008): La carga ganadera "real" en la provincia de Corrientes.

[20] INDEC, 2002, Censo Nacional Agropecuario 2002. Dirección de Estadística de la Provincia de Corrientes.: http://www.indec.gov.ar/agropecuario/cna_defini.asp

[21] Elizondo, Mario et al (2008); Primer inventario forestal de la provincia de Corrientes: metodología, trabajo de campo y resultados. http://www.cfired.org.ar/Default.aspx?nId=8305

- Specifically for other alternative land uses: As shown above Corrientes has other agricultural uses including soy production. However, the predominant land use in the area is grasslands. In addition, soy production would be possible only on some of the areas (the fertile soils that do not suffer flooding in case of rainfalls). Again, soy production is rarely an option for local people traditionally involved in grassland management.
According to Censo Nacional Agropecuario (2002), soy production in the project vicinity is rare, especially when compared to grasslands, and a shift from established grasslands is unlikely.
A more detailed description of different land use scenarios and their barriers is given in Step 5.

Table 12: Land use in Corrientes

Land use in Corrientes	Area (ha)
Soy production[22]	**5,800**
AR due to law 25,080[23]	**55,358**
AR total[24]	**418,134.42**
Forestable area[25]	**2,700,000**
Grazing Land	**6,860,000**
Total area	**8,819,900**

Step 2: Assessment of national and sector policies and legislation

An analysis of specific political contexts and legal frameworks was conducted. There are several governmental legal measures that support forestry development in Argentina. Argentina currently does not have restrictions limiting the cultivation of forests in private properties. Incentives for forestry plantations are described in Forestry Law number 25,080. The main incentives are summarized below.

a) Policies related to the creation of wood sources

Law number 25, 080 (Cultivated Forest Investment Act) was implemented in January 1999 and is intended to increase land development by the Argentine forestry industry to 3 million hectares of cultivated forest in 10 years. It also establishes an inventory process for planted forests and it has provided guidelines for the establishments of agreements with international organizations that focus on

[22] INDEC, 2002, Censo Nacional Agropecuario 2002. Dirección de Estadística de la Provincia de Corrientes.: http://www.indec.gov.ar/agropecuario/cna_defini.asp

[23] Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA), 2009. http://www.sagpya.mecon.gov.ar/

[24] Elizondo, Mario et al (2008); Primer inventario forestal de la provincia de Corrientes: metodología, trabajo de campo y resultados. http://www.cfired.org.ar/Default.aspx?nId=8305

[25] Banco Mundial (2009): Estrategia de Desarollo Productivo. Provincia de Corrientes Informe Primera Fase, Mayo 2009.

development and technology transfer for this industry. This law also provides tax benefits and economic support for Argentine and foreign investors.

Tax benefits (25,080)[26]:
- Tax stability for 30 to 50 years for companies with forestry investment projects
- Accelerated amortization of income taxes
- Accelerated return of value-added tax (21 percent)
- Tax breaks on assets, real estate, sales, and gross income from state and municipal governments
- Accelerated depreciation of capital goods

Economic Support (25,080):
- The Argentine government will finance up to 80 percent for projects up to 300 ha/year, 20 percent for forests between 301 and 500 ha/year. The project activity has therefore no access to direct economic support.
- Support for projects focused in plantation of traditional species and enrichment of native forests
- Forest management support

Law Number 13,273: This law is intended to conserve the forests, prohibit deforestation, and the unfavorable use of native woodland products. It also specifies that any investment project carried out in natural forests needs to be approved by the Argentine government.

The project activity has chosen to apply for the size-independent tax benefits. These benefits do not impact any tenure rights or carbon rights. Being tax benefits they do not directly impact initial investment risks taken by project owner.

b) Legislation related to the requirements of A/R activities and wood use

Argentina currently does not have restrictions limiting the cultivation of forests in private properties. Only native forests are regulated by the government contingent upon the approval of the cultivation project by local government.

Step 3: Assessment of demand and supply of wood resources for industrial and commercial purposes

The total area of forest plantations in Argentina is now approaching 1 million hectares, the vast majority of which are southern pine, eucalyptus, willow and cottonwood. The government estimates that an additional 20 million hectares of land is suitable for forest plantations, in that they have favourable growing conditions and do not compete directly with agriculture or native timber stands. Plantations have been subsidized for decades, but most have not been managed properly until recently. Hence, the quality of the plantation timber available now is still quite low but is rapidly improving. The results of genetic improvement programs, already evident in the production of pine and eucalyptus in the subtropical northern regions of Argentina, are now being developed for Douglas-fir, ponderosa pine and lodge pole pine in southern regions that are similar in climate to the Pacific Northwest. Southern pine grown in the northern regions of Argentina will primarily be exported to North American and European markets.

---

[26] Ley 25,080. http://www.sagpya.mecon.gov.ar/

Argentina's government has deregulated the forestry sector and offered subsidies to reimburse plantation development. Due to the low quality of plantation timber and the underdeveloped nature of the industry, Argentina tends to export raw materials such as pulp logs and import higher-value wood products such as paper. Forest products exports, though low by global standards, are increasing at a rapid rate. Argentine producers are now very active in trade within MERCOSUR and have recently penetrated the US structural timber market for the first time. The pulp and paper sector and the composite panel sector are more highly developed than the sawnwood, plywood, and veneer sectors. The former sectors utilize lower quality timber and enjoy higher domestic market demand. The latter two are currently developing, and should continue to do so as more well-managed plantation timber matures.
In the Province of Misiones, the forest industry activity prevails and it is mainly based on the utilization of planted forests of conifers (pines and araucarias) and the sustainable use of the native forests (1,6 million ha). Main forest industries are pulp and paper plants and, more recently, modernized sawmills and other wood processing plants. With these tendencies, the demand for high quality native species timber and wood products can be expected to grow in the coming years. The proposed project activities is a pioneer project in terms of using native species for high value added wood products and hence may state an example for other forestry companies and help to enhance demand for such products.

Step 4: Assessment of land-use practices and prevailing land uses in the project region

As described in Step 1 of this section, the most likely land use and land cover within the project boundary in the absence of the project is the continuation of extensive grassland management for cattle meat production. The lands have been used in the last 50 years as extensively managed grasslands, according to statements of former owners and local people. The predominant land use practice in the project region is grasslands used for cattle[27]. Some areas in the vicinity contain forest plantations. However forest plantations require high upfront investments and usually are characterized by long pay back periods which are two important constraints to further expanding. Grazing land is the traditional land use and often large areas are managed by few people or single families. The setup and management of more labour-intense land-uses like forestry or agricultural production is rarely an option for local people traditionally involved in grassland management.
Since the existing governmental incentives described in section C.5.1. Step 2 have national scope, they principally can also impact the project activity area. i.e. the baseline, even though reasons described above make a switch by former owner from grassland management to forestry plantations or a partial forest plantation unlikely. In order to calculate a potential baseline reforestation rate regional data are applied. Regional reforestation rate in the last years in average was 9,226 ha[28] per year totalling in an annual reforestation rate in Corrientes of 0.34%. This regional reforestation rate is included in the baseline calculations. This is considered a conservative assumption because, for the above reasons, a baseline reforestation in the project area is rather unlikely. Since most reforestation activities in the area use Pinus species[29], respective growth rates are used for the baseline removals by sinks (see Section C.7).

[27] Corrientes en Cifras 2008; Direccion de estadistica y censos; Secretaria General de Gobernacion

[28] Secretaría de Agricultura Ganadería y Pesca de la Nación (SAGPyA), Dirección de Forestación (http://www.sagpya.mecon.gov.ar/)

[29] Corrientes en Cifras 2008; Direccion de estadistica y censos; Secretaria General de Gobernacion (Table 10.6) Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA), 2009. http://www.sagpya.mecon.gov.ar/

Step 5: Identification of plausible and credible land-use alternatives

There are different alternative land uses possible on the project area, that are consistent with current laws and regulation, including:

Scenario 1: Continuation of the pre-project land use activities. The current land use has been extensive grassland management for cattle for meat production. This is the predominant land use in the region (see also C.5.1 Step 4).

Scenario 2: Combination of grassland management with production of soy on adequate sites: Soy production would be possible on some of the areas (the fertile soils that do not suffer flooding in case of rainfalls). However, soy production in the project vicinity is rare, especially when compared to grasslands, and a shift from established grassland is unlikely, also because the former land owners traditionally engaged in cattle farming.

Scenario 3: Forest plantations: Forest plantations are possible on the land. Some areas in the vicinity contain forest plantations. The reforestation rate in Corrientes is 9,226 ha per year. Compared to the total forestable area in Corrientes (2,700,000 ha[30]) this is equivalent to an annual reforestation rate of 0.34%. These forest plantations use exotic timber species like *Pinus* spp. and *Eucaliptus* spp.

Scenario 4: The project activity undertaken without CDM incentive. The proposed project activity is innovative in the region since it is the first one to apply a mix of native species on commercial scale .[31]. There are several barriers that prevent the implementation of the project activity without the CDM incentive, as described in Table 13 (see below). Explanations of how the CDM helps to overcome these barriers are given in section C.6.

[30] Banco Mundial (2009): Estrategia de Desarollo Productivo. Provincia de Corrientes Informe Primera Fase, Mayo 2009..

[31] Dellacha, Juan Modesto et al. 2007: Cadena forestal Argentina, FAM; see Page 7 Table 3.

Table 13: Summary of barriers for alternative land uses

Alternative Scenarios	Barriers (Prevent the alternative scenario?)				Comments on each scenario	References
	Technological Barriers	Investment Barriers	Institutional Barriers	Market		
1	No	No	No	No	Continuation of grassland management does not face any barriers. As shown before, grassland management is by far the prevailing land use. Grassland management is a family tradition and large areas can be managed by only few persons with constantly low operating costs.	- Corrientes en Cifras 2008; Direccion de estadistica y censos; Secretaria General de Gobernacion --Chiossone, Guillermo (2006): Sistemas de produccion ganaderos del noreste de Argentina, INTA. -Kurtz, Dietmar; Ligier, Daniel (INTA 2008): La carga ganadera “real” en la provincia de Corrientes. - Ecoconsulting SRL. (2007): Informe Aspectos Sociales del Proyecto Forestal Santo Domingo.
2	Yes	Yes	Yes	No	The technological barrier refers to the fact that only few soils (the red soils) are suitable for soy production while other soils (eg. wet soils, or Inceptisols) are not. This would lead to restrictions and make optimal land use difficult. .As shown before, soy production in Corrientes is still low. Soy production requires initial investments and has high operational costs in plantation set up phase and during harvest. Soy production would require the former land owner to hire staff for crop management.	- eg. Tecnologias de Produção de Soja – Região Central do Brasil 2009 e 2010 -- Londrina: Embrapa Soja: Embrapa Cerrados : Embrapa Agro-pecuária Oeste, 2008.– (Sistemas de Produção/ Embrapa Soja, ISSN 1677-8499; n.13) - INDEC, 2002, Censo Nacional Agropecuario 2002. Dirección de Estadística de la Provincia de Corrientes.: http://www.indec.gov.ar/agropecuario/cna_defini.asp
3	No	Yes	Yes	No	The main barrier to setup a forest plantation using exotic species is the investment barrier. Forestry plantations need high initial investments and payback periods are long. Furthermore, a larger plantation as in Santo Domingo does not benefit by direct subsidies by the government. While Misiones and Corrientes show largest reforestation areas in Argentina, these are still small when compared to grassland management As in case of scenario 2 and 4, setup and management of forest plantation would require hiring additional staff especially at plantation start and during thinning and harvest.	- Corrientes en Cifras 2008; Direccion de estadistica y censos; Secretaria General de Gobernacion - INDEC, 2002, Censo Nacional Agropecuario 2002. Dirección de Estadística de la Provincia de Corrientes.: http://www.indec.gov.ar/agropecuario/cna_defini.asp
4	Yes	Yes	Yes	Yes	The main barrier of a reforestation project using to large amounts native species is the technological one. There is limited or no experience with regard to breeding, planting and successful management of such species in plantations. This makes also the investment barrier more difficult	- LEY DE INVERSIONES PARABOSQUES CULTIVADOS Ley 25.080. Dirección de Forestación, Resolución 9/2001 - Corrientes en Cifras 2008; Direccion de estadistica y

					to overcome when compared to exotic species plantation since the payback period is significantly longer than with exotic species and project finance is riskier due to the uncertainties related to survival rate, biomass growth, forest management and processing of timber. Finally, infrastructure for processing native species and local and international markets are less developed than for conventional exotic species.	censos; Secretaria General de Gobernacion

Step 6: Identification of the most likely land-use

Scenario 2 is not plausible in the near future, since the soy production in the vicinity is rare, and a shift from established grassland is unlikely. **Scenario 3** is the forest plantation with exotic tree species. Forest plantations are characterized by long pay back periods and require high upfront investments. Therefore, it is unlikely that the former land owners would have started forest plantations. Scenario 4 is the project activity without CDM incentive.
Scenario 1 is the continuation of the pre-project land use activities, which is identified as the baseline scenario.

The analysis indicates that the plausible alternative land uses available to the project participants are either continuation of the current status of the land or forest plantations, the latter being less likely, among others because of financial barriers.

C.5.2. Description of the identified baseline scenario (separately for each stratum defined in Section C.4.):

This methodology foresees two categories of land uses in the baseline scenario: maintenance of grassland in its present state; and reforestation at a specific pre-project rate or a combination of both. Since no natural regeneration of trees can be identified within the project boundary the carbon pools considered in this methodology are assumed to be in steady state. Hence, the sum of the carbon stock changes of the living biomass in the grassland, for any year, is considered to be zero. The changes in carbon stocks of the living biomass for isolated trees and the changes from A/R activities undertaken under pre-project activities have been estimated (see C.7).

C.6. Assessment and demonstration of additionality:

The adopted approved methodology uses the latest version of the "Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02)[32]. The steps as outlined in the additionality tool are followed to demonstrate that the proposed A/R CDM project activity is additional and not the baseline scenario. In order to demonstrate and assess additionality barrier arguments (Step 3) are used.

[32] http://cdm.unfccc.int/EB/035/eb35_repan17.pdf

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

The proposed A/R CDM project activity started on 02/05/2007, and the proof that the land is currently not forest can be found in land eligibility elaborated in Section A.7 of the PDD.

The project is an integral part of Novartis' climate strategy based on a voluntary commitment to reduce its direct global GHG emissions by 5% below the 1990 level in the period of 2008-2012. In order to reach this emission reduction targets, in-house measures and external offsets are realized. The A/R CDM project activity is part of the external offsetting. As a leading pharmaceutical company the management of the proposed project activity is far from business-as-usual activities of Novartis.

Step 1: Identification of alternative land use scenarios to the A/R project activity

Sub-step 1a. Identify credible alternative land use scenarios to the proposed CDM project activity

The land to be forested within the project boundary is grassland with scattered trees. As elaborated in section C.5.1 in the absence of the proposed AR CDM project activity the following land-use scenarios are likely that would have occurred on the land within the project boundary of the proposed AR project activity:

- **Scenario 1:** Continuation of pre-project land use activities, i.e. extensive grassland management;
- **Scenario 2:** Combination of grassland management with production of soy on adequate sites
- **Scenario 3:** Plantation with exotic tree species;
- **Scenario 4:** The project activity undertaken without the CDM incentive.

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations

Current laws and/or regulations allow the continuation of the current land use (extensive grassland management), soy production and reforestation of the grassland. Therefore, the identified alternatives are entirely in compliance with applicable legal and regulatory requirements, currently and in the foreseeable future. Consequently the proposed AR project activities are not the only alternatives that are in compliance with all national or international laws and regulations.

Sub-step 1c. Selection of the baseline scenario

As per section C.5.1., **Scenario 1** is the baseline scenario. For the last 50 years the land has been used as extensively managed grassland for cattle dedicated to meat production. Currently the lands to be reforested in the project boundary consist mainly of pastures with native grass species and some scattered trees.

In **Scenario 1**, natural regeneration will not occur, because dense grass cover prevents seeds from landing on the mineral soil and compete with young seedling if any, which has been demonstrated by the

failure of previous air-seeding. Continuous extensive cattle grazing also prevents from natural regeneration.

Thus, the baseline scenario or the most plausible alternative land use is the continuation of the grassland management.

Step 2: Investment analysis:

In this CDM project activity step 2 is not considered for demonstrating additionality.

Step 3: Barrier analysis

Several barriers that could prevent a wide spread implementation of the project activity have been identified. The main barrier that was identified is the technological barrier which is described below. Further barriers that were identified are subsequently described.

Sub-Step 3a: Identify barriers that could prevent a wide spread implementation of the proposed project activity.

a) Technological Barriers

A prior to project regional research showed that access to qualitative native seed sources and know how with regard to management of native species plantation in the region is poor[33]. The proposed project activity therefore can be seen as driver of innovation and knowledge with regard to future use of native species in the region. There is a wide spread lack of skills for producing high quality native seedlings and for successful native tree planting, as well as for preventing planted native trees from being subject to fire, pest and disease attack. The proposed A/R CDM project activity is innovative in the region since it is the first one to apply a mix of native species on commercial scale, while *Pinus* or *Eucaliptus* plantations are more common[34].

As stated above, the technological barrier is seen as the main one. For sake of completeness below other barriers are described, partly related to technological barrier.

b) Investment barriers

The main land-use in the region around the project area is extensive managed grassland (grazing land) used for cattle dedicated to meat production. Forest plantations are slowly growing in the region at a reforestation rate of 9,226 ha per year[35]. However, it is hardly possible for local people to afford establishment investment for afforestation as an alternative in the early stage, because of the long payback periods of timberland investments and lack of access to project finance. This holds especially true in case of long rotation native species plantations as is the case in the proposed project activity. Compared to regional Pine and Eucalyptus plantations, the project's native species plantation is

---

[33] Informe Aspectos Sociales Del Proyecto Forestal Santo Domingo by Eco Consuting (2007)

[34] See Juan Modesto Dellacha et al. 2007: Cadena forestal Argentina, FAM; see Page 7 Table 3.

[35] Ley 25,080 Montos, Superficies, Forestadores y Planes por Provincia por Año.. http://www.sagpya.mecon.gov.ar/

characterized by a longer rotation period and longer payback period. On this back ground and given the fact that local people like former land owners are not in the position to receive loans from banks it is unlikely that former owners would have overcome these investment barriers. Given the fact that incomes from timber, and lCERs are only obtained after several years after the start of the proposed A/R CDM project activity it is extremely unlikely that local people like the former land owners could overcome these investment barriers. In addition, the typical grassland and cattle owner in the region are not in the position to receive favourable loans from banks. In addition, according to Law 25,080 (as described in Section C.5.1, Step 2 of the PDD) fiscal stimuli and non-refundable economic support (subsidies) are available only for plantations smaller than 500 ha/year. Given this, the project activity would have access to direct subsidies only for planting area of the year 2009. In any case, the project activity does not receive subsidies for either of the planting years as documented in an official renounce letter from the authorities. As outlined before, the main driver of the proposed project activity is the generation of lCERs that are accounted for the voluntary emission reduction target the project owner has set. Only with the generation of lCERs the project owners were willing to commit the required capital in order to realize the proposed A/R CDM project activity.

c) Institutional barriers

The population in the surroundings of the project area is of low density with little connection to larger streets and cities[36]. The project area with regard to population and infrastructure is remote. According to estimates of the INDEC (National Census of Population, Home and Housing 2005), the population is density of Ituzaingó (Department of the AR CDM project activity) is 3,6 hab/km². There are approximately 12 families in charge of cattle raising activities in the region[37]. Individual households are economically and family size-wise too weak to manage the value chain of long term timberland investments which have longer pay back periods than cattle farming or cash crop production while requiring high initial investments. In addition, the lack of organizational instruments and infrastructure access also prevents local people from overcoming technological barriers mentioned above.

d) Market

The risks of the timber market are perceived as quite high, since the market for native species timber is basically not existing yet[38]. Project owners take this risk to generate the required amount of lCERs for compliance with voluntary carbon emission reduction target and to play a pioneer role in establishing grounds for enhanced production of value added native timber products in northern Argentina. In addition the project area is quite remote which brings along higher transportation costs. This in combination with pioneering native species plantations leads to relatively high production costs of timber, while the modeling of returns is difficult due to market uncertainties for native species products. As the lCERs are the main driver for the project activity and will be retired by Novartis Pharma AG in order to be accpounted to the voluntarly set emission reduction target, the generation of lCERs can be seen as avoided costs when compared to purchase a similar amount of lCERs from another project. However, so far no lCERs have been issued and therefore clear price indications in order to model avoided costs are not available. This provides another uncertainty in modeling revenues and market risks.

[36] Informe Aspectos Sociales Del Proyecto Forestal Santo Domingo by Eco Consuting (2007)

[37] Environmental Impact Assessment (2007) Tree Plantation Project Santo Domingo by Eco Consulting S.R.L (p.29)

[38] Juan Modesto Dellacha et. al (2007); La Cadena Forestal

Although the market risks do exist for all other reforestation projects, the higher productivity of other projects in other areas tends to reduce the risks.

The CDM incentive will help to overcome the main barriers. The A/R CDM project activity is part of Novartis' carbon offsetting targets. The goal of the project activity is not based on optimizing timber returns. Optimization of timber returns would require a plantation setup with exotic fast growing species that have shorter pay back periods and provide sooner timber revenues. The generation of lCERs as main incentive allows for the establishment of a long term native species plantation, which would hardly be possible from a purely timber-return driven point of view. Only with the generation of lCERs the project owners were willing to commit the required capital in order to realize the proposed A/R CDM project activity and to take the above-mentioned market risks.
This is sustained by the fact that there is hardly experience in the region with regard to native species plantations. It is therefore evident that forestry investors in the region usually do not overcome the abovementioned barriers related to native species plantations.

Step 4: Common practice analysis

In 2003, the Argentine agricultural sector launched the plan to increase grain and oilseed production with 50% to 100 million tons over the next decade, mainly in Santiago del Estero, Chaco, Salta and Tucumán provinces. Currently 50% of the total area of arable crops is planted with soy, up from 24% in 1997. As global demand growth for soy is much higher than for cereals, most of the production increase required to attain this target is expected to be covered by soy.

The total area of forest plantations in Argentina is now approaching 1 million hectares, the vast majority of which are southern pine, eucalyptus, willow and cottonwood. The government estimates that an additional 20 million hectares of land is suitable for forest plantations, in that they have favorable growing conditions and do not compete directly with agriculture or native timber stands[39]. Plantations have been subsidized for decades, but most have not been managed properly until recently. Hence, the quality of the plantation timber available now is still quite low but is rapidly improving. There has been very limited reforestation with native species in Northern Argentina in the past. Pinus species cover 54% of the planted area, *Eucaliptus* 32%, *Salicaceae* 9% and 5% Hardwoods[40]. The total area of forest plantation in Corrientes is 420,000 ha. The annual reforestation area in Corrientes is 9,226 ha[41]. Compared to the total forestable area in Corrientes (see Section C.5.1 of this PDD) this is equivalent to an annual reforestation rate of 0.34%. As the cost of labor and planting materials including seedling and fertilizers has increased significantly in recent years, the farmers and forest farm are not willing to plant trees in remote, degraded land, which is economically unattractive. This is consistent with the above barrier analysis results.

C.7. Estimation of the *ex ante* baseline net GHG removals by sinks:

Based on the approved methodology AR-AM0005/Version 03 the *ex-ante* baseline net GHG removals by sinks can be estimated based on land use categories identified in the baseline scenario.

[39] Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA), 2009. http://www.sagpya.mecon.gov.ar/

[40] See Juan Modesto Dellacha et al. 2007: Cadena forestal Argentina, FAM; see Page 7 Table 3

[41] Secretariat of Agriculture, Livestock, Fisheries and Food (SAGPyA), 2009. http://www.sagpya.mecon.gov.ar/

(1) Maintenance of grassland in its steady state

The baseline net GHG removals by sinks from grassland is assumed to be in steady state. Hence the sum of the carbon stock changes of grassland at the time before the project started is considered to be zero (Equation B.2). Natural forest patches are not included in the project area. Only the projected biomass growth of existing single trees is included in the baseline. The existing trees are dominated by *Enterolobium contortisuliquom* and *Sapium haematospermum* In a first step GMF identified via actual satellite images, the sectors within the project area with existing growing trees, all in the baseline stratum 2 (see section C.4). These sectors are described in Section C.4. This assessment was combined with fieldwork. During the fieldwork the DBH and tree height have been measured. The mean DBH is 20 cm and mean height 5 m. During the fieldwork 290 trees were counted, The changes in carbon stock in living biomass of trees have been estimated using the stock change method.

(2) AR implemented during the pre-project period

- Step 1: The changes in carbon stock in the living biomass expected from the annual rate of A/R activities undertaken during pre-project, are also included in the estimation of ex-ante baseline net GHG removals by sinks. As described in Section C.5.1 (S tep4) the reforestation rate in Corrientes is 9,226 ha per year.
- Step 2: The annual average reforestation area in Corrientes for the period of 2003 to 2008 is 9,226 ha. Compared to the total forestable area in Corrientes (see Section C.5.1 of this PDD) this is equivalent to an annual reforestation rate of 0.34%. Considering this reforestation rate as conservative assumption in the project area, these equals to 7,83 ha/year of the project area.
- Step 3: Since most reforestation activities in the area use *Pinus* species[42], respective growth rates are used for the baseline removals by sinks.
- Step 4: The carbon stock change was estimated using the stock.change method.

[42] Corrientes en Cifras 2008; Direccion de estadistica y censos; Secretaria General de Gobernacion (Table 10.6)

ID number[43]	**Data variable**	**Data unit**	**Value applied**	**Data Source**	**Comment**
C.7.01	*Sample plot ID*	*Alpha numeric*	*named*		*Numeric series ID assigned to each temporary sample plot*
C.7.02	*Grass species*	*Dimensionsless*	*named*	*Published data*	
C.7.03	*Tree species*	*Dimensionsless*	*named*	*Local derived*	*Each tree species*
C.7.04	*Diameter at breast height (DBH)*	*cm*	*m*	*Local derived*	*Measured from each tree*
C.7.05	*Tree height (H)*	*m*	*m*	*Local derived*	*Measured from each tree*
C.7.06	*Wood density (D)*	*td.m.m^{-3}*	*measured*	*Local derived*	*Local derived species specific value*
C.7.07	*Carbon Fraction (CF)*	*tC(td.m)$^{-1}$*	*0.45*	*GPG 2006*	*Species specific value from GPG 2006*
C.7.08	*Root-shoot ratio (R)*	*Dimensionsless*	*0.28*	*GPG 2006 (Table 4.4)Sub-tropical dry forest.*	*Region specific*
C.7.09	*BEF*	*Dimensionsless*	*1.74*	*Estimación de Volumen, Biomasa y Contenido de Carbono de las Regiones ForestalesArgentinas (2004). Secretaria de Ambiente y Desarollo Sustentable. pp. 12.*	*Local derived species specific value.*
C.7.10	*V*	*m^{3} ha^{-1} yr^{-1}*	*c*	*Source: Costas, R. et al (2006):Funciones de volumen para especies de bosque secundario de la Reserva Guarani Misiones (Argentina). Rev.FCA UNCuyo..*	*Annual increment in volume for growth for living trees and woody perennials in pasture lands.*
C.7.11	*Carbon stock in*	*tCha^{-1}*	*c*		*B.11*

.

	aboveground biomass				
C.7.12	*Carbon stock in belowground biomass*	*$tCha^{-1}$*	*c*		*B.12*

In accordance to the approved methodology, monitoring of the baseline is not required; therefore no data is collected during the crediting period.

Year	**Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2 e**
Year 2007	5
Year 2008	22
Year 2009	35
Year 2010	85
Year 2011	180
Year 2012	323
Year 2013	513
Year 2014	744
Year 2015	764
Year 2016	971
Year 2017	1,207
Year 2018	1,466
Year 2019	1,747
Year 2020	1,125
Year 2021	1,356
Year 2022	1,608
Year 2023	1,876
Year 2024	2,155
Year 2025	2,443
Year 2026	2,740
Total estimated baseline net GHG removals by sinks (tonnes of CO2 e)	21,366
Total number of crediting years	20
Annual average over the crediting period of estimated baseline net GHG removals by sinks (tonnes of CO2 e)	1,068

C.8. Date of completion of the baseline study and the name of person(s)/entity(ies) determining the baseline:

The detailed baseline information is attached in Annex 3.

Date of completion of the baseline study: 6th of August 2007

Name of the person/entity determining the baseline:

First Climate

- Joachim Sell
- Ana Cristina Moeri

GMF Latinoamericana S.A:

- Matias Penalba
- Griselda Guarino
- Jorge Esquivel

SECTION D. Estimation of *ex ante* actual net GHG removals by sinks, leakage and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period

D.1. Estimate of the *ex ante* actual net GHG removals by sinks:

The actual net greenhouse gas removals by sinks represent the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in GHG emissions measured in CO_2 equivalents by the sources that are increased as a result of the implementation of an A/R CDM project activity, while avoiding double accounting, within the project boundary, attributable to the A/R CDM project activity. As described in section C, carbon stock changes in pools of soil organic matter, dead wood and litter are not accounted as part of the net GHG removals by sinks. As described in section C.4 no gaseous emissions from sources other than those resulting from changes in carbon pools are included in this AR CDM project activity, as per EB42 and EB 44 decision. The equations described in Section II.7 of the approved methodology have been used.

$$\Delta C_{ACTUAL} = \sum_{i=1}^{I} \sum_{j=1}^{J} \sum_{k=1}^{K} \Delta C_{ijk,t} - GHG_{E,t} \quad \text{B.14}$$

Where:

ΔC_{Actual} = Actual net greenhouse gas removals by sinks; tones CO_2-e yr^{-1} in year t

$\Delta C_{ijk,t}$ =Average annual change in carbon stock in living biomass of trees for stratum I, species j, sub-stratum k, tones CO_2 yr^{-1} in year t

$GHGE_{,t}$ = GHG emissions by sources within the project boundary as a result of the implementation of the A/R CDM project activity; (as per EB42 and EB 44 decision)

t = 1 to 20 (end of crediting period)
i = Stratum i (I = total number of strata)
j = Species j (J= total number of species)
k = Substratum (not applicable)

Changes in carbon stocks of living biomass of trees

Verifiable changes in carbon stocks of living biomass of trees (above-ground and below-ground) occurring annually is estimated using Equation B.15. For above- and below-ground biomass, Equations B.16 and B.17 are used. The annual increase of living biomass can be estimated using equations B.18 and B.19.

$$\Delta C_{G,AB,ijk,t} = A \cdot V \cdot D \cdot BEF \cdot CF \cdot \frac{44}{12} \quad \text{B.18}$$

$$\Delta C_{G,BB,ijk,t} = \Delta C_{G,AB,ijk,t} \cdot R \quad \text{B.19}$$

The parameters used for the biomass calculations are shown in the table below:

Table 14: Parameters used for different species

Tree species	**Wood Density (tonnes d.m.m^{-3} standing volume)**	**BEF**	**Root-shoot ratio**	**Carbon Fraction (CF)**
Pinus elliotti	0.57[44]	1.3	0.24	0.47
Pinus taeda	0.57[45]	1.3		
Grevillea robusta	0.55[46]	3.4		
Native Species	0.90[47]	3.4		
Source		IPCC GPG LULUCF 2006 (Table 3A.1.10)	IPCC GPG LULUCF 2006 (Table 4.4)	IPCC GPG LULUCF 2006 (Table 4.3)

Due to absence of project-specific and regional parameters for the Carbon fraction (CF) and Root to shoot ratio, default values from the GPG LULUCF 2006 (Table 4.4 and 4.5) were used.
With exception of Baccara all native species are hardwoods of high wood density. For the ex ante calculations the wood density of *Peltophorum dubium* (0.90) was choosen[48] as representative for the

[44] Moura Dias, Fabricio, et al. (2005): Relation between the Compaction Rate and Physical and Mechanical Properties of Particleboards.

[45] Moura Dias, Fabricio, et al. (2005): Relation between the Compaction Rate and Physical and Mechanical Properties of Particleboards.

[46] Obdulio, Oereyra; Fidelina, Silvia (2004), Durabilidad Natural de la Madera de cinco especies aptas para la Industria de la Construcción.

[47] I.Fo.NA. – Istituto Forestal Nacional (1960) . Fichas Técnicas de Especies Forestales. Argentina. Available online: http://www.sagpya.mecon.gov.ar/new/0-0/forestacion/biblos/ficha120.htm

native species. This approach was chosen because *Peltophorum dubium* is the most frequently planted native species and survival and growth rates are best known (see Table 15).

Table 15: List of native species planted in 2009

Species	Nr. of seedlings	(%)
Parapiptadenia rígida	50	0,01%
Peltophorum dubium	261306	68,88%
Apidosperma australe	50	0,01%
Patagonula americana	50	0,01%
Myrocarpus frondosus	7.250	1,91%
Inga uruguensis	2.800	0,74%
Tabebuia ochracea	21.538	5,68%
Tabebuia heptaphylla	66635	17,57%
Tabebuia pulcherrima	7.520	1,98%
Bastardiopsis densiflora	1.000	0,26%
Cordia trichotoma	108	0,03%
Enterolobium contortisiliquum	2.270	0,60%
Pterogyne nitens	8.775	2,31%

For ex-post calculations specific wood densities for each species will be applied. The wood density of *Pinus elliotti* and *Pinus taeda* is based on local data. The wood density of *Grevillea robusta* is 0.55. The biomass expansion factor (BEF) uses default values from the GPG LULUCF 2003 (Table 3A.1.10).

The changes in carbon stock in living biomass of trees have been estimated using the stock change method. The calculations were performed for each stratum and each species:

Pinus eliotti, Pinus taeda (Cases 1,2,3,4)
The growth data of *Pinus elliottii* is based on SISPINUS[49] which was used as growth and yield model to calculate volume (m3/ha) of the 4 cases with different planting densities (800, 1140, 1317 trees/ ha).
The volume function used for the calculations of *Pinus eliottii* is[50]:

V = 7.854*(10^(-5))*(DBH^2)*0.4676*H

V = Volume (dm3)/tree at year y
DBH = Diameter at breast height (cm)
H = Tree height (m)

---

[48] I.Fo.NA. – Istituto Forestal Nacional (1960). Fichas Técnicas de Especies Forestales. Argentina . Available online: http://www.sagpya.mecon.gov.ar/new/0-0/forestacion/biblos/ficha120.htm

[49] Batista de Oliveira, Edilson (2002): V.SISEUCALIPTO-SISPINUS: Softwares para el manejo de plantaciones de Pinos y Eucaliptos. EMBRAPA-Floresta. Paraná, Brasil.

[50] SISPINUS. Equation EMBRAPA, ver 2.2

Grevillea robusta (Case 5)
The growth data for *Grevillea robusta* was calculated using local data and volume functions[51]. The calculations are described Korth (2009)[52]. The function used for the calculation of *Grevillea robusta* is:

$V = (2404.49)*(1-exp(-(0.051189)*Age))^{2.90451}$

Native species
Given the small dataset available for native species, data of a species often applied in project activity were used, i.e. *Peltophorum dubium.* The according tree height (H) and Diameter at breast height (DBH) are based on studies conducted in the region.[53].

DBH=a*(1-exp(-b*Age))^c
y=(41,9456)*(1-exp(-(,047258)*x))^(1,11885)

H
y=(8,68164)*(1-exp(-(,303661)*x))^(1,18463)

The volume (m3/ha) was determined using local volume functions[54].

V
y=(4,18709)*(1-exp(-(,022848)*x))^(2,39781)

V = Volume (m3)/tree at year y
DBH = Diameter at breast height (cm)
H = Tree height (m)

As a final step the calculated volumes were transformed into carbon stock in aboveground biomass and belowground biomass via basic wood density, BEF root-shoot ratio and carbon fraction (Table 14), given by: equations B.18 and B.19.

The approved methodology recommends estimating the annual decrease or losses of the carbon in living trees as a result of commercial harvest and fuel wood harvest. There will be no fuel wood harvest during the crediting period. The growth data are provided from the project participants. The project participants

[51] CRECHI, E.; MOSCOVICH, F.; FASSOLA, H.; HENNIG, A.; HAMPEL, H.; DOMECQ, C.; MALETTI, C. 2003. TVHAla de volumen para Grevillea robusta A. en Misiones, Argentina. 10°Jornadas Técnicas Forestales y Ambientales - Facultad de Ciencias Forestales -UNaM y EEA Montecarlo - INTA. Eldorado, Misiones, Argentina.

MOSCOVICH, F.; CRECHI, E.; FASSOLA, H.; HENNIG, A.; HAMPEL, H.; DOMECQ, C.; MALETTI, C. 2004a. Funciones de volumen y forma para Grevillea robusta A. en Misiones, Argentina. 11°Jornadas Técnicas Forestales y Ambientales - Facultad de Ciencias Forestales - UNaM y EEA Montecarlo - INTA. Eldorado, Misiones, Argentina.

MOSCOVICH, F.; FASSOLA, H.; CRECHI, E.; COLCOMBET, L.; LACORTE, S.; DOMECQ, C.; HAMPEL, H. 2004b. Silvicultura y manejo de Grevillea robusta. 3° Simpósio Latino-americano sobre Manejo Florestal. Brasil.

[52] Korth, Silvia Marisel (2009): Modelos de Producción de Grevillea robusta.

[53] Korth, Silvia Marisel (2009): MODELO DE PRODUCCIÓN PARA “Peltophorum dubium” CAÑA FÍSTOLA

[54]Korth, Silvia Marisel (2009): MODELO DE PRODUCCIÓN PARA “Peltophorum dubium” CAÑA FÍSTOLA

consider that any changes due to thinning have been taken into consideration. However the trend shall be monitored. The impact of disturbances e.g. losses from fire pests are considered to be small and are a result of natural event.

Increase in emissions of greenhouse gases
The following emission sources will occur as a result of the proposed A/R CDM project activity:

- Decrease in carbon stock in living biomass of existing non-tree vegetation, caused either by competition of planted trees or site preparation;
- Emissions from fossil fuel consumption

Guidance provided in para 37, EB 44 meeting report (November 28th, 2008) regarding accounting of GHG emissions in A/R CDM project activities, includes the agreement that emissions from fossil fuel consumption may be considered as insignificant in A/R CDM project activities and may therefore be neglected. As indicated in EB42 changes in carbon stocks and emissions from any removal, including but not limited to burning, harvesting or decay, of herbaceous vegetation can be considered as insignificant and therefore be accounted for as zero.

The increase in greenhouse gas emissions is estimated as follows:

$$GHG_{E,t} = E_{Biomass\ Loss,\ t} + E_{Fuel\ Burn,\ t} = 0$$

Where:

$GHG_{E,t}$	= annual GHG emissions as a result of the implementation of A/R CDM project activity within the project boundary; tones CO_2 e/yr in year *t*
$E_{Biomass\ Loss,\ t}$	= GHG emissions from the loss of biomass in site preparation and conversion to A/R within the project boundary; tones CO_2 e/yr in year *t*
$E_{Fuel\ Burn,\ t}$	= CO2 emissions from combustion of fossil fuels within the project boundary; tones CO_2 e/yr in year *t*

D.2. Estimate of the *ex ante* leakage:

The approved methodology assumes leakage to be occurring from displacement of fuelwood collection ($LK_{Fuelwood,\ t}$) and displacement of grazing activities to areas outside the project that lead to deforestation and land use change to grazing lands ($LK_{Displacement\_grazing,t}$).

Fuelwood collection is not relevant in the project region and therefore leakage from fuelwood collection is assumed to be zero.

Since 2007 and until May 2009 all cattle were sold and displaced, partly directly to slaughterhouses partly to other livestock farmers in the vicinity. The displacement of cattle outside the project boundary is temporarily, i.e. cattle are fed for few months and than being slaughtered in short term. Accordingly the overall number of cattle will stay constant or decrease in the region. According to the methodological tool “Estimation of GHG emissions to displacement of grazing activities in A/R CDM project activity” (Version 2); the sale of grazing animals to an entity not involved in the CDM project activity or slaughter

of grazing animals does not result in leakage. No permanent vegetation loss or land use change will occur outside the project boundary due to the project activity.

Therefore there are no potential leakage emissions attributable to the AR CDM project activity.

$LE_t = 0$

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

Monitoring of the project boundary

With respect to monitoring project area or boundary the following activities are foreseen:

- Field surveys to verify that the delineated project boundary is congruent with the descriptions in this PDD;
- Measuring geographical positions (UTM position of each corner polygon sites) using GPS;
- Record the spatial extend and location of the species planted in each stratum;
- Compare the changes observed in the planted area using remote sensing data and the data from the ground checks, field monitoring, and from planting records.
- The project boundary, and the integrity of the planted area, will be monitored periodically through the crediting period. If the boundary is changed during the crediting period, for instance, because deforestation has occurred on the project area, the specific location and area of the deforested land will be identified, the boundary will be modified and reported to DOE for subsequent verifications. The deforested area will then be excluded from the project monitoring. Similarly, if the planting on certain lands within the project boundary fails and other land uses take place, these lands will be documented and excluded from the project carbon monitoring.
- Land ownership and access to carbon rights during the crediting period described in "Operating and Forestry Rights Agreement" and "Purchase Agreement". The transfer of land owner rights from trustee to Novartis Argentina S.A. and lCERs owner rights from Novartis Argentina S.A. to Novartis Pharma AG shall be recorded in the monitoring before first verification. An official statement by trustee will be provided. Validity of this transfer will be confirmed before verifications.

ID number [55]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[56]	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
E.1.01	*Plot location UTM of each polygon corner*	*UTM position*	*m*	*5 years*	*100% of parcels*	*Measured using GPS and usual land surveys methods*
E.1.02	*Parcels area*	*ha*	*c*	*5 Years*	*100% of parcels*	*Calculated using Data from 1.1.01*

[55] Please provide ID number for cross-referencing in the PDD.

[56] Please provide full reference to data source.

E.1.1. Monitoring of forest establishment and management:

Monitoring of the forest establishment:

To ensure the planting quality and confirm the practices described in section A being well-implemented, the following monitoring activities will be conducted in the first 5 year after planting:

- Confirm that site and soil preparation are implemented based on practice documented in section A, no slash and burn and overall tillage will be used in the site and soil preparation.
- Assess and confirm that the size and strength of the seedlings to be planted conforms to the silvicultural activities described in this PDD.
- Confirm that site preparation does not cause significant longer term net emissions from soil carbon. This will be done by checking and confirming that site preparation technique described in Section A.5.7 are well implemented.
- Survival checking
    - The initial survival rate of planted trees will be checked within six to eight months after the planting, and re-planting will be conducted if the survival rate is lower than 90%.
    - Final survival checking will be carried out three years after the planting.
    - Survival checking will be conducted for each plantation site (Strata 1 to Strata 5).
- Weeding checking: to check and confirm that the weeding practice is well-implemented.
- Surveying and checking the area of planted species and planting year for each stratum.
- Establishment of permanent sample plots during year 3 after planting in every compartment, GPS readings will be taken at the centre of the plot, determine radius of the plot, mark all trees in the plot, take measurements (H, DBH, slope, elevation, geographical coordinates).

Monitoring of the forest management activities:

- No fertilizer use included in the forest management;
- Tending procedures and practices are implemented; for instance pruning and thinning and the biomass removed recorded including damage occurring as a result of tending procedure and practice;
- Record natural or anthropogenic disturbances (including the fire or other catastrophic events) by date, locations, species, volume of biomass lost or affected, and the preventive, salvation or curative measures, if any, implemented, and their success (monitoring of the re-growth).
- Confirm and checking the information on forest protection practices such as fire breaks controlled burning of fire breaks, and closure of compartments to prevent anthropogenic activities that impact the standing biomass.

The data used to monitor forest establishment and management are shown in the table below:

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of data points / Other measure of number of collected data.	Comment
E1.1.1	*Site preparation for parcel*	*NA*	*d*	*During every plantation and re-plantation*	*100% of the parcels*	*To confirm that site and soil preparations are implemented based on practice described in section A.5.4 of this PDD.*
E1.1.2	*Survival rate*	*%*	*c*	*Six to eight months after the planting*		*Re-planting will be conducted if the survival rate is lower than 90 per cent; Final checking three years after the planting; Survival checking will be conducted for each plantation site*
E1.1.3	*Weeding*	*NA*	*d*	*During every plantation and re-plantation*	*Conducted using permanent sample plots*	*Check and confirm that the weeding practice is well implemented*
E1.1.4	*Thinning date*	*Date*	*m*	*According to PDD proposed management*	*100% of parcels*	
E.1.1.5	*Thinning No of trees cut*	*No. of trees*	*m*	*According to PDD proposed management*		
E.1.1.6	*Biomass stock lost per ha during thinning*	*t d.m.ha^{-1}*	*c*			*The thinning areas are stored in the GIS database and on management (silviculture) maps to determine thinning schedule.*
E.1.1.7	*Harvesting*		*m*	*Once*	*100%*	*Spatial location of mature blocks to be harvested in a given time are prepared GIS*

E.1.1.8	*Area of harvest*	*ha*	*c*	*once*	*100%*	*The harvested areas are stored in the GIS database and on management (silviculture) maps to determine harvesting schedule, by species.*
E.1.1.9	*Volume harvested*	*m^3*	*c*	*Once*	*100%*	*The volume harvested is recorded and tracked*
E.1.1.10	*Area affected by diseases and pest*	*ha*	*c*	*Annually*	*100%*	*The area will be measured and mapped. The damage will be assessed and the area will be monitored to see how the vegetation develops/recover*
E.1.1.11	*Area burnt by fire*	*ha*	*c*	*Annually*	*100%*	*Salvation measures will be implemented if needed. The area will be measured and mapped. Damage will be assessed and the area will be monitored to see how the vegetation recovers. If it doesn't recover it will be replanted.*
E.1.1.12	*Location burnt*	*m*	*m*	*Annually*	*100%*	*By species*
E.1.1.13	*Volume of biomass lost due to fire*	*m^3*	*c*	*Annually*	*100%*	*Will be calculated on the basis of last inventory data.*
E.1.1.14	*Area re-growth after fire*	*m^2*	*c*	*Once*	*100%*	*Will be calculated from ground surveys*
E.1.1.15	*Area of breaks*	*m^2*	*c*	*Once*	*100%*	*Will be calculated from ground surveys*

E.1.2. If required by the selected approved methodology, describe or provide reference to, SOPs and quality control/quality assurance (QA/QC) procedures applied.

>>

To ensure the net anthropogenic GHG removals by sinks to be measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure will be implemented. The data collection and organization are based on the Procedure Manual (Manual de Procedimiento) described in Annex 4.

a) Quality assurance of field measurements

To ensure the reliable field measurements,

- The company in charge of monitoring has not been contracted yet. Several candidates are being looked at. Project participants will select locally available and experienced staff. Therefore training courses are not necessary. In order to ensure consistency in field monitoring and measurements, the team members are trained in all procedures of data collection. The monitoring and data collection unit is organized and the team's responsibilities are clearly outlined.
- Any new staff will be adequately trained.

b) Verification of field data collection

To verify that the plots have been installed and the measurements taken correctly, the following work would be undertaken:

- The field data collection is verified by undertaking random checks of plots, including their re-measurement by a senior member of the monitoring team. In case of errors, these is corrected and recorded for each stratum. The errors identified are recorded as a percentage of errors on all the verified plots to estimate the measurement error.

c) Verification of data entry and analysis

To minimize the possible errors in the process of data entry, the entry of both field data and laboratory data will be reviewed by an independent expert team and compared with independent data to ensure that the data are realistic. Communication between all personnel involved in measuring and analysing data will be used to resolve any apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

d) Data maintenance and archiving

Data archiving will take both electronic and paper forms, and copies of all data will be provided to each project participant. All electronic data and reports will also be copied on durable media such as CDs and copies of the CDs are stored in multiple locations. The archives include:

- Copies of all original field measurement data, laboratory data, data analysis spreadsheet;
- Estimates of the carbon stock changes in all pools and non-CO2 GHG and corresponding calculation spreadsheets;
- GIS products;
- Copies of the measuring and monitoring reports.

E.2. Sampling design and stratification

a) Stratification of the project area

The stratification map will be created on a GIS platform. However, post stratification will be conducted after the first monitoring event to address the possible changes of project boundary and planting timing in comparison with the project design, and to respond any differences in growth conditions compared to what was expected. The following factors will be considered in the post-stratification:

- Catastrophic disturbances such as fire, pest, or disease outbreaks that modify the homogeneous character of a stratum;
- The influence of grassland vegetation on stand development
- Management and silvicultural activities implemented at different intervals and locations than those proposed at the start of the project

b) Sampling Frame

Permanent sampling plots are used for sampling over time to measure and monitor changes in carbon stocks of the relevant carbon pools. The plots will be located with GPS and are invisible so as to be treated in the same way as other lands within the project boundary, e.g., during site and soil preparation, weeding, fertilization, harvesting, etc., and will be prevented from being deforested over the crediting period.

Sample size

The approved methodology recommends the number of sample plots in a compartment to be established depending on accuracy desired, variability of carbon stocks, composition of species and costs associated species growth variation, stocking and the accuracy required during monitoring the interval. In the proposed A/R CDM project activity numbers of sample plots were established using parameters described in Equations M.1 and M.2 of the approved methodology. The standard deviation of each stratum (sti) is set at 50% of the standing volume. The precision level was set as 10%. The t value is determined based on the 95% confidence level. The cost to establish a plot in each stratum is assumed to be same. To ensure statistical independence for each stratum, a minimum of 3 plots will be set for each stratum.

$$n = \left(\frac{t\alpha}{E}\right)^2 \left[\sum_{i=1}^{mp} Wi \cdot si \cdot \sqrt{Ci}\right] \cdot \left[\sum_{i=1}^{mp} Wi \cdot \frac{si}{\sqrt{Ci}}\right]$$

where:

n = sample size (number of sample plots required for monitoring)
tα = t value for a significance level of 95%
Ni = number of sample units for stratum i
N = total number of sample units of all stratum levels, N= $\sum Ni$

si = standard deviation of stratum I (50% of the mean standing volume)
E = allowable error (10% of the mean)
Ci = cost to select a plot of the stratum i is assumed as 1.

Wi $= \frac{Ni}{N}$

The number of plots shall be allocated among the strata as per equation below

$$ni = n \cdot \frac{W \cdot \frac{si}{\sqrt{Ci}}}{\sum_{i=1}^{I} Wi \cdot \frac{si}{\sqrt{Ci}}}$$

where:
ni = number of sample units (permanent sample plots) per stratum, that are allocated proportional to $Wh \cdot \frac{si}{\sqrt{Ci}}$
Ci =cost to select a plot of the stratum i is assumed as 1.
n =sample size (number of sample plots required for monitoring)
si =standard deviation of stratum i
I = stratum i

However, after the first monitoring event, when there are actual project data for sample size estimation, the sample size shall be recalculated considering the observed variation in the strata and plot establishment and measuring costs.

Table 16: Number of plots in the first monitoring

Stratum	Area (ha)	Planting density (trees/ha)	Number of plots
Case 1	143	800	6
Case 2	830	1,129	36
Case 3	571	1,067	25
Case 4	464	1,873	20
Case 5	285	1,448	12
Total	2,292		99

Plot size

The project participants have chosen to use circular shaped permanent sample plots since are easy to establish and are traceable in the terrain within the project activity boundary. Since the plot size depends on the density of stands (stocking) and spatial heterogeneity of compartment, sample plot area of 400 m^2 shall be used to minimize sampling intensity, time, and resources spent in the measurements.

Locating permanent sample plots

To avoid subjective choice of plot locations, the permanent sample plots (PSP) will be located systematically with a random start from now on. In case of special circumstances, e.g. forest fires, uneven growth, additional PSPs may be laid out. This will be accomplished with the help of a GPS in the field. The geographic position (GPS coordinate), administrative location, compartment series number of each plots is recorded and archived. It is to be ensured that the sampling plots are distributed randomly, and as evenly spread as possible.

c) Monitoring interval

The planting activity has been conducted from 2007 to 2009. The trees in the present project activity would be thinned at the age of 8/9, 13/14 and 19 (Stratum 5). Native species and *Grevillea robusta* will only be thinned in Starata 5. This distribution allows for a smoothing of the carbon sequestration curve, avoiding extreme peaks and minimums. The first monitoring will be conducted in the year 2012 with subsequent monitoring in 5 year periods of 2017, 2022 (Table 17). *Pinus eliottii* and *Pinus taeda* will be harvested after 20 years. *Grevillea robusta* and the native species wil be harvested between 25 and 30 years. In the cases 5 and 6, within Stratum 4, due to forest management optimisation it can be that thinnings in *Pinus eliotti* and *Pinus taeda* will be advanced approximately 1 year.

Table 17: Monitoring

Year No	Year	Monitoring	Verification	Thinning				
				Stratum 1	Stratum 2	Stratum 3	Stratum 4	Stratum 5
1	2007							
2	2008							
3	2009							
4	2010							
5	2011							
6	2012	X	X					
7	2013							
8	2014			X		X		
9	2015				X		X	
10	2016							
11	2017	X	X					
12	2018							
13	2019			X		X		
14	2020				X		X	X
15	2021							
16	2022	X	X					
17	2023							
18	2024							
19	2025							X
20	2026							

E.3. Monitoring of the baseline net GHG removals by sinks, if required by the selected approved methodology:

The methodology does not require the monitoring of baseline scenario during the crediting period. In addition, the participants use 20 years renewable period as the crediting period in which the baseline removals shall be re-estimated at each renewal period. Under this methodology there is no need for collecting data to estimated baseline net GHG removals by sinks.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of sample plots at which the data will be monitored	Comment

E.4. Monitoring of the actual net GHG removals by sinks:

>>

E.4.1. Data to be collected in order to monitor the verifiable changes in carbon stock in the carbon pools within the project boundary resulting from the proposed A/R CDM project activity:

Monitoring the actual net GHG removals by sinks

The project participants shall monitor changes in carbon stocks associated with the carbon stock changes in above-ground and below-ground biomass from native and exotic species. These pools shall form a basis for monitoring actual net GHG removals by sinks within the project boundary. Carbon stocks in dead wood, litter and soil pools are not monitored. However the project participants shall periodically monitor changes in soil carbon as part of the requirements in the management plan. The monitoring of the actual net GHG removals by sinks includes:

- Monitoring the changes in the aboveground biomass pools of the A/R project through taking measurements from the Permanent Sample Plots established in each substratum (Belowground biomass pools will be calculated using the aboveground biomass pool and the Root-shoot-ratio).
- Monitoring of GHG emissions within the project boundary that results from the implementation of the A/R project activities such as site preparation and use of fossil fuel.
- Monitoring the leakage outside the project activity boundary as a result of implementation of the A/R project activities such as use of fossil fuel.

Measuring and estimating carbon stock changes within the project activity boundary

The carbon stock changes in every substratum are calculated using equations M.3 to M.5 of the approved methodology. The approved methodology recommends use of allometric equations. The mean carbon

stock in above- and below-ground biomass per unit area is estimated based on field measurements on permanent plots using the Biomass Expansion Factors (BEF) method, with specific steps as follows:

Estimation of living biomass of trees using BEF

Measuring the diameter at breast height (DBH, at 1.3 m above ground) and preferably height of all the trees in the permanent sample plots above a minimum DBH (2 cm). Better data for the biomass expansion factor (BEF) and root-shoot-ratio (R) shall be used in case they are available.

Estimation of the carbon stock of living biomass of trees in one permanent sample plot:

The living biomass of trees in one single permanent plot is the sum of the living biomass measured trees within the sample plot and converted to carbon stock using equations M17 and M.18 of the approved methodology.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of sample plots at which the data will be monitored	Comment
E.4.1.01	*Stratum ID*	*Alpha numeric*		*Before the start of the project activity*	*100%*	*Each stratum has a particular combination of soil type, planting year and planting density*
E.4.1.02	*Sub-Stratum ID*	*Alpha numeric*		*Before the start of the project activity*	*100%*	*Each sub-stratum has a particular year to be planted under each stratum*
E.4.1.03	*Confidence level*	*%*		*Before the start of the project activity*	*100%*	*For the purpose of QA/QC and measuring and monitoring accuracy*
E.4.1.04	*Accuracy*	*%*		*Before the start of the project activity*	*100%*	*For the purpose of QA/QC and measuring and monitoring accuracy*

E.4.1.05	*Standard deviation of each stratum*		*e*	*Before the start of the project activity*	*100%*	*Used for estimating numbers of sample plots of each stratum*
E.4.1.06	*Number of sample plots*		*c*	*Before the start of the project activity*	*100%*	*Plot ID shall be provided to each permanent sample plot ID.*
E.4.1.07	*Sample plot ID*	*Alpha numeric*		*Before the start of the project activity*	*100%*	*Numeric ID will be assigned to each permanent sample plot*
E.4.1.08	*Plot location*	*Project and plot map; GPS*	*m*	*5 years*	*100%*	*Using GPS to locate before start of the project and at time of each field measurement.*
E.4.1.09	*Tree species*	*Project design map*		*5 years*	*100%*	*Arranged in the CDM-AR PDD A.5.3*
E.4.1.10	*Age of plantation*	*year*	*m*	*5 years*	*100% sampling plot*	*Counted since the planted year*
E.4.1.11	*Number of trees*	*number*	*m*	*5 years*	*100% of trees on plots*	*Counted in plot measurements*
E.4.1.12	*Diameter at Breast Height (DBH)*	*cm*	*m*	*5 years*	*100%of trees on plots*	*Measured at each monitoring interval*
E.4.1.13	*Mean DBH*	*cm*	*c*	*5 years*	*100% of sampling plots*	*Calculated from DBH and Number of Trees.*
E.4.1.14	*Tree height*	*m*	*m*	*5 years*	*100% of trees on plots*	*Monitoring at each monitoring time per sampling method.*
E.4.1.15	*Mean tree height*	*m*	*c*	*5 years*	*100% of trees on plots*	*Calculated from Number of Trees and Tree height*
E4.1.16	*Merchandable Volume*	*m3/ha*	*c/m*	*5 years*	*100% of sampling plots*	*Calculated from Mean DBH and Tree height*

						using local-derived equation.
E.4.1.17	*Wood density*	*t d.m. m-3*	*e*	*5 years*	*100% of plots*	*Species specific value*
E.4.1.18	*Biomass expansion factor (BEF)*	*dimensionless*	*e*	*5 years*	*100% of plots*	*Species specific value*
E.4.1.19	*Crbon Fraction*	*$tC(td.m)^{-1}$*	*e*	*5 years*	*100% of plots*	*IPCC species specific value*
E.4.1.20	*Root-shoot ratio*	*dimensionless*	*e*	*5 years*	*100% of plots*	*IPCC species specific value*
E.4.1.21	*Carbon stock in above ground biomass of tree*	*kg C tree-1*	*c*	*5 years*	*100% of sampling plots*	*Calculated from equation (M.15)*
E.4.1.22	*Carbon stock in below ground biomass of tree*	*kg C tree-1*	*c*	*5 years*	*100% of sampling plots*	*Calculated from equation (M.16)*
E.4.1.23	*Carbon stock in above ground biomass of plot*	*t C ha-1*	*c*	*5 years*	*100% of sampling plots*	*Calculated from equation (M.17)*
E.4.1.24	*Carbon stock in below ground biomass of plot*	*t C ha-1*	*c*	*5 years*	*100% of sampling plots*	*Calculated from equation (M.18)*
E.4.1.25	*Mean carbon stock in above ground biomass per unit area per stratum per species*	*t C ha-1*	*c*	*5 years*	*100% of stratum*	*Calculated from E.1.1.05 to E1.1.22*
E.4.1.26	*Mean carbon stock in below ground biomass per unit area per stratum per species*	*t C ha-1*	*c*	*5 years*		*Calculated from E.1.1.05 to E1.1.19*
E.4.1.27	*Area of*	*ha*	*m*	*5 years*	*100%*	*Actual area of*

	stratum					*each stratum*
E.4.1.28	*Carbon stock in above ground biomass of stratum per species*	*t C*	*c*	*5 years*	*100% of stratum*	*Calculated from equation (M.15)*
E.4.1.29	*Carbon stock in below ground biomass of stratum per species*	*t C*	*c*	*5 years*	*100% of stratum*	*Calculated from equation (M.16)*
E.4.1.30	*Carbon stock change in above ground biomass of stratum per species*	*t C yr-1*	*c*	*5 years*	*100% of stratum*	*Calculated from equation (M.4)*
E.4.1.31	*Carbon stock change in below ground biomass of stratum per species*	*t C yr-1*	*c*	*5 years*	*100% of stratum*	*Calculated from equation (M.5)*
E.4.1.32	*Total carbon stock change*	*t C yr-1*	*c*	*5 years*	*100% project area*	*Summing up carbon stock change in for all strata*

E.4.2. Data to be collected in order to monitor the GHG emissions by the sources, measured in units of CO_2 equivalent, that are increased as a result of the implementation of the proposed A/R CDM project activity within the project boundary:

As described in Section C.3 Table 8, no gaseous emissions from sources are included in this AR CDM project activity.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of sample plots at which the data will be monitored	Comment

E.5. Leakage:

>>

E.5.1. If applicable, please describe the data and information that will be collected in order to monitor leakage of the proposed A/R CDM project activity:

Since animals were slaughtered or sold to entities not involved in the project activity leakage from activity displacement is zero. In order to assure that entities involved in the project activity do not manage animals formerly managed on the project activity area this will be monitored during first monitoring year in form of official confirmation in written by entities involved in project activity.

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)	Recording frequency	Number of data points	Comment
E.5.1.1	*Confirmation letter*	*NA*	*m*	*once*	*100% project area*	*During first monitoring year.*

E.5.2. Specify the procedures for the periodic review of implementation of activities and measures to minimize leakage, if required by the selected approved methodology:

>>

E.6. Provide any additional quality control (QC) and quality assurance (QA) procedures undertaken for data monitored not included in section E.1.3:

>>

Data ***(Indicate ID number)***	Uncertainty level of data (High/Medium/Low)	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**
Plot location (E.4.1.07)	*low*	*Random verification using GPS to ensure the consistent measuring and monitoring of the carbon stock change over time*
Tree species(E.4.1.08)	*low*	*Random verification over the project area to ensure the area of each tree species is correctly measured*
Age of plantation (E.4.1.09)	*low*	*Random verification over the project area to ensure the area in terms of plantation age is correctly measured*
Diameter at Breast heigh of living trees (DBH)(E.4.1.11)	*low*	*Random plot verification*

Tree heigh (E.4.1.13)	*low*	*Random plot verification*
Standing Volume (E.4.1.15)	*low*	*All equations used to calculate this data shall be verified*

E.7. Please describe the operational and management structure(s) that the project operator will implement in order to monitor actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity:

The proposed A/R CDM project activity is operated by GMF while the local company in charge of implementing the monitoring is in the process to be contracted. A major aspect in the selection process is experience with regard to local forest management. Financing and management backstopping is provided by Novartis Pharma AG. The GMF project management team is fully responsible for administrating and coordinating all project activities. GMF is facilitating and supervising the implementation of the proposed A/R CDM project activity, organizing technical training and consultation, and organizing the monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity. Any activity data and monitoring data will be reported and archived by GMF in both, electronic and paper copy. In the proposed A/R CDM project activity, GMF will:

- Provide technical instruction on reforestation and forest management, and conduct the specific supervision of the implementation of the proposed A/R CDM project activity and collect specific activity data at routine basis.
- Be responsible for measuring and monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity.
- Provide technical consultation and training in the measuring and monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity, and will be responsible for drafting monitoring report.
- Establish an expert team where necessary for instance in addressing any technical issues arising, conducting checking and verification of measured and monitored data.

E.8. Name of person(s)/entity(ies) applying the monitoring plan:

The company in charge of monitoring has not been contracted yet. Several candidates are being looked at. Project participants will select locally available and experienced staff from National Universities. The persons that apply and ensure the monitoring plan is being implemented are listed below:

Name of the Person	Entity	Contact Information (email)
Griselda Guarino	GMF, Supervision	guarino@gmfsa.com.ar
Heinrich Burschel	GMF, Supervision	burschel@gmfsa.com.ar

SECTION F. Environmental impacts of the proposed A/R CDM project activity:

F.1. Documentation on the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary of the proposed A/R CDM project activity:

The purpose of this project through establishing 2,292 ha forests of native and exotic species, according to the general principles of sustainable management of the natural resources, is to ensure environmental benefits, social responsibility and economic viability, contributing to the reduction of GHG emissions and mitigate therefore global climate changes. An environmental impact assessment has been conducted for the FSC certification process by ECO-CONSULTING S.R.L. The assessment covers the topics outlined in the IPCC GPG. The aim of this Environmental Impact Assessment can be summarized in the following points: Determine sensible environmental factors, identify and value qualitatively the environmental impact that may take place as a result of the Project; propose mitigation procedures in order to avoid, to correct or to minimize the negative impact; and to identify necessary indicators to prepare a monitoring and assessment program for the diverse stages of the project. For the Environmental Impact Assessment, the Law Nº 5,067 - Evaluation of Environmental Impact and the legislation related to the natural resources of the Province of Corrientes, as well as the Decree Nº 133/99 of the Law Nº 25,080 and all the relevant environmental legislation (detailed in the EIA[57]) were considered.

Risk analysis and countermeasures

- **Water Resources**

  - Superficial runoff and infiltration: whole site preparation will increase the infiltration; Growing trees increase the infiltration because of the roots; the total precipitation reaching the soil will be smaller due to interception.
  - Quality and quantity of superficial water: Quality can be affected if the minimum distance of the operations is not respected. The quality can also be affected by the traffic of the machines
  - The decrease of the livestock activity and establishment of the plantations will improve water run-off in areas that periodically were subject to flooding.
  - It is known that plantations consume more water than grassland and that they intercept and evaporate a greater quantity in their crowns than grasslands. The consequence could be a reduced amount of water drained toward the superficial bodies. Nevertheless the new systematization of the land can increase the proportion of runoff and consequently contribute to the riparian areas and water bodies in the surrounding areas.

- **Species**

  - To reduce or avoid the potential negative impacts by planting pure exotic species, mitigation measures will be taken: the fast growing exotic tree species have the objective to support the development of the native species. In the beginning, fast growing species will be planted that are known to be well suitable for the local conditions. These include for example *Pinus*

[57] Environmenta Impact Assessment (2007) Tree Plantation Project Santo Domingo by Eco Consulting S.R.L

teada and *Pinus elliottii*. The number of fast growing trees will be reduced successively by thinnings. Furthermore, there are few trees and bushes on the area. Some small natural forest patches adjacent to the project area are kept for protection of water resources and habitats of fauna and flora..

- **Biodiversity and natural ecosystems**

  - The project activity aims at establishing a plantation consisting of 75% of native timber species and 25% of exotic species well adapted top local growing conditions. The native species mix to be planted reflect native species that occur in natural forest patches adjacent to the project area that are kept to protect water resources and local species' habitats. The native species will be managed in long rotations and in some areas native species groups are planted (instead of interplanting in rows). This plantation design is favorable to local fauna and flora and, compared to prevailing pure exotic species plantations, contributes to biodiversity protection in the area.
  - The forest can serve as refuge for some species, especially for mammals. The replacement of grassland, through forestation with native species will produce positive changes in the environmental conditions for the fauna in the project region.

- **Site preparation**

  - To prevent soil erosion, reduce GHG emissions and protect existing carbon stocks, site burning will not be employed during site preparation. Traditionally in northern Argentina, grassland burning is used as a management tool for the renewal of the sites, which results in carbon and non-CO_2 GHG being released into the atmosphere.

- **Fire and pest risk:**

  - The fire risk in the region of the project area is high in certain periods of the year. This can be alleviated through technical and awareness training to local farmers/communities, strengthening patrolling and monitoring, reducing the biomass of the grasslands in the neighborhoods, arranging water tanks, as well as building the fire-break belt. Furthermore, a mixed reforestation arrangements will be adopted to reduce fire and pest risks.

- **Pesticide**:

  - Improper pesticide application would be harmful to natural environment, including polluting soil, water and air conditions, as well as the habitat of the wildlife. Weeds and leave cutter ants will be treated with common chemicals in line with FSC principles and indicators.

None of these risks and/or negative impacts are considered to be significant.

F.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken an environmental impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to support documentation:

No significant negative impacts have been identified due to the environmental-friendly techniques adopted in the proposed A/R CDM project activity, e.g., avoidance of slash and burn and overall tillage, proper choice of tree species and their spatial arrangement, etc.

F.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section F.2. above:

No significant negative impacts have been identified.

SECTION G. Socio-economic impacts of the proposed A/R CDM project activity:

G.1. Documentation on the analysis of the major socio-economic impacts, including impacts outside the project boundary of the proposed A/R CDM project activity:

The main source of income for local communities in the province of Corrientes is Agriculture (livestock). The forestry sector showed some growth in the last years with focus on exotic species plantations. The resident population in the surrounding of the estate is scarce, given that the cattle stock exploitations located in the zone are extensive and with little resident population. Approximately 12 families are responsible for managing the cattle. In the region there is reduced access to common commodities of daily life.. For this reason the residents move to more populated centers, mainly Gobernador Virasoro and Posadas. The main socio-economic benefits of the project include:

(1) **Creating employment**: The proposed A/R CDM project will generate employment and even though that technologies and machinery will be applied in the manner described, employment will increase substantially when compared to the baseline..

(2) **Safety Program**: Considering the national demand, the free provision of tools, machineries, safety equipment and working clothes. The employees will be appropriate protected against labor accident and/or damages of any type within the labor environment.

(3) **Technical training and demonstration**: Interview with local communities indicated that local farmers/communities are usually short of access to quality seed sources and lack skills for producing high quality seedlings and for successful tree planting, as well as for preventing planted trees from being subject to fire, pest and disease attack. This is one of the important barriers of local communities in planting trees on their lands. In the proposed A/R CDM project activity, the project participants will organize the training for local communities to assist them in understanding and evaluating the issues of hosting the proposed A/R CDM project activity such as seed and seedling selection, nursery management, site preparation and planting models.

(4) **Improvement of local Infrastructure**: The A/R CDM project activity proposes a network of roads to permit the access with reduced impact to the establishment. These roads will remain accessible for the future silvicultural and harvesting work. Furthermore the roads will be connected with the roads of the neighboring establishments.

(5) **Conservation of the planting areas**: Harvesting, settlement and other illegal activities will be prevented through the employment of warning signs in the area of the establishment.

G.2. If any negative impact is considered significant by the project participants or the host Party, a statement that project participants have undertaken a socio-economic impact assessment, in accordance with the procedures required by the host Party, including conclusions and all references to supporting documentation:

None of the potential negative impacts is considered to be significant.

G.3. Description of planned monitoring and remedial measures to address significant impacts referred to in section G.2 above:

N/A

SECTION H. Stakeholders' comments:

H.1. Brief description of how comments by local stakeholders have been invited and compiled:

The collection of the comments by stakeholders was conducted by GMF,. The following stakeholders groups have been identified:

- Governmental: Direccion de Recursos Forestales, ICCA (Instituto Correntino del Agua), INTA EEA Corrientes, UNAM (Universidade Nacional de Missiones), Dirección de Catastro Corrientes, UNLP (Universidad Nacional de La Planta).
- Non-Governmental: Eco Consulting, Fundación Vida Silvestre
- Immediate neighbours: UBS, Bosque de la Plata
- Private companies: Danzer, Alto Paraná
- Service Providers: Vivero San, Vivero Huagro/San Juan Corá, Pernigotti
- FSC-SmartWood
- Santo Domingo: Administrator, Administrator Assistant, foreman
- Associations: Consorcio de manejo del Fuego
- Persons: Former Owners, tenant

A short introduction of the project was given to the stakeholders in order to let them know the objectives of the A/R CDM project and leave a margin for ideas exchange and cooperation. The clarifications have been done in different ways and moments according to the progress of the project. The Resumen Publico, Management Plan and Environmental Impact Assessment have been sent by email. To some stakeholders the introduction was given orally.
An introduction of the project to the immediate neighbors and former owners was given so as to let them be aware of the project activities and objectives and to inform about cooperation to develop some activities together, maintenance of counter fire breaks, ant and fire control. The former owners were informed verbally about the project.

H.2. Summary of the comments received:

Summary of stakeholder comments:

Stakeholder concerns / question / comment	Answer / clarifications
The forestation could affect some areas of the Santo Domingo Estate.	**The planting plan is adequate to the soil conditions of the area.**
The forest patches must be protected and a restoration of the area should be conducted.	**GMF have since early planning state a protecting plan for these forest patches adjacent to the project area. Natural regeneration is expected. If natural regeneration is not taking place, measures of restoration will be taken.**

The project area could include endemic species with a high value of conservation.	**GMF conducted a study to evaluate the grassland to be planted and there are no rare or endangered species under pressure due to project activity. Natives species planted are derived from natural forest patches and these habitats are protected.**
The Eucaliptus located in the Santo Domingo Estate are very close to the plantation area and could represent a fire risk.	**Measures have been taken by GMF to reduce the fire risk (firebreak).**

H.3. Report on how due account was taken of any comments received:

>>

The stakeholders were provided clarifications on the issues raised to their satisfaction. None of the concerns expressed by the stakeholders required an action to be taken by GMF during the project activity stage or any other stage. GMF maintains a friendly contact to the stakeholders and is open for dialog at any time. There is no evidence or registration of opposition or disagreement at this point.

Annex 1

CONTACT INFORMATION ON PARTICIPANTS IN THE PROPOSED A/R CDM PROJECT ACTIVITY

Organization:	Novartis Pharma AG
Street/P.O.Box:	Fabrikstrasse 1
Building:	Forum 1
City:	Basel
State/Region:	Basel
Postfix/ZIP:	4002
Country:	Switzerland
Telephone:	+ 41 61 324
FAX:	+ 41 61 324
E-Mail:	
URL:	www.novartis.com
Represented by:	
Title:	Dr
Salutation:	Mr
Last Name:	Lehni
Middle Name:	
First Name:	Markus
Department:	Corporate Health, Safety and Environment
Mobile:	+ 41 79 334 1827
Direct FAX:	+ 41 61 324 7499
Direct tel:	+ 41 61 324 2899
Personal E-Mail:	markus.lehni@novartis.com

Organization:	Novartis Argentina S.A
Street/P.O.Box:	Ramallo 1851
Building:	
City:	Buenos Aires
State/Region:	Buenos Aires
Postfix/ZIP:	C1429DUC
Country:	Argentina
Telephone:	
FAX:	
E-Mail:	
URL:	www.ar.novartis.com
Represented by:	
Title:	
Salutation:	Mr.
Last Name:	Thurburn
Middle Name:	Miguel

First Name:	Juan
Department:	Legal, Public Affairs, Communications, Health-Safety and Environmental
Mobile:	
Direct FAX:	+54 11 4703 7278
Direct tel:	+54 11 4703 7280
Personal E-Mail:	juan_miguel.thurburn@novartis.com

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No funding will be used from Official Development Assistance.

Annex 3

BASELINE INFORMATION

1. Site classification

6 categories and 8 types of soils were determined, belonging to the following groups according to soil taxanomy. Subsequently taxonomy aspects are detailed of the series of soils and the most common position where they can be identified:

Order	Suborder	Series	Position
Inceptisoles	Acueptes	Boquerón	Flood Plains
	Acueptes	Caá Carai	Flood plains with valleys among hillock cupuliformes
	Ocreptes	Sosa Cué	Medium hillock.
Ultisoles	Humultes	Díaz de Vivar	Red hillock cupuliformes
Molisoles	Acuoles	Palmita	Alluvial complex
	Udoles	Arroyo Yacarey	Foot Hillock and hillock
	Alboles	Cuarajhí Yara	Alluvial plains
Histosoles	Sapristes	Leandra	Sloughs and alluvial valleys

Based on the collected information, in combination with landform, soil types and vegetation type, the lands to be planted have been classified into 6 landscapes that are described below.

Category I Alluvial complex of the Aguapey River and Tributaries

Compound by hydromorphic environments hygrophyte vegetations and slough formations. The dominant soils are dark, very well provided with organic matter, very hardly acid and of medium provision of bases (mainly calcium and magnesium). They are characterized by presenting a surface horizon of dark colors, loamy, with speckled almost from surface by the water season excess that are submitted about the 40 cm., a clay sub horizon is visualized, with signs of hydromorphism and concretions of iron-manganese. Are observed organic soils with "bog" formation of thick materials and floating vegetation; known as sloughs. The soils that integrate this category are: Curajhí Yara (50%), Palmita (40%) and Leandra (10%). Surface: 454.0 ha (13.76%).

Category II Hydromorphic plains with valleys among cupuliformes hillocks

This environment is associated to cupuliformes red hillocks. The soils are in smooth slopes from 1% to 2% (in medium hillocks); the contact with rocky outcrops in scarce depth infers an imperfect drainage and produces a groundwater level near to surface. It is constituted from an A horizon of around 8 cm of depth; loamy, dark grey color, with blocks and grained structure. In the B2 cambic horizon is also loamy and with the same structure. The concretion of iron-manganese is abundant since the surface horizons strengthening in the C2 horizon. Their main constraint is of physical order, on the root growth, since no

more than 42-68 cm begins the rocky formation contact. Also, they are very strongly acid and with very high levels of interchangeable aluminum. The soil to this category is: Caa Caraí (100%). Surface: 27 ha (0.82%).

Category III Hydromorphic plains with weeds (seasonally waterlogged)

Depressed areas surrounding the hillocks in the north center of the establishment which carry out the catchement of the runoff of the highest parts (hills). They occupy sub-concave depressed flat sectors with red straw scrublands presence, Paspalum durifolium, Paspalum intermedium and Panicum grumosum, among others of hygrophyte type. The soils vary from poor drainage to imperfect, inundables and flood, with slow runoff and permeability; they have severe limitations because to their position (low), sensitivity to flood, deficient drainage, sensitivity to the water erosion and high concentration of aluminum. The soils that integrate are: Cuarajhí Yara (60%) and Boquerón (40%).
Surface: 527.0 ha (15.97%).

Category IV Cupuliformes red hillocks

Are low areas surrounding the hillocks in the north center of the establishment and receiving hillocks of convex tops and slopes of medium length with slopes from 2% to 4%, which are associated to medium hillocks, foot hillocks and small catchment valleys of runoff, toward the alluvial complex of the Streams. The soils are well drained with medium to fast runoff and medium permeability, without danger of flood. These soils have excellent conditions for the development of roots, but they are very susceptible to the water erosion. The called red soils are of medium fertility and in conditions of rational management; they present good levels of organic matter. They are hardly acid, mainly by aluminum and the levels of calcium that are normally low. The dominant soil on this category is: Díaz de Vivar (100%). Surface: 926.0 ha (28.05%).

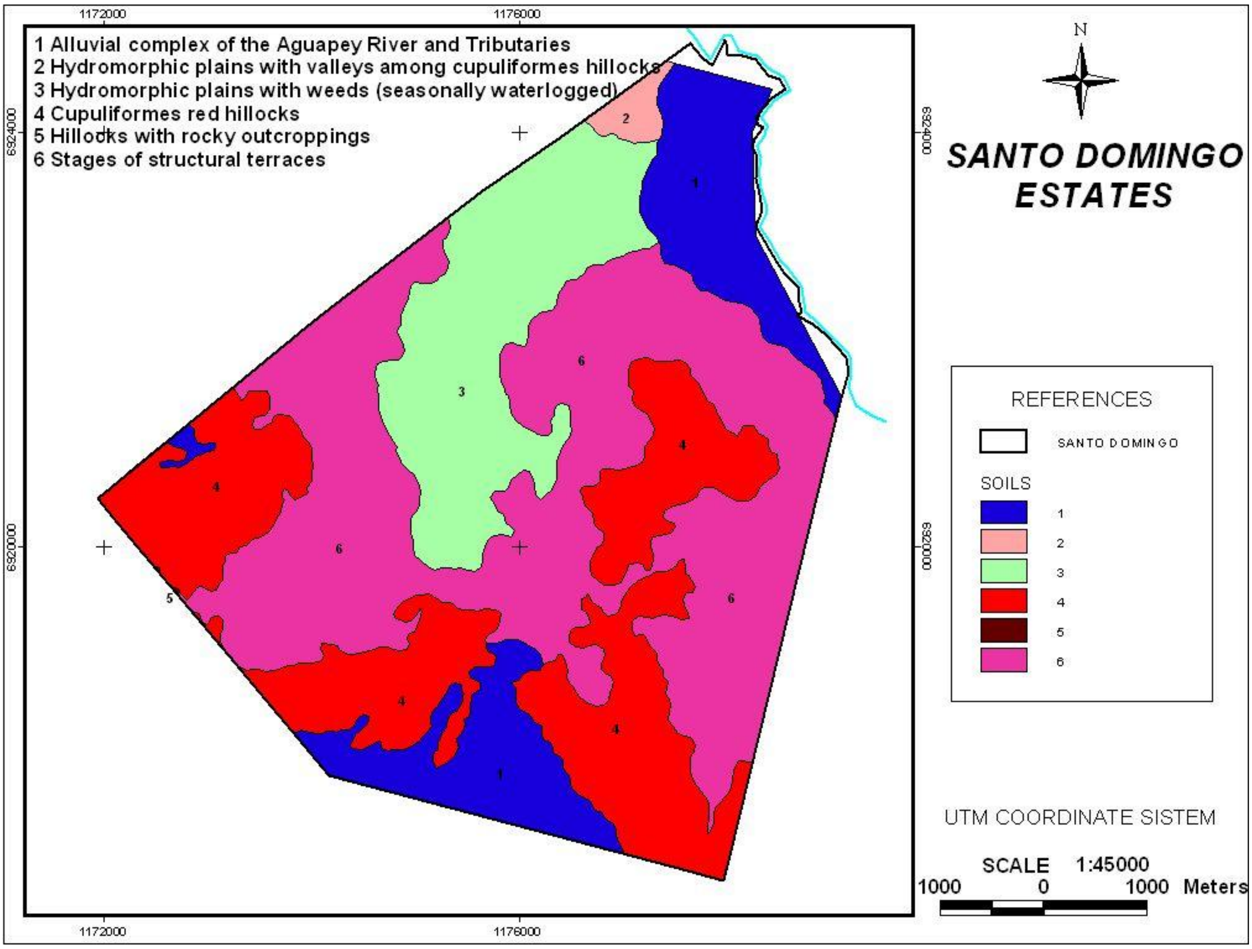
Category V Hillocks with rocky outcroppings

This environment is located between red hillocks and the alluvial valley of the Aguapey. The soils of medium low hillock are defined in short slopes of not more than the 2%; they are of moderate permeability, imperfect drainage and with a typical dark yellowish-brown color to ochre in the first horizon. It is detected a "layer" enriched with clay and cemented by iron, with abundant dark "small grains” of iron manganese. This layer can have a greater thickness to the 40 cm. Since the point of view of the fertility the limitation corresponds to pH very hardly acid, related to very high levels of aluminum, almost since the surface. The effective depth of the soil is of 50-70 cm. The soils located at the foot of the hillocks present long slopes, from 0,5 to 1%, with a high proportion of Ciperaceae, Sporobolus spp., Cynodon spp. and, Paspalum notatum, among others. They present a surface horizon of dark grey color, with imperfect drainage and slow permeability. They are observed from surface mottled by humidity excess and present also a layer hardened by iron from the 30 to 40 cm that restricts severely the growth of roots. Since the 90 cm are observed clearly plinthites (dots of iron connected with sand grains) and mottled. Also they are very hardly acid and with very high levels of interchangeable aluminum. As smaller soils, were detected in this LU superficial, soil with little fractured rock formation since the surface. The members of this category are: Boquerón (65%), Sosa Cué (25%), Arroyo Yacarey (10%). Surface: 23.0 ha (0.70%).

Category VI Stages of structural terraces

This unit is conformed by positions of medium low hillocks to foot hillocks, and a low plain with slopes from 1% to 2%. This environment presents symptoms associated to water excess by flood or by false groundwater level near to the surface. The runoff is medium to slow and the drainage is deficient. It is of low fertility and presents high values of saturation of aluminum and iron toxicity risks by the presence of plinthites. The soils that integrate it present chemical limitations (iron and/or aluminum) and physical limitation (rocks near the surface) in a smaller proportion. The soils that integrate it are: Boquerón (60%) (temporary hydromorphism) and Sosa Cué (40%) (layer hardened by iron). Surface: 1343.0 ha (40.70%).

Figure 15: Landscapes definded on the baseline study



2. Ex-ante stratification

Based on site investigation and assessment, the project area is categorized in 2 strata. The two strata include landscapes 1-3 and the second strata the landscapes 4-6.

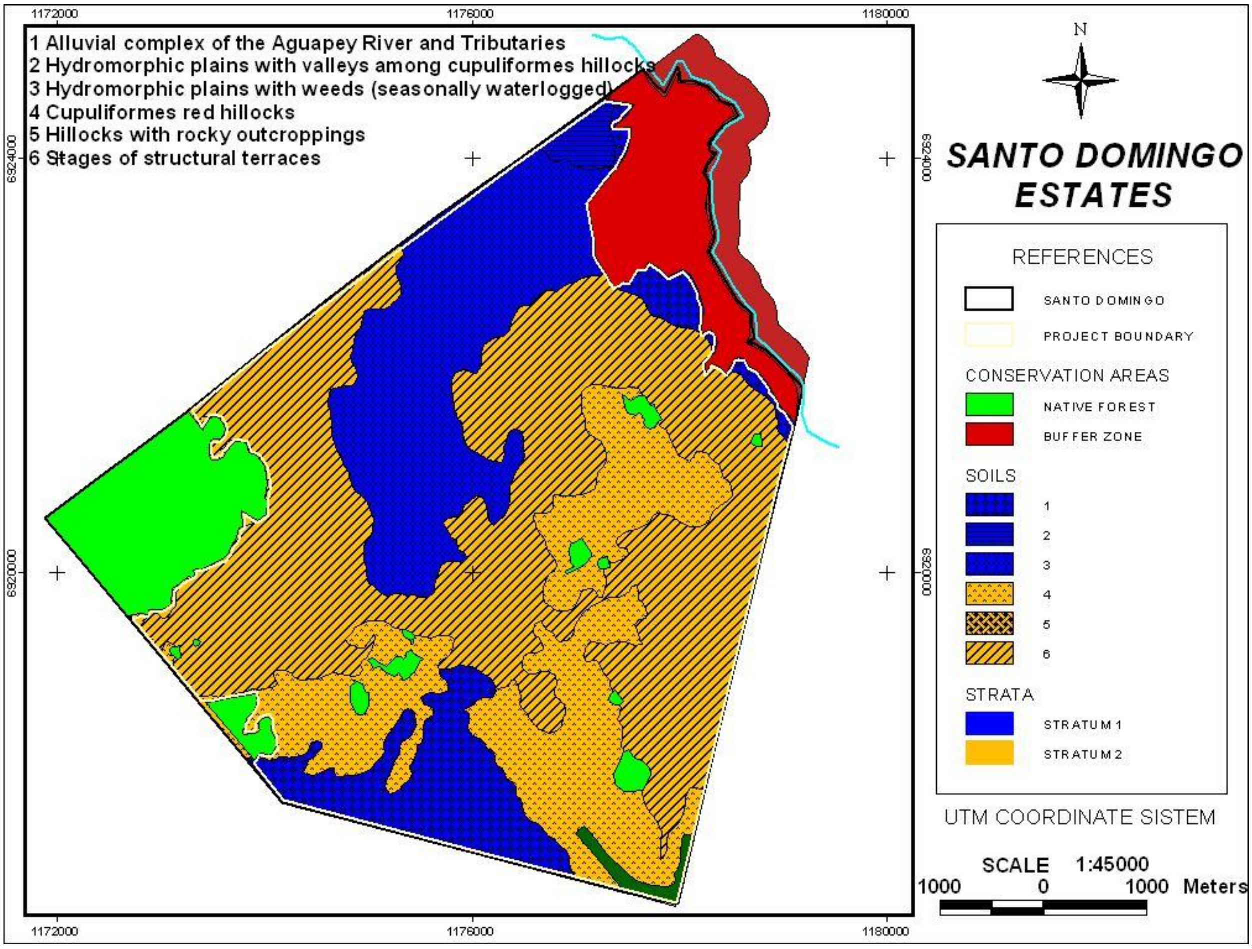
PROJECT DESIGN DOCUMENT FORM
FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) - Version 04

Table 18: Ex-ante stratification

Strata	Categories	Growing trees	Landscape	Surface (ha)
1	I	No	Alluvial complex of the Aguapey River and Tributaries	386
	II	No	Hydromorphic plains with valleys among cupuliformes hillocks	27
	III	No	Hydromorphic plains with weeds (seasonally waterlogged)	527
2	IV	Yes	Cupuliformes red hillocks	632
	V	Yes	Hillocks with rocky outcroppings	23
	VI	Yes	Stages of structural terraces	1340

The stratification has been built into a GIS that has been used to produce stratification Maps. The stratification map with the two strata is shown in Figure . Stratum 1 (blue) has no growing trees and stratum 2 has single growing trees.

Figure 16: Soil types



4. Estimation of the baseline net GHG removals by sink

There are a few growing trees on Stratum 2 (Figure 16). By means of a complete census realized by GMF of all single standing trees 290 growing trees have been counted on the entire project area . Five main sectors (Figure 17) with a high tree density have been defined. The main sectors are located in the "potreros" listed in Table 19.

Table 19: Single growing trees

Sectors	Potreros	Number of trees
1	10	130
2	7-8	45
3	5-6-7	70
4	4-5	20
5	2	25
Total		290

Figure 12: Single growing trees on the Project area

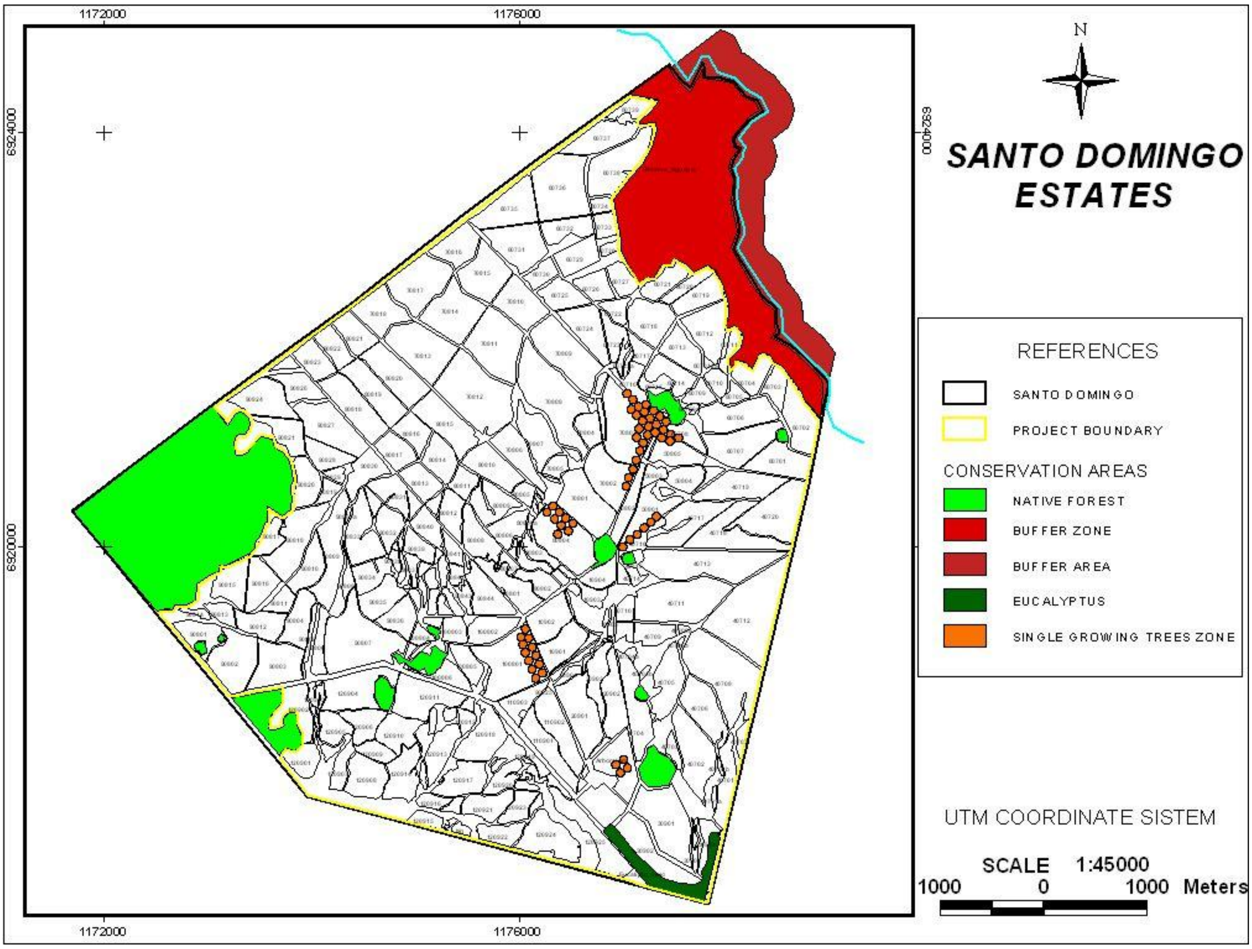
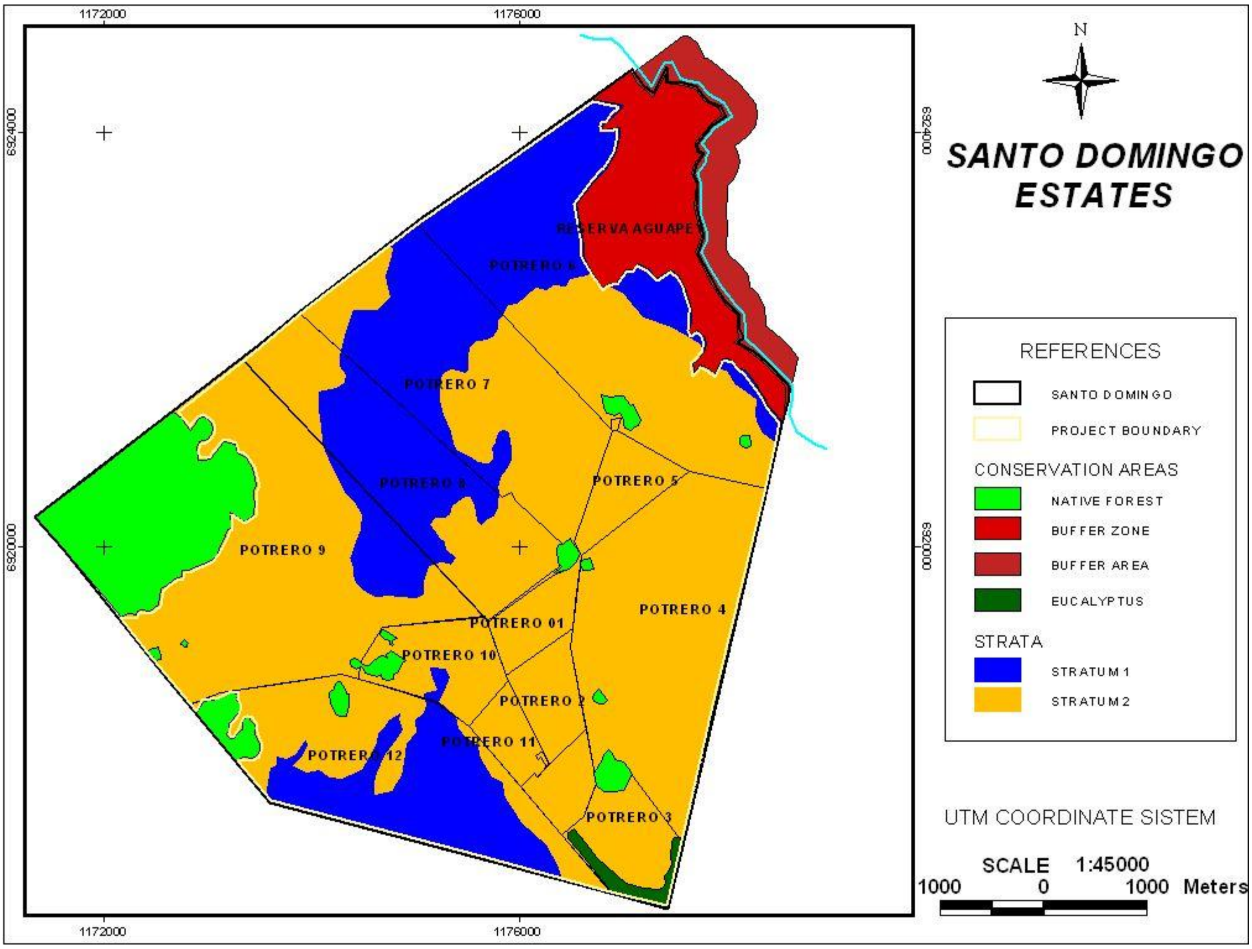


Figure18: Baseline stratification



The carbon stock change is estimated by projecting the continuous growth rate of existing trees. The existing trees are *Enterolobium contortisuliquom* and *Sapium haematospermum* with mean DBH of 20 cm and mean height 5 m. The mean DBH and tree height were calculated using data collected during the census

The stem volume of single growing trees was calculated using the volume functions taken from Costas R. et al (2006)[58]:

$$V = -1{,}5336 + 0{,}0525 DBH^2 + 0{,}0569 * DBH^2 * H + 0{,}0161 * DBH * H^2$$

Where
V = stem volume (m^3/tree)

[58] Costas R. et al. 2006; Funciones de volumen para especies de bosque secundario de la reserva guarani. Misiones Argentina, p 55

DBH = diameter at breast height (cm)
H = tree height (m)

The stem volume of trees was then converted into carbon stock in aboveground biomass and belowground biomass through wood density (D), biomass expansion factor (BEF), root-shoot ratio (R) and carbon fraction (CF) using equations of the stock change method described in the PDD:

$C_{ARB} = C_{AB} + C_{BB}$
$C_{AB} = V * D * BEF * CF$
$C_{BB} = C_{AB} * R$

Where

C_{ARB} = Total carbon stock in living biomass of trees
C_{AB} = carbon stock aboveground biomass, t C. tree^{-1}
C_{BB}: = carbon stock in belowground biomass, t C. tree
V: = stem volume, m3 tree-1
D: = wood density, t d.m.m-3
BEF: = biomass expansion factor from stem bioimass to aboveground biomass, dimensionless
CF: = carbon fraction, (t C t d.m)$^{-1}$, IPCC default = 0.5
R: = Root-shoot ratio, dimensionless

Annex 4

MONITORING PLAN

PROCEDURE MANUAL – FOREST INVENTORY- BIOMASS SAMPLING AND MONITORING

ESTABLECIMIENTO SANTO DOMINGO

Ituzaingó - Corrientes

1. INTRODUCTION

The amount of carbon captured by forest plantations depends on the variable biomass. This can be estimated through a sampling of forest biomass. There are methodologies that allow the estimation of volume and biomass of the different tree compartments and in all pools of the forest, converting these results into carbon amounts through some conversion.

The changes in carbon stocks are not directly measurable; nevertheless it is possible to estimate the carbon stock in different periods of time. Therefore, the changes are estimated by the difference between two measurements of the carbon stocks. The methodologies for the quantification and monitoring of carbon stocks combine different basic tools, such as: mapping, forest inventory, biomass sampling, the determination of carbon fraction and the mathematical modelling. This work will take into consideration procedures of forest inventory, determination and estimation of forest biomass.

The necessity to carry out a forest inventory arises from the impossibility of measuring of the stocks of the total area of the project, so that it is necessary to take representative samples of the population. These samples, named sample units or sampling plots, are a relatively small proportion of the project area, established over the entire area in order to obtain estimations of the variables of interest.

Through the realization of a forest inventory it is possible to obtain qualitative and quantitative information of the existing forest resources. An inventory includes activities of planning and execution of measurements on field of the different tree variables. Since them it is possible estimate the volume and the quantity of biomass for each pool and compartment of the tree.

The forest biomass is defined as the weight (or equivalent estimation) of organic matter that exists in a certain forest ecosystem above and below ground. Normally it is quantified in tons per hectare of green or dry weight. Frequently the biomass is separated into compartments or components, such as the weight of the bole (trunk), branches, leaves, bark, roots, litter and dead wood.

The determination of the forest biomass plays an important role since it allows determining the existing quantities of carbon in each one of the pools and compartments. The planning of an inventory involves the prior determination of the sampling method, sampling process and the definition of the tree variables to be measured. For definition of the sampling method and process to be used it is necessary to bear in

mind that the sampling shall take into account three basic requirements: to be representative of the population, to include the whole population and to have statistical validity, as well as the plots must be randomly distributed, satisfying all statistical assumptions.

The sample size involves the number of plots to be distributed with a certain statistical criterion in every stratum. The representative number of plots of the total project area and of every stratum shall be previously decided in order to accomplish the predefined level of accuracy and precision.

2. OBJECTIVES OF THE INVENTORY AND BIOMASS SAMPLING

2.1 General objectives

The determination of the tree variables, such as diameter at breast height (DBH), total height (HT), height of the bole (HB), crown diameter, is necessary to estimate the total volume of biomass for each species, for each stratum and for the total project area. The quantification of the forest biomass of the total area and in the established strata is also a requirement. With the results of the biomass determination it is possible to fit regression equations and its further use in estimations.

2.2 Specific objectives

In case that published functions are not available to estimate biomass of the different compartments, it will be necessary to determine biomass by destructive methods for each species. Therefore, they will be proposed as specific objectives, as follows:

- Determination of factors or conversion coefficients of commercial volume or commercial biomass to total biomass.

- Development of total biomass functions, for each species and for each compartment of the tree.

- Development of general biomass functions, depending on parameters of the stand or environmental factors.

3. GENERAL ASPECTS

3.1 Carbon pools

The biomass sampling will take into consideration two carbon pools:

3.1.1 Above-ground

They include living parts of trees (exotic and native species), determining the biomass of the following compartments:

- Stem

- Crowns

3.1.2 Below-ground

Here they consider only the living parts of the planted trees:

- Roots (estimated)

The carbon stock of the pool of dead wood, litter and organic carbon of the soil will not be monitored.

3.2 Inventory and carbon monitoring

From the biomass inventory it will be determined the carbon stocked by each one of these pools. The monitoring implies the determination of the carbon through the periodic calculation of the changes in these pools.

4. PROCEDURES OF FOREST INVENTORY AND BIOMASS SAMPLING

Permanent sampling plots (PPM) are used to measure and monitor changes in carbon stocks from the most relevant carbon pools over the time. The plots will be located with GPS and are invisible so can be treated in the same way as all the project extension (e.g. during site and soil preparation, weeding, fertilization, harvesting, etc.) and they will be prevented from being deforested over the crediting period.

The forest inventory is carried out taking into account statistical predefined parameters, aiming at establishing the precision and the probability level of the results. The selection of the work methodology for developing forest inventory involves the determination of:

- Sample size refers to the number of sample units (UM) established in the population, which must be sufficient to obtain precise estimations to a certain probability level. Its determination is previously done in accordance with a certain criteria and satisfying the precision level.

- Sampling error is the error caused due to measuring of a proportion of the population, or the difference between the real value and the estimated one obtained from the use of sampling procedures. The acceptable sampling error used in this work will be 10% of the mean estimated measure.

- Sampling process.

- Sampling method.

- Mapping of the sampling, that is a "layout" of the PPM established on the inventorying area, whose are to be well delimited to make easier the visualization and further location on the field.

- Capture of field data shall be done, indicating the variables which will be measured on the field, as DBH, HT, etc., as well as the instruments to be used for measurement and the procedures to be adopted.

- Calculation processes, reporting which will be the processes of calculation used (DBH-HT relationship, volume and biomass equations, etc.) are also required.

- Statistical analysis, indicating which will be the precision and the probability level used, the statistical analysis results, are also necessary.

- Report of the results must include, in accordance with the inventory objective, the number of trees, basal area and volume for each species and diameter class per hectare, for the total area and for every stratum. And also the quantification of the biomass for every species and for each compartment of the tree, stratum and total area of the project, etc.

4.1 Sample size per stratum

The population under study is heterogeneous , because of the topography and soil type on which the plantations are established, and so the year of plantation, the combination (mix) of species, the plantation density, etc. represents sources of variability. Due to the existence of these factors it is necessary to divide the whole population in homogeneous sub-populations, so that the variable of interest reduces its variability, because they will have a remarkable influence on the changes of carbon stocks such as in above and below ground pools.

The stratification eliminates sources of variation that can mask the results of the inventory, once the variability inside the strata shall be lower than that of the whole population. Hence, it will be possible to obtain more precise statistics due to the population stratification. The stratification also facilitates the data collection and the processing of it per stratum, being also suitable for the planning and execution of the work on the field.

The approved methodology recommends the number of sample plots in a compartment to be established depending on accuracy desired, variability of carbon stocks, composition of species and costs associated species growth variation, stocking and the accuracy required during monitoring the interval in the proposed A/R CDM project activity.

So, for every stratum it was determined a total number sampling units, following the approved methodology and using the described parameters in the equations M. 1 and M. 2 (table 1).

The standard deviation of each stratum is set at 20% of the standing volume. The precision level was set as 10%. The t value is determined based on the 95% confidence level. The cost to establish a plot in each stratum is assumed to be same in every case. To ensure statistical independence for each stratum, a minimum of 3 plots will be set for each stratum.

Table 1. Sample size per stratum in the first monitoring..

Strata	**Area** (ha)	**Planting Density** (trees/ha)	**Number of parcels**
Case 1	143	800	6
Case 2	830	1129	36
Case 3	571	1067	25
Case 4	464	1873	20
Case 5	285	1448	12
Total	**2292**		**99**

However, after the first monitoring event, when there are actual project data for sample size estimation, the sample size shall be recalculated considering the observed variation in the strata and plot establishment and measuring costs.

4.2 Method and process of sampling

The sampling method is the way in which the population is accessed by the sample units, e.g. the sample plots to be used in the inventory. In the present case it will be used the fixed area method. In this sampling the selection of the trees to be included is done proportional to the area of the sample unit, where all the data will be collected and calculated in a sample unit of fixed area and extrapolated to the hectare, through the factor of proportionality. The form of the sample units of fixed area will be circular in the present case, which can be established and identified in a rapid way, based on a single fixed midpoint.

The sampling process alsorefers to the form in which the sample is distributed all over the population. To avoid subjective choice of plot locations, the permanent sample plots will be located systematically with a random start from now on. The main reason for use the systematic sampling is the operational advantages and the better possibilities of supervision and control. Therefore, the circular plots of sampling will be distributed in systematic way inside each stratum. In case of special circunstances, e.g. forest fires, uneven growth, additional PPM may be laid out.

The location of the sample units will be accomplished with the help of a GPS (GLOBAL POSITIONING SYSTEM) in the field. The geographic position (GPS coordinate), administrative location, compartment series number of each plots is recorded and archived. It is to be ensured that the sampling plots are distributed randomly, and as evenly spread as possible. The plot center will be established and registered through a GPS point, which can also be identified by marking a given reference tree (focal tree). Besides this tree a stake will be placed in order to characterize the plot center in a very clear manner.

4.3 Mapping and sampling planning

The planning of the location of the sample units on the field maps, in order to generate a grid of sample units, will be carried out by the use of geoprocessing tools. For that purpose the sampling intensity for each stratum shall be defined as well for the total area or the total number of strata.

Geoprocessing facilitates the generation of a sample unit grid, as well as the evaluation of the units inside the population. The geographical coordinates of the map are obtained by superposing the grid and each sample unit (Table 2). Then, with the support of a GPS receiver it is possible to locate, approximately, the point in the field by using the go to tool available in this device. With this tool, on having entered a known coordinate, the device orientates the direction and the distance to be followed. The location of the point will be approximate, due to the fact that the GPS pursues an error in its location, which can be from 5 to 10 m in the best cases.

To avoid inconveniences during the field work, for example when the GPS loses the signal due to interferences, it is possible to use other procedures to locate the same point of interest on the field. Once a known point (focal tree, etc.) is located, all the others may be also identified by using tape and compass to orientate the advance direction.

Table 2. Example of a list of sample units (UM) with its respective UTM coordinates.

UM Number	UTM Coordinates	
	X	Y
1	…	…
2	…	…
3	…	…

4.4 Establishment of sampling units

The monitoring of the carbon stocks must quantify necessarily the changes across long periods of time, in such way that the PPM shall be efficient to determine these changes, and provide statistically reliable information that are to be obtained from them. These types of plots are more suitable than the temporary plots, since the measurements are to be carried out from time to time and during a long term span.

Biomass sampling must be carried out always in the period of the year where the deciduous species have their crows (foliage) fully developed, like spring or summer. This fact is fundamental for the correct estimation of the weight of the crown biomass (foliage).

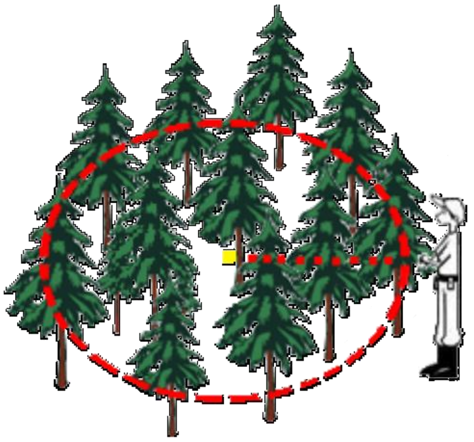
Winter is considered the best period for monitoring the tree measurable variables, like DBH and HT, and to determine volume and growth, since trees stop their physiological process in that colder season. During this season field work can also be carried out without difficulty and

excess of effort. If the measurements must be carried out periodically it is suitable that these should be conducted approximately in the same dates or period.

The PPM must be well delimited and identified to locate the plots easily and avoiding mistakes in subsequent measurements. In this case, the plots will be established and located by using a GPS device. The use of GPS allows the location and the efficient and precise relocation of the plots, particularly in places with a scarce route network. The limits of the sampling plots must be invisible, so that the managing and the applied cultural and silvicultural treatments will be homogeneous in the whole extension of the project.

The circular plot will be delimited with the VERTEX IV hypsometer in conjunction with the transponder, adapter and the monopod, conforming all together the plotcenter. The use of the transponder attached to the 360°adapter on the monopod (Figure 2), reduces the time of installation and measurement of circular plots (Figure 1).

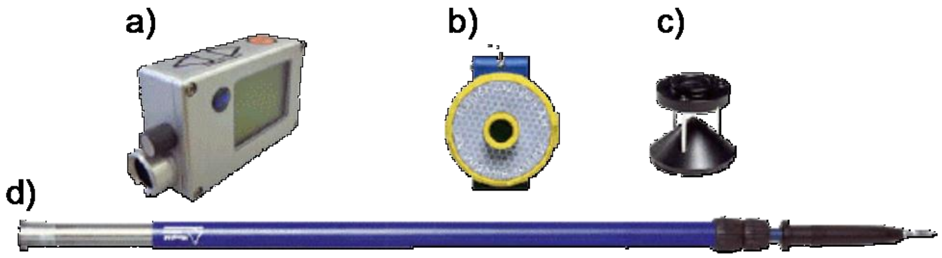
Figur 1. Representation of the delimiting of a circular sample unit. Source: CATALOGUE HAGLÖF (2005).



The Vertex IV uses ultrasound to measure distances. VERTEX IV is used as a telemeter with the function DME. To measure a distance, press the left arrow button when the VERTEX is in off modus. The result, the distance between the VERTEX and the transponder is presented on the screen. With the adapter the ultrasound is spread and it is possible to measure from any direction.

The hypsometer and telemeter VERTEX IV uses ultrasonic impulses, avoided hereby the use of metric tape and the elimination of the understory to measure the distances up to the trees of the sample. The registered data can be transmitted through IR (or Bluetooth for the Vertex IV BT model) by pressing the IR key.

Figure 2. a) VERTEX IV Hypsometer; b) Transponder T3 (emisor); c) Adapter; d) Support or monopod. Source: CATÁLOGO HAGLÖF.



4.5 Shape and size of the plot of sampling

Circular shaped permanent sample plots have been chosen since they are easy to establish and traceable in the terrain within the project activity boundary. Since the plot size depends on the stand density and spatial heterogeneity of stratum, sample plot area of 400 m² shall be used to minimize sampling intensity, time, and resources spent in the measurements, and there is also a suitable size in case of woody vegetation with a moderate dispersion.

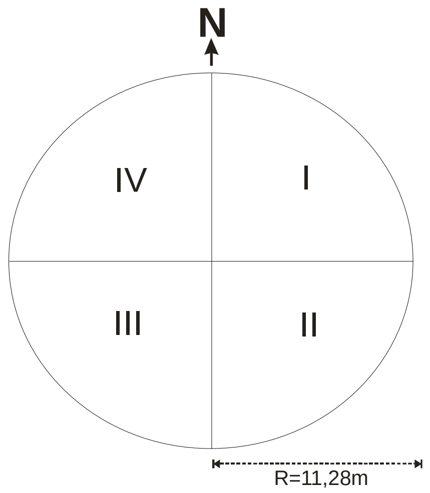
The installation of circular plots needs of the strict control of the radius to guarantee the correct incorporation of the involved trees. The radius required to achieve an area of 400 m² is of 11,28 m. Several reasons exist in favour of the circular plots in detriment of other shapes. The difficulty of establishing rectangular and squared plots in thinned plantations, which lost the alignment, is maybe the strongest motivation. The circular plots win in efficiency comparing all the possible forms of plots, and considering the same surface, because of its minor perimeter, they minimize the problem of marginal trees.

4.6 Measurement procedures during the forest inventory

Diverse measures are taken from the trees; some can be obtained directly by measurement equipment or indirectly by means of geometric or trigonometrical solutions (optical systems of measurement).

The inventory activities begin with the installation of the circular sample plots. In case of not counting with the aid of the VERTEX IV, for the establishment of the PPM, they will be installed using ropes of 11,28 m situated towards the four cardinal points (Figure 3). The distance will have to be corrected by help of a clinometer if the slope is bigger than 10 % (Annex 1).

Figure 3. Design of the circular PPM of 400 m ² with its four quadrants (I, II, III, IV).



The procedure includes the measuring of all trees with a DBH equal or greater than 2 cm, beginning by the northern radius and advancing in sense of the clock needles. All dendrometric variables of the trees included in the PPM were measured up and registered. The trees located close to the plot border will be measured if more than the half of the trunk falls into the plot.

The instruments used in the inventory will define the configuration of the field team. A team composed by three qualified workmen equipped with VERTEX IV and a diameter tape, requires that one of operator registers all data, that the second one measures HT and determine the limits of the plot and the third one will measure DBH and other variables of interest. The last operator takes paint or plastic tape in case of needing to mark the tree or the DBH measurement height.

In case of counting with a digital caliper with an incorporated data collector (Digitech Professional), the team would be formed by two operators. The operator of the digital caliper will capture all the information like DBH and the remaining information with the data collector. The HT data, taken with VERTEX IV, would be transferred via Bluetooth or IR to the data collector incorporated in the caliper.

Many experiences exist in Brazil (Iratí - Parana), and in the whole world, which indicate that combining VERTEX with a computerized caliper (Digitech Professional), will reduce the time of measuring the trees in each UM significantly. It is so that the time of work for the installation of the circular plot and its measure with a mechanic hypsometer and metric tape was about 150 minutes, including the time of elimination the understory. In another UM, using VERTEX IV and a computerized caliper the time reduced to less than 30 minutes in the first day of use. Basic characteristic of the inventory were: Radius of the plot = 12,62 m; trees per plot = 88; measurement of the DBH to 100 %; measurement of the HT to 20 % of the total of trees per plot).

It is also necessary to consider that they will not exist any error during the record and transfer of the data to the PC with the use of these modern devices, since the same ones carry it out automatically with some specific functions of the collector.

4.7 Variables of the tree to measuring during the forest inventory

In the forest inventories several dendrometric measures will be taken. These measures can be obtained directly by some measurement instruments (such calipers, diameter tape, etc.) or indirectly by means of geometric or trigonometrical solutions (optical systems of measurement).

4.7.1 DBH measuring

By convention, the diameter is measured at 1,30 m from the ground level, so this measure remains standardized independently of the operator and its height. At this height the instrument is also easily to manage.

The DBH will be measured with a diametric tape or caliper. The values delivered by calipers are less reliable than those obtained by diameter tapes. All trees with a DBH equal or greater than 2 cm will be measured, arriving to them always in the same orientation (N-S).

The DBH is a direct measure from which it is possible to calculate the transverse area, the basal area, the individual and total volume, the growth and the form quotient of the tree, and other variables of interest. In the estimating processes that involve the use of regression functions, theDBH is always the first independent variable because of its easy assessment and for presenting normally a high correlation with the volume, weight and other dependent variables.

4.7.2 Height measuring

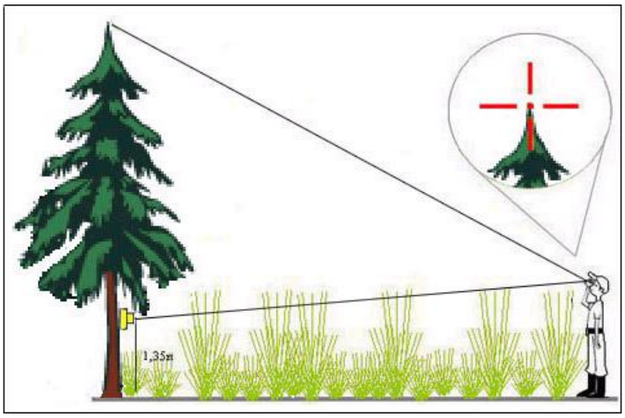
The height of a tree or portion of it is the linear distance along its principal axis, departing from the ground up to the top or up to another referential point, always in conformity with the type of height that is needed to measure. The height serves essentially for the calculation of volume and for the calculation of increases in height and in volume. This variable acquires importance in sites studies (site quality), like evaluation of the performance of a specie in a certain place throughout the time.in the forest measurements, always it is necessary to specify the type of height that will be measured, like: total height (HT), commercial height, bole height, stump height, etc. So HT refers to the distance between the ground and the apex along the principal axis. The commercial height is the length of the bole from the ground or the cut height up to a point defined by a minimal diameter of use, or up to some limitation for the commercial use, such as bifurcations, branches, defects and deviousnesses.

The height measuring on field will be done in a direct manner when the tree still not overcome 10-15 m of height, increasing in this way the precision. In these cases this variable is measured using a telescopic pole, decreasing its practicity when the tree exceeds 10 m in height. This is due to the weight of the instrument and the need to extend and contract (reinstate) the pole whenever a tree is measured. For higher trees the HT measure becomes indirectly, by the use of hypsometers which make an estimation of it.

With modern hypsometers like VERTEX IV the measuring time of the tree height of a PPM decreases significantly. Trigonometric functions calculate the height based on two angles and one distance. Vertex IV measures an indefinite number of heights of every object and shows the last four

heights on the screen at the same time. Heights, distance and angles can be transferred to the Digitech Professional Caliper or other computer device for storage/processing with IR or Bluetooth (Vertex IV BT model only) by pressing right arrow key. For height measuring, the 3 last measured heights with angle and distance can be transferred.

Figure 4. Representation of the measurement of tree height with VERTEX III (Source: www.eloforte.com, 2005)



The cross hair sight allows the measuring of the tree height from 0,1 to 999 meters rapidly and with high precision, from distances up to 30 meters. The instrument possesses a sensor of inclination that makes the measurement of trees possible in case of sites with slopes.

To carry out the measuring of height with the VERTEX IV and the transponder (Figure 4), follow the next steps (ELOFORTE, 2005):

1. Start the transponder T3 and place it on/towards the object to measure. Note that the transponder should be placed at the T.HEIGHT (transponder height) that has been set in the SETUP menu.

2. Walk a suitable distance from the object – for optimal result accuracy, a distance equal to the approximate height.

3. Press ON to start the Vertex and aim at the transponder. Keep pressing ON until the cross hair sight goes out momentarily. Now release ON. The Vertex has measured the distance, the angle and the horizontal distance to the transponder.

4. Aim at the height to measure with the sight cross blinking. Press ON until the cross hair disappears. The first height is locked and displayed Repeat until all heights on the object are measured.

5. BIOMASS SAMPLING

The most relevant aspect in carbon sequestration studies is the variable biomass. To obtain representative results of this variable, it must be determined or estimated accurately, achieving in this way the quantification of the carbon captured from the forest ecosystems. They are conceptual distinctions between determination and estimation of biomass, existing direct and indirect methods for its evaluation. Independently of the activity that will be carried out in this work, there will be described both methods of biomass evaluation.

5.1 Biomass determination

The determination refers to the real measurement of the biomass, by means of direct methods, for example weighing the entire bole with the use of a scale, resulting in the biomass of this compartment. This detailed determination bycompartment is justified by the fact that the tenor of carbon and weight of the biomass are different according to the compartment of the tree that is aimed.

5.1.1 Selection of sampling trees

Due to the fact that the use all trees for the destructive analysis of biomass it is impossible, and because of the high cost that this means, a sample of trees will be chosen, and since them all necessary variables will be measured.

In biomass studies, depending on the variability of the forests, the predetermined precision, the mix of species and the available resources, different numbers of sample trees are used, varying between 20 and 40 trees, choosing about 5 per plot. For wide zones, they are chosen near to 30 trees, but if it is necessary to determine biomass in specific places, 15 trees are a sufficient number.

While the large variability of situations considered in the different units of study, the number of sample trees will depend on the quantity of species found with a DBH of 2 cm. In this way, they will be selected for every unit:

25-30 trees in stands with 1 species

35-40 trees in stands with 2 species

40-45 trees in stands with 3 or more species

In some cases, especially in stands with a mix of species, the number of trees can be small. Nevertheless, the fact of working with several units of study, where some species will coincide, each one will complement the other.

In some cases, especially in stands with a mix of species, the number of trees can be small. Nevertheless, the fact of working with several units of study, where some species will coincide, each one will complement the other.

With the the forest inventory data it is possible to construct a frequency table of all trees distributed by diameter classes with an amplitude of 1 cm, for every specie. Traditionally a sample of trees are chosen in agreement to the frequency of trees in each diametric class and per species, but for the determination of biomass this procedure is not the most suitable, since it concentrates the trees in those classes which present the minor biomass, which in addition, normally they are the least variable.

Because of the motives specified previously, the defined procedure consists of the selection of trees with a mixed method, which implies obtaining at least a tree, of every species, for every diametric class with more than 3 individuals.

The procedure is the following one:

a. The total sampling number of trees is defined in the conglomerate of species (between 20 and 40).

b. Using the frequency table of trees it is possible to determine the number of individuals which correspond in every diametric class.

c. Clases with less than 3 trees are omitted.

d. If there are any trees remaining and not assigned, it is possible to complement with the class that have the highest number of trees, or to assigned some trees to classes of interest (especially trees with large biomass).

e. If many trees were assigned, it is feasible to eliminate some classes that are between two represented classes.

The final step consists of selecting the individuals directly from the field sheets. In this step the trees must be selected randomly in each plot, but in equal number of individuals per plot. Trees must be chosen from the same class in the different plots, and all species per plots, except in that case that some specie exists only in one or in few plots.

The sample trees must be homogenously distributed and not be concentrated in a section of the plot, in addition, they must represent several crown classes, sanitary situations and microsites.

Thus, to have a good representation the trees must be chosen at random

and it also important having in mind that they have to represent all situations. The most important variables that influence the amounts of tree biomass must be considered and measuered:

- Tree size (measured through the DBH or DBH²HT, age, HT, etc.)
- Tree species (which present different biological behaviors)
- Crown volume (registered throug the sociological position, crown length or crown ratio, etc.).

5.1.2 Measuring sample trees

ABOVE-GROUND BIOMASS

Two different types of measures were carrying out on the selected tree. The first one is taking at the standing tree and the second one when the tree was cutted off. The tree must be healthy, morphologically normal, without faults and anomalies.

It is necessary to incorporate a group of variables of interest for a posterior use of the data. Before the trees were cutted off, it is necessary to register of each one the following information:

1) Number of tree corresponding to the PPM
2) Species
3) DBH
4) HT
5) Crown diameter in direction N-S and W-E.

Once registered all the variables of interest, it is necessary to indicate the zone where the tree will fall. In addition it is important to eliminate the understory, cutting bushes and other minor trees that could impede the work and posterior processing of the cutted sample tree. In addition the zone where the trees

were weighted must be identified in order to enable it for the work of measurement and weighting the biomass. In this area the scale, other materials and equipments necessary for the processing were located.

The weighing will be carried out per compartment, contemplating the weight of the bole with bark, of the living and dead branches, of the leaves and roots. The other components found in the tree that do not fit in some of the mentioned compartments will be named as miscellaneous.

The procedure is:

a. Before the tree will be cutted off the zone must be delimited and the personnel must be located in a safe place (aprox. 2 lengths of the tree).

b. The cut will be realized as near as possible to the ground.

c. Then all branches were cutted off, dividing their components in three classes: the trunk up to a diameter limit dependent on the type of specie and industrial use, the thick branches and the thin branches (less than 1 cm of diameter includind all leaves).

d. When the tree lays on the ground and all its length is free of branches it is possible to measure the HT (total length of the tree), height of the green crown or height of pruning, diameter in the base of the green crown, diameter and height of the stump, diameter at every 2 m from 1,3 m, (at 2, 4, 6 m, etc.), changing slightly the measurement point in case of finding a branch stump. This rigorous measurement of the tree bole is necessary for the cubication or determination of the individual volume and for the fit of taper functions.

e. The thickness of bark is registered along the principal bole, taking the measurement in the same place in which the measurements of diameters are realized.

f. At first the biomass of living, dead branches and also the leaves were weighed separately, and so:

- The thin branches up to 1 cm with the leaves were weighed separately. The thin branches were assessed as leaves (minor to 1 cm).

- The thicker branches are weighed. If it were necessary they must be cutted into pieces to facilitate the determination of its weight.

- 3 samples of each component (3 samples of branches, 3 samples of leaves and 3 samples of thin branches and leaves) were extracted to determine its green weight.

- These subsamples were sended to laboratory to be analyzed and dried up to a constant weight to 105ºC of temperature.

- For every subsample the dry weight/green weight ratio (Ps/Ph) were calculated. Since them it is possible to determine the mean ratio dry weight/green weight (Ps/Ph) per component.

- The measurement of the foliar biomass to must be realized carefully, because this component presents the major variability of all. In case of coniferous species it is necessary to register separately the weight of the biomass of cones.

- It is very important not to leave any branch on the forest ground without weighting, identifying it like a part of the cutted tree, and not of a damaged and already measured tree.

g. The commercial bole is cutted into sections and weighed, considering that:

- Every section must not weigh beyond 100 kg (they must be able to be loaded by one or two persons).

- 4 subsamples (disk or slice) are extracted of different parts of the bole (for example at the stump height, DBH, height, in the base of the crown and at some intermediate height)

- These subsamples are packed and taken to the laboratory, where they will be dried up to constant a weight at a temperature of 105ºC.

- From there it is possible to calculate Ps/Ph's average ratio for the bole biomass.

h. When the green total weight of every component is multiplying by the corresponding Ps/Ph average ratio it is possible to obtain an estimation of the dry total weight of the component.

i. The sum of the weights of all components of the tree results in the dry weight of the tree, expressed in kg.

j. As soon as the biomass of all the selected trees is determined, it is possible to develop a regression function of biomass using statistical software. To determine factors of expansion of commercial volume to total volume it is necessary to follow steps a to f and then continue from k. Instead of weighing the commercial bole to determine its volume, its feasible the use of local volume functions or Smalian's formula.

k. The measurements of the bole on every 2 m are indispensable for determining the volume of every section. The dry weights of these sections were determined multiplying the volume by the density.

l. To determine the wood density from the bole follow the next steps:

- 4 or more samples of wood and bark per tree (sample of every two meters of the bole) were taken and analyzed in the laboratory. These samples are numbered correlativly, from the base of the tree up to the top.

- Each sample will be saturated in water and calculating its volume through the water displacement method.

- After measuring the volume, every sample is dried up to a constant weight at 105ºC.

- The dry weight divided by its green volume delivers the basic density.

- Finally the weight of the bole is calculated, taking into account that all measures must have the same units.

BELOW-GROUND BIOMASS

The determination of the below-ground biomass is calculated using the above-ground biomass and the root-shoot-ratio.

5.2 Biomass estimation

The estimation of the biomass is carried out through indirect methods using mathematical relationships like the regression functions.

Because of the unfeasibility of realizing determinations in big extensions, representative trees of the population are taken for the fitting and calibration of mathematical models used for the estimation of biomass. Therefore in most studies of forest biomass it is practical to generate estimations and not determinations.

The equations to estimate total dry biomass for each species are fitted on the basis of the data obtained by means of the destructive method. This one is the method that consists of cutting and weighing trees selected from the population of interest.

The total biomass of every tree is estimated with a function which uses as indipendent variables values of DBH and HT. The allometric equation was fitted to especific data of each species under study:

$BT = b_0 + b_1\ DBH + b_2\ HT$

Where:

BT = total biomass in kg;

DBH = diameter to 1,30 m above ground;

HT = total height in meters;

b_0, b_1 e b_2 = coefficients of equation.

Then, the biomass of every compartment is obtained by the multiplication of the calculated percentage of every compartment (for each species) by the value of total biomass estimated with the equation. If the species being estimated was not sampled by means of destructive method, the quantities of biomass of every compartment are obtained multiplying the average percentages of all sampled species with the destructive method by the total biomass estimated for the species by the fitted equation.

The necessary estimations are for each species and diameter classes, for the total of all the species, for the amounts of total biomass, of the bole, of the bark, of the living and dead branches, of the leaves and of the miscellaneous in kg/ha.

It is also feasible to estimate the above-ground biomass multiplying the biomass of the bole by the expansion factor, which its obtaining procedure through the destructive sampling was described previously. This expansion factor of (FE) is a constant equal to 1,74 if the biomass of the bole (Bbole) is greater than 190 tn/ha; and if it is lower than 190 tn/ha the expansion factor is calculated by the following formula:

FE = Exp (3,213-0,506*LN (BEF)

This formula was fitted on the basis of tropical forests information with a n = 56. Its goodness of fit was described with an r = 0,76; and it determines that the lower the biomass of boles the greater

the expansion factor, acquiring greater participation other compartments of the above biomass like branches and leaves (GASPARRI, 2004).

5.3 Use of equations and parameters fitted by other authors

The estimation of changes in carbon stocks inside the project boundary is realized using the equations M. 3 to M. 5 of the approved methodology. This methodology recommends the use of allometric equations. The mean carbon stock in above- and below-ground biomass per unit area is estimated based on field measurements on permanent plots using the Biomass Expansion Factors (BEF) method, with specific steps as follows:

a. Estimation of living biomass of the trees using BEF:

Measuring the DBH (at 1,3 m above ground) and preferably height of all trees in the permanent sample plots above a minimum DBH (2 cm). The biomass expansion factor (BEF) and root-shoot-ratio (R) are the same used in the ex-ante estimates (Table 3).

Tree species	**Wood Density (tonnes d.m.m^{-3} standing volume)**	**BEF**	**Root-shoot ratio**	**Carbon Fraction (CF)**
Pinus elliotti	0.57[59]	1.3	0.24	0.47
Pinus taeda	0.57[60]	1.3		
Grevillea robusta	0.55[61]	3.4		
Native Species	0.90[62]	3.4		
Source		IPCC GPG LULUCF 2006 (Table 3A.1.10)	IPCC GPG LULUCF 2006 (Table 4.4)	IPCC GPG LULUCF 2006 (Table 4.3)

b. Estimation of the carbon stock of living biomass of the trees inside the PPM:

[59] Moura Dias, Fabricio, et al. (2005): Relation between the Compaction Rate and Physical and Mechanical Properties of Particleboards.

[60] Moura Dias, Fabricio, et al. (2005): Relation between the Compaction Rate and Physical and Mechanical Properties of Particleboards.

[61] Obdulio, Oereyra; Fidelina, Silvia (2004), Durabilidad Natural de la Madera de cinco especies aptas para la Industria de la Construcción.

[62] I.Fo.NA. – Istituto Forestal Nacional (1960). Fichas Técnicas de Especies Forestales. Argentina . Available online: http://www.sagpya.mecon.gov.ar/new/0-0/forestacion/biblios/ficha120.htm

The tree biomass in a single UM is the sum of the biomass of the measured trees within the sample plot and converted to carbon stock using the equations M. 17 and M. 18 of the approved methodology.

Tabla 4. Biomass equations of *Pinus taeda* and its coefficients fitted by the UFPR..

Compartment	**Equation**	**Coeficients** a	b
PVF (Bole green weight)	$a\,(DBH^2HT)^b$	0,0595	0,9279
PVFl (Leaves green weight)		0,0012	1,0480
PVGv (Living bracnches green weight)		0,0001	1,3922
PVR (Root green weight)		0,4484	0,5619

Source: UFPR; ECOPLAN (2003).

Tabla 5. Equations for the calculation of individual volume of carbon (in the different compartments of *Pinus taeda* trees).

Compartment	**Equation**
Bole	PCF = 0,1737 PVF
Leaves	PCFl = 0,1422 PVFl
Living branches	PCGv = 0,1595 PVGv
Root	PCR = 0,1676 PVR

Fuente: UFPR; ECOPLAN (2003).
PCF: Weight of the bole carbon
PCFl: Weight of the leaves carbon
PCGv: Weight of the Carbon in living branches

The equations mentioned in the previous table estimate the amount of carbon in tons per hectare. The definitions contained in the articles 1 and 14 of the Kioto Protocol indicate that a "unit of emission reduction " - UER is equal to a equivalent metric ton of carbon dioxide - CO2. For ROCHA (2003), one ton of carbon, unit used normally by the carbon market, is equivalent to 3,67 tons of CO2, which means that a ton of CO2 is equivalent to 0,27 tons of carbon.

Table 6. % of dry biomass.

Especie	Bole	Branches	Leaves	Roots
Araucaria angustifolia	76,30	15,60	4,00	4,10
Mimosa scabrella	64,20	17,40	3,40	15,00
Tabebuia cassinoides	46,47	37,56	4,89	11,08
Virola surinamensis	77,40	12,40	3,20	7,00
Carapa guianensis	55,80	6,50	25,50	12,20
Pinus taeda	77,20	9,70	4,00	9,10
Eucalyptus grandis	88,20	3,20	1,70	6,90

Table 7. Capture of carbon.

Species	tree/ha	Rotation (years)	C (t/ha.year^{-1})	CO_2eq. (t/ha. year^{-1})
Araucaria angustifolia	1.667	20	5,48	20,10
Mimosa scabrella	3.000	7	4,21	15,44
Tabebuia cassinoides	2.000	20	1,20	4,40
Virola surinamensis	1.000	30	6,05	22,18
Carapa guianensis	500	30	9,16	33,59
Pinus taeda	1.667	20	12,35	45,28
Eucalyptus grandis	1.667	7	19,87	72,86

5.4 Determination of carbon tenors

The estimations of carbon amounts per compartment of the tree are obtained from the results of the tenors achieved from the laboratory results. For every sampled compartment the tenor of carbon is determined. The estimations of the stock of captured carbon are obtained multiplying the biomass estimated per compartment by the respective tenor. If the species in question was not sampled for the determination of its biomass, the carbon stocks are estimated using the average tenors per compartment of all the sampled species.

Some results of recently studies done in Brazil about carbon tenors in the different compartments for different species of economic interest are showed as following:

Table 7. Carbon Tenors (%)of different forest species

Species	Bole	Branches	Leaves	Roots	Average
Araucaria angustifolia	44,17	43,67	44,66	42,31	43,70
Mimosa scabrella	43,53	43,58	47,69	44,76	44,89

Tabebuia cassinoides	43,51	42,91	40,70	41,10	42,06
Virola surinamensis	45,09	42,83	47,27	44,40	44,90
Carapa guianensis	43,54	44,51	43,00	44,03	43,77
Pinus taeda	44,17	44,18	45,10	43,98	44,36
Eucalyptus grandis	41,04	42,06	48,17	42,20	43,37

6. MATERIALS, INSTRUMENTS AND PERSONAL EQUIPMENT

A detailed list of necessary materials, instruments and personal equipment to realize a forest inventory and sampling biomass are shown as following:

6.1 Materials

- Manual of forest inventory procedures and biomass sampling
- Field maps, aerial photographies, thematic maps, etc.
- Field sheets
- Plastic etiquettes
- Painting spray (colors orange, yellow)
- Biodegradable plastic tapes of several colours
- Plastic bags for samples
- Permanent markers
- Stake
- Machete
- First aid kit

1.1 Instrumentos

- GPS
- Compass
- VERTEX IV digital hypsometer or similar
- Plastic rope (100m)
- Calculator
- Diamteric Tape or a 50 cm caliper

7. BIBLIOGRAPHY

GASPARRI, I. 2004. Estimación de volumen, biomasa y contenido de carbono de las regiones forestales Argentinas.

RENNER, R. M. 2004. **SEQÜESTRO DE CARBONO E A VIABILIZAÇÃO DE NOVOS REFLORESTAMENTOS NO BRASIL**. Disertación de Maestría. Ciências Florestais do Curso de Pós-Graduação em Engenharia Florestal, Setor de Ciências Agrárias, Universidade Federal do Paraná. CURITIBA, Brasil.

MOURA DIAS, F. 2005. Relation between the Compaction Rate and Physical and Mechanical Properties of Particleboards.

History of the document