Voluntary Carbon Standard
Project Description

19 November 2007

19 February 2011

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1. Description of Project:

1.1. Project title

Restoration of degraded areas and reforestation in Cáceres and Cravo Norte, Colombia

1.2. Type/Category of the project

According to the UNFCCC Methodologies for afforestation and reforestation of large scale CDM project activities, the project type is defined as follows:

Approved afforestation and reforestation baseline methodology AR-AM0005
"Afforestation and reforestation project activities implemented for industrial and/or commercial uses" (Version 03)

Remark: The project is not a "Grouped Project" as defined in the VCS guidelines.

1.3. Estimated amount of emission reductions over the crediting period, including project size:

Based on the carbon stock ex – ante calculation, the project will sequester on ~ 11,000 ha around 2, 4 million tCO2e over 30 years of project duration.

1.4. A brief description of the project:

The project envisions the reforestation of grasslands in Colombia. The grasslands show low soil carbon content because of soil degradation and/or climate-edaphic conditions. The A/R project activity proposes to reforest ~ 1,230 ha in the area of Cáceres/Antioquia and ~ 9,640 ha in Cravo Norte/Arauca. The project areas were previously exposed to extensive cattle grazing activities. In addition to cattle grazing, some parts of the Cáceres area was exposed to alluvial gold mining. The project seeks to promote sustainable management of forest resources in a manner that fosters natural regeneration.

Cáceres is a town and municipality in the Colombian department of Antioquia. Cáceres is bordered on the north by the department of Córdoba and the municipality of Caucasia, on the east by the municipalities of Caucasia and Zaragoza, on the south by the Anorí Tarazá, and on the west by Tarazá and the department of Cordoba.
Besides subsistence agriculture, the main legal economic activity of the district is mining. Two indigenous groups are settled in Cáceres: Nutabes and Tahamíes.[1]

Arauca is a department of Colombia located in the extreme northern part of Colombia that borders Venezuela (the Orinoco or Llanos Oriental area). It is bordered in the south by the Casanare River and the Meta River, which separate it from the departments of Casanare and Vichada. The Boyacá department is on the western border. The Caño Limón oil fields, located in its territory, account for 30% of Colombian oil output. The department's indigenous population is at least 3,591

[1] http://www.caceres-antioquia.gov.co/

people. Six indigenous groups are among them with the following populations: U'wa, 1,124 members; Betoye, 800; Guahibo/Sikuani, 782; Hitnü, 441; Cuiva/Kuiba, 241; Chiricoa, 173 and Piapoco, 30. Twenty six reserves (resguardos) cover an area of 1,281.67 km².[2]

Since 2002, Asorpar Ltd. has been reforesting land with various tree species planted in different stand models that allow for natural regeneration of flown in seeds on the reforestation sites. Asorpar Ltd. puts emphasis on promoting mixed stands. This sets their approach apart from other commercial plantation forestry entities active in Colombia. The management of mixed stands is far more challenging than of monocultures. This circumstance is reinforced by the fact that little is known about several tree species planted in the project, particularly with regard to their growth performance and silvicultural management. Hence, the proposed project activity offers a unique opportunity to obtain valuable knowledge about silvicultural management practices for mixed plantation forestry and suitability of native tree species for commercial plantation forestry.

Tree species that are considered for planting in the project area were originally selected according to the following factors: adaptability, volumetric efficiency, ecological and cultural value, availability of seeds, and resistance to pests and diseases. Due to the practical experience gained by Asorpar Ltd., it was decided to use the following most promising native timber species[3] for the two reforestation areas:

Cáceres:

- *Acacia mangium*
- *Cariniana pyriformis*
- *Cedrela odorata*
- *Cespedesia macrophylla*
- *Cordia gerascanthus*
- *Croton smithianus*
- *Didimopanax morototoni*
- *Dipteryx oleifera*
- *Enterolobium cyclocarpum*
- *Gmelina arborea*
- *Hevea sp*
- *Hymenaea courbaril*
- *Ochroma pyramidale*
- *Pochota quinata*
- *Schyzolobium parahyba*
- *Swietenia macrophylla*
- *Tabebuia rosea*
- *Tapirira guianensis*

Cravo Norte:

- *Acacia mangium*

[2] http://wpedia.goo.ne.jp/enwiki/Department_of_Arauca#Indigenous_population

[3] Considerable more native tree species can be found within the plantations, since the micro-climate condition created by the reforestation project allow natural regeneration from the already planted trees, the Gallery forest in Cravo Norte or form the selective trees that have been in the project area before the project start.

- *Calophyllum mariae*
- *Cariniana pyriformis*
- *Cedrela odorata*
- *Copaifera pubiflora*
- *Cordia alliodora*
- *Cupania sp*
- *Dipteryx oleifera*
- *Enterolobium cyclocarpum*
- *Guadua angustifolia*
- *Hymenaea courbaril*
- *Nectandra sp*
- *Ochroma pyramidale*
- *Pithecellobium sp*
- *Pochota quinata*
- *Pseudosamanea guachepele*
- *Swietenia macrophylla*
- *Tabebuia rosea*
- *Terminalia ivorensis*

The project is expected to generate an increment in existing carbon stocks and GHG removals by sinks that are additional to those changes that would have occurred in the absence of the project activity. This will be achieved by replacing unsustainable activities (cattle farming and gold mining) with a sustainable commercial activity (plantation forestry/reforestation).

In terms of its contribution to sustainable development, the proposed A/R VCS project is expected to:

- Energize the socio-economic dynamics of the region via the generation of new jobs (direct and indirect) for locals[4]
- Alter land use patterns in the region, moving away from extensive, unmanaged cattle farming (and in some parts of Cáceres, gold mining)—demonstrating that native commercial reforestation processes are viable in the area
- Provide local and international markets with a new source of wood (legally and sustainably produced)
- Conserve species and ecosystems through the establishment of "natural" forest plantations of native species that are selected according to local biodiversity conservation needs and adapted to the soils found in the region
- Contribute to the conservation of flora and fauna species that are threatened in the project regions of Cáceres and Cravo Norte (see Annex I & II)

[4] La cadena forestal y madera en Colombia, 1991-2005, page 15. Ministerio de Agricultura y Desarrollo Rural Observatorio Agrocadenas Colombia, Bogota, March 2005. http://201.234.78.28:8080/dspace/bitstream/123456789/875/1/20051121663_caracterizacion_forestal.pdf

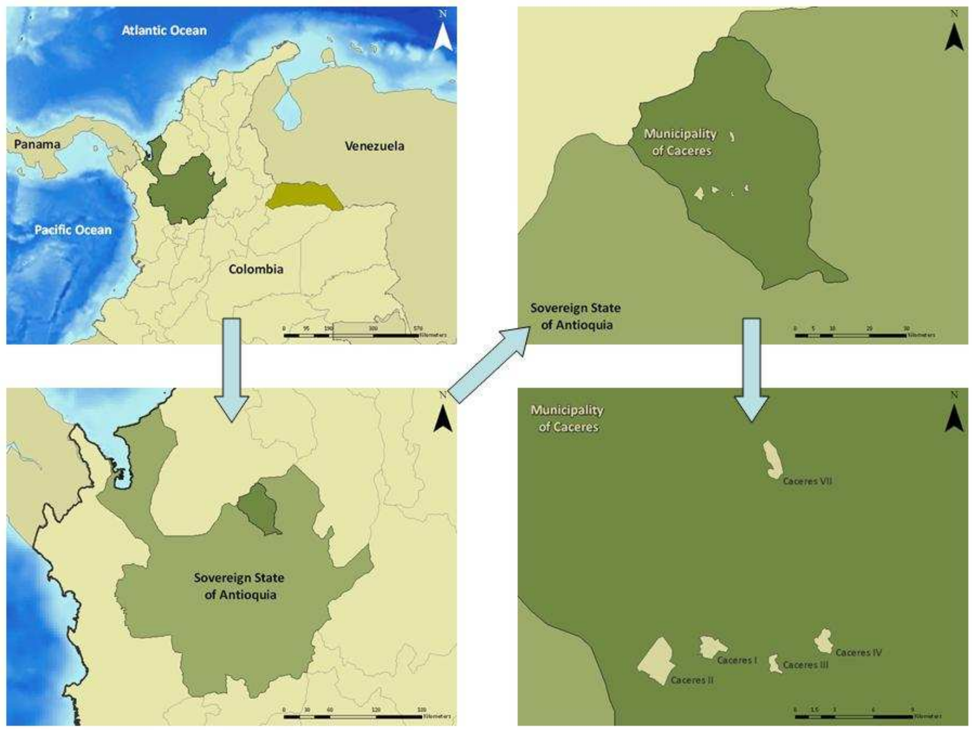
Picture 1: Alluvial gold mining as the baseline activity in some parts of Cáceres

Picture 2: Reforestation of land where gold mining has occurred, Cáceres

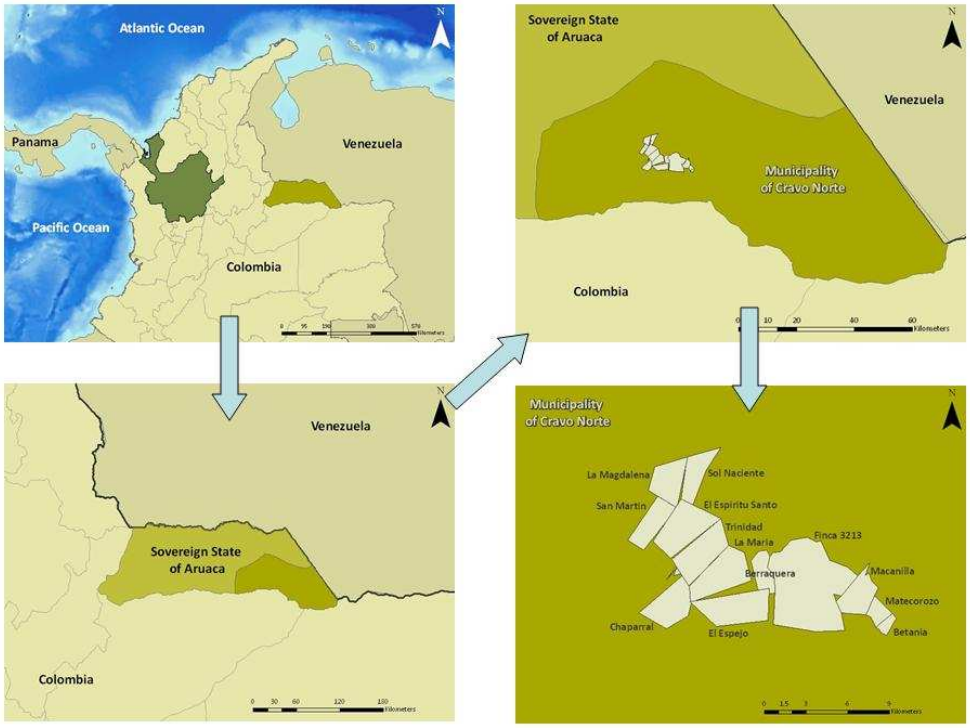
Picture 3: Project baseline scenario of extensive cattle grazing (Arauca)

Picture 4: Reforestation in Arauca

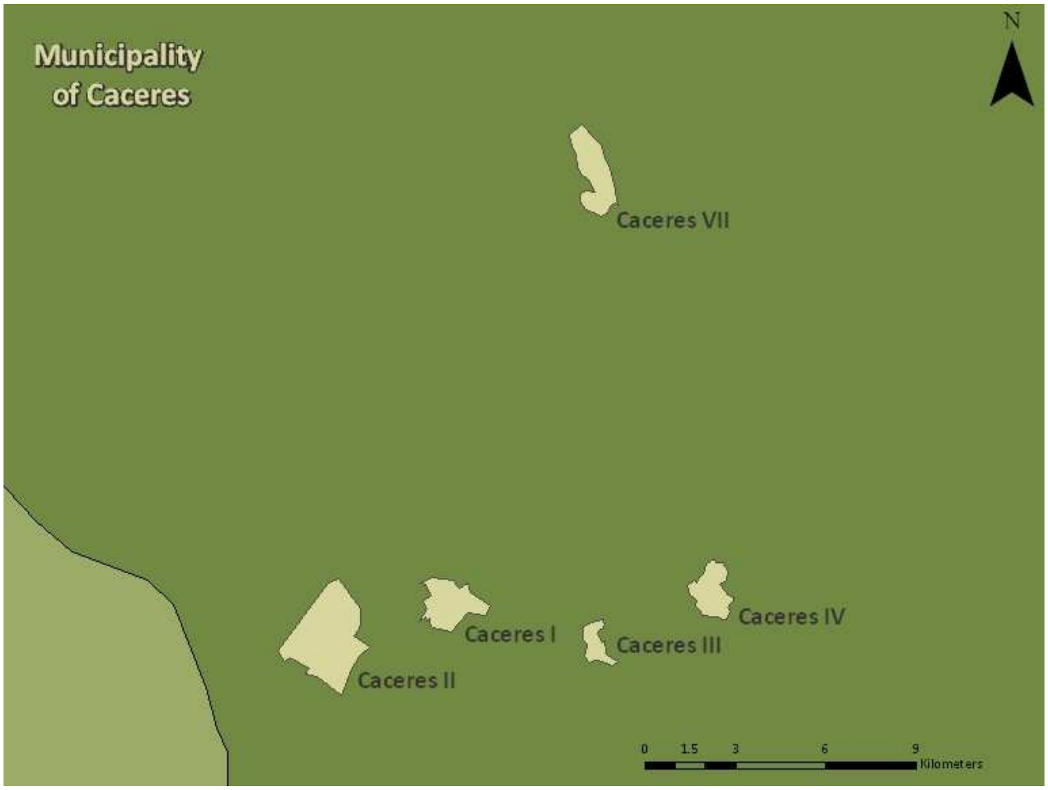
1.5. Project location including geographic and physical information allowing the unique identification and delineation of the specific extent of the project:



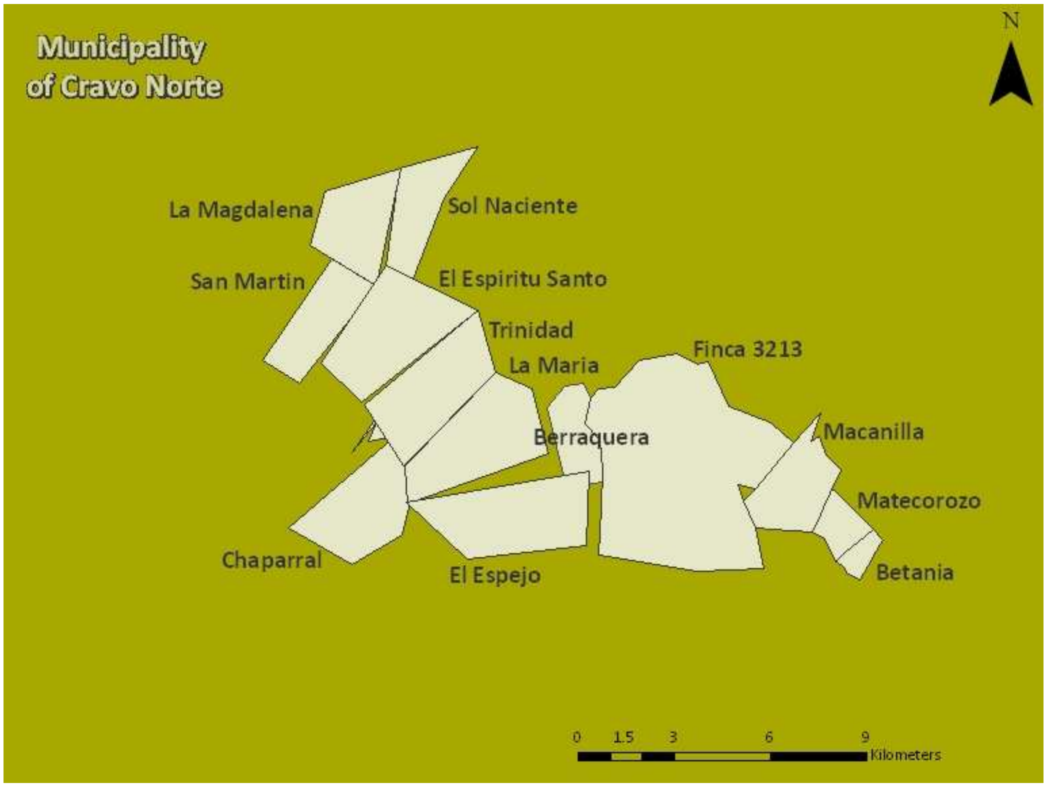
Map 1: Situational map of the Caceres project in the State of Antioquia



Map 2: Situational Map of the Cravo Norte project in the State of Arauca



Map 3: Caceres project parcel location



Map 4: Cravo Norte project parcel location

Table 1: Boundary coordinates for project areas

Name	Latitude	Longitude	Name	Latitude	Longitude
Caceres I	7º 36' 20.36"	75º 17' 54.96"	Finca El Espiritu Santo	70°20'01,18"	6°24'28,39"
	7º 36' 13.72"	75º 18' 08.04"		70°20'45,22"	6°24'49,63"
	7º 36' 12.85	75º 18' 02.00"		70°21'05,53"	6°24'59,43"
	7º 36' 00.54"	75º 17' 55.64"		70°21'33,79"	6°25'12,69"
	7º 35' 53.61"	75º 18' 04.60"		70°21'43,51"	6°24'52,68"
	7º 35' 46.73"	75º 18' 00.17"		70°21'57,82"	6°24'13,58"
	7º 35' 32.75"	75º 18' 09.40"		70°22'39,79"	6°23'33,53"
	7º 35' 37.62"	75º 18' 01.76"		70°21'57,16"	6°22'54,16"
	7º 35' 33.51"	75º 18' 01.16"		70°21'25,75"	6°23'20,55"
	7º 35' 35.87"	75º 17' 57.34"		70°20'39,34"	6°23'57,78"
	7º 35' 30.44"	75º 17' 57.62"	Finca La Magdalena	70°21'33,79"	6°25'12,69"
	7º 35' 26.19"	75º 17' 54.37"		70°21'43,51"	6°24'52,68"
	7º 35' 21.25"	75º 17' 34.05"		70°22'50,10"	6°25'34,08"
	7º 35' 41.71"	75º 17' 16.89"		70°22'36,52"	6°26'28,29"
	7º 35' 38.97"	75º 16' 58.64"		70°21'19,49"	6°26'51,26"
	7º 35' 50.14"	75º 16' 52.35"		70°21'26,55"	6°26'02,62"
	7º 36' 04.47"	75º 17' 14.46"	Finca La Maria	70°19'55,863"W	6°23'35,297"N
	7º 36' 14.74"	75º 17' 17.13"		70°19'18,211"W	6°23'19,347"N
	7º 36' 08.84"	75º 17' 25.36"		70°19'2,261"W	6°22'12,933"N
	7º 36' 16.60"	75º 17' 32.59"		70°21'24,764"W	6°21'22,626"N
Caceres II	7°36` 18.28"	75°19`35.41"		70°21'27,64"W	6°22'1,062"N
	7°36` 14.43"	75°19`46.25"	Finca La Trinidad	70°20'13,251"W	6°24'37,605"N
	7°35` 01.896"	75°20`40.214"		70°19'55,814"W	6°23'35,374"N
	7°34` 49.738"	75°20`32.554"		70°21'27,753"W	6°22'1,572"N
	7°34` 53.901"	75°20`27.309"		70°22'8,563"W	6°23'2,582"N
	7°34` 42.615"	75°20`06.736"	Finca San Martin	70°21'43,51"	6°24'52,68"
	7°34` 36.869"	75°20`10.876"		70°22'28,12"	6°25'20,42"
	7°34` 33.976"	75°19`58.641"		70°22'45,48"	6°24'54,60"
	7°34` 13.36"	75°19`31.984"		70°23'09,68"	6°24'17,45"
	7°34` 41.05"	75°19`21.763"		70°23'37,91"	6°23'36,58"
	7°34` 55.521"	75°19`13.175"		70°23'00,60"	6°23'13,45"
	7°35` 05.373"	75°19`01.021"		70°22'39,79"	6°23'33,53"
	7°35` 17.568"	75°19`19.159"		70°21'57,82"	6°24'13,58"
	7°35` 25.143"	75°19`12.725"	Finca Macanilla	70°14'27,57"	6°22'53,80"
	7°35` 31.045"	75°19`12.078"		70°14'29,06"	6°22'31,32"
	7°35` 46.822"	75°19`11.777"		70°14'36,19"	6°22'25,63"
Caceres III	7º 35' 35.23"	75º 14' 52.21"		70°14'22,23"	6°22'12,01"
	7º 35' 32.02"	75º 15' 04.14"		70°14'07,01"	6°21'57,17"
	7º 35' 27.04"	75º 15' 13.38"		70°14'09,93"	6°21'50,59"
	7º 35' 12.74"	75 º15' 13.14"		70°14'15,66"	6°21'37,65"
	7 º35' 08.88"	75º 15' 09.25"		70°14'34,93"	6°20'54,09"
	7º 35' 06.30"	75º 15' 9.24"		70°15'15,83"	6°20'57,06"
	7º 34' 55.77"	75º 15' 11.90"		70°15'32,61"	6°20'58,28"
	7º 34' 48.14"	75º 15' 06.41"		70°15'44,52"	6°21'15,79"
	7º 34' 51.83"	75º 15' 02.04"		70°15'46,65"	6°21'19,78"
	7º 34' 51.54"	75º 14' 57.76"		70°15'44,84"	6°21'26,00"
	7º 34' 48.59"	75º 14' 48.70"		70°15'50,99"	6°21'41,65"
	7º 34' 45.43"	75º 14' 42.03"		70°15'33,52"	6°21'38,26"
	7º 34' 50.01"	75º 14' 35.77"		70°15'25,76"	6°21'47,41"
	7º 34' 52.98"	75º 14' 39.86"		70°15'10,42"	6°22'05,49"
	7º 34' 52.87"	75º 14' 42.05"		70°14'54,17"	6°22'24,64"

	7º 34' 58.12"	75º 14' 48.92"		70°14'42,57"	6°22'38,32"
	7º 35' 03.87"	75º 14' 48.84"		70°14'18,21"	6°21'31,87"
	7º 35' 08.44"	75º 14' 50.25"		70°14'20,05"	6°21'27,71"
	7º 35' 11.42"	75º 14' 48.86"		70°14'31,32"	6°21'02,29"
	7º 35' 11.81"	75º 14' 50.35"	Finca Matecorozo	70°14'15,66"	6°21'37,65"
	7º 35' 09.72"	75º 14' 53.53"		70°14'10,98"	6°21'34,02"
	7º 35' 19.83"	75º 14' 57.34"		70°13'34,02"	6°20'56,94"
	7º 35' 23.01"	75º 14' 55.66"		70°13'49,19"	6°20'44,29"
	7º 35' 24.61"	75º 14' 52.68"		70°14'02,55"	6°20'33,08"
	7º 35' 28.89"	75º 14' 49.70"		70°14'12,88"	6°20'24,42"
Caceres IV	7°36'17,023"N	75°12'39,638"W		70°14'22,77"	6°20'47,22"
	7°36'27,611"N	75°12'37,73"W		70°14'34,93"	6°20'54,09"
	7°36'35,49"N	75°12'43,979"W		70°14'31,32"	6°21'02,29"
	7°36'36,061"N	75°12'50,631"W		70°14'20,05"	6°21'27,71"
	7°36'39,751"N	75°12'52,577"W		70°14'18,21"	6°21'31,87"
	7°36'33,85"N	75°13'0,811"W	Finca Betania	70°13'34,02"	6°20'56,94"
	7°36'24,517"N	75°13'4,743"W		70°13'25,02"	6°20'45,30"
	7°36'19,633"N	75°13'9,192"W		70°13'30,79"	6°20'35,37"
	7°36'13,831"N	75°13'11,702"W		70°13'39,50"	6°20'20,30"
	7°36'16,847"N	75°13'14,74"W		70°13'47,84"	6°20'05,86"
	7°36'11,031"N	75°13'22,469"W		70°13'59,67"	6°20'11,50"
	7°36'1,348"N	75°13'18,908"W		70°14'03,37"	6°20'18,47"
	7°35'58,199"N	75°13'15,112"W		70°14'09,43"	6°20'22,48"
	7°35'54,596"N	75°13'11,904"W		70°14'12,88"	6°20'24,42"
	7°35'54,597"N	75°13'11,735"W		70°14'02,55"	6°20'33,08"
	7°35'49,638"N	75°13'13,069"W		70°13'49,19"	6°20'44,29"
	7°35'44,361"N	75°13'7,163"W	Finca 3213 Has	70°14'54,46"	6°22'24,32"
	7°35'39,493"N	75°13'5,887"W		70°15'17,64"	6°22'44,45"
	7°35'39,588"N	75°13'1,763"W		70°16'00,53"	6°23'00,69"
	7°35'37,75"N	75°12'57,97"W		70°16'20,08"	6°23'46,15"
	7°35'37,266"N	75°12'50,224"W		70°16'31,81"	6°23'43,44"
	7°35'34,387"N	75°12'44,156"W		70°16'51,57"	6°23'54,01"
	7°35'34,903"N	75°12'39,444"W		70°17'30,58"	6°23'48,13"
	7°35'39,611"N	75°12'37,857"W		70°17'54,65"	6°23'19,64"
	7°35'43,399"N	75°12'34,668"W		70°18'11,93"	6°23'19,44"
	7°35'47,504"N	75°12'38,466"W		70°18'19,02"	6°23'08,97"
	7°35'58,61"N	75°12'31,509"W		70°18'25,23"	6°22'43,49"
	7°36'1,449"N	75°12'37,914"W		70°18'10,71"	6°22'26,42"
	7°36'5,628"N	75°12'41,797"W		70°18'07,23"	6°21'57,23"
	7°36'12,08"N	75°12'47,622"W		70°18'08,73"	6°21'18,32"
Caceres VII	7°44'7,668"N	75°14'59,755"W		70°18'11,78"	6°20'30,14"
	7°44'25,069"N	75°15'14,442"W		70°16'32,09"	6°20'14,32"
	7°44'13,674"N	75°15'28,236"W		70°15'23,99"	6°20'17,63"
	7°44'1,918"N	75°15'25,764"W		70°15'32,61"	6°20'58,28"
	7°43'53,21"N	75°15'21,063"W		70°15'44,84"	6°21'26,00"
	7°43'38,816"N	75°15'18,99"W		70°15'50,99"	6°21'41,65"
	7°43'30,916"N	75°15'15,715"W		70°15'33,52"	6°21'38,26"
	7°43'25,663"N	75°15'8,382"W	Finca Chaparral	70°21'16,52"	6°22'05,97"
	7°43'12,906"N	75°15'1,23"W		70°21'36,97"	6°22'30,73"
	7°43'13,49"N	75°15'10,178"W		70°21'51,55"	6°22'48,37"
	7°43'9,417"N	75°15'16,063"W		70°21'55,10"	6°22'44,14"
	7°43'1,708"N	75°15'17,058"W		70°22'10,80"	6°22'25,16"
	7°42'54,02"N	75°15'10,124"W		70°22'20,36"	6°22'14,07"

	7°42'45,955"N	75°14'53,024"W		70°23'24,64"	6°20'57,53"
	7°42'49,416"N	75°14'47,951"W		70°22'20,01"	6°20'21,52"
	7°42'56,117"N	75°14'45,123"W		70°21'29,83"	6°20'51,62"
	7°43'0,798"N	75°14'38,833"W		70°21'22,78"	6°21'19,27"
	7°42'58,371"N	75°14'36,387"W	Finca Berraquera	70°18'26,42"	6°23'24,00"
	7°43'20,67"N	75°14'40,107"W		70°18'19,02"	6°23'08,97"
	7°43'36,274"N	75°14'44,623"W		70°18'25,23"	6°22'43,49"
	7°43'49,847"N	75°14'50,15"W		70°18'10,71"	6°22'26,42"
	7°44'1,195"N	75°14'53,637"W		70°18'07,23"	6°21'57,23"
Finca El Espejo	70°18'20,97"W	6°21'55,972"N		70°18'07,09"	6°21'44,23"
	70°18'23,404"W	6°20'40,592"N		70°18'15,71"	6°21'43,33"
	70°20'24,711"W	6°20'26,393"N		70°18'31,02"	6°21'41,73"
	70°21'25,846"W	6°21'23,385"N		70°18'44,53"	6°21'40,32"
Finca Sol Naciente	70°20'12,804"W	6°27'23,955"N		70°19'03,94"	6°23'00,33"
	70°20'47,913"W	6°26'31,614"N		70°18'45,67"	6°23'21,53"
	70°21'18,205"W	6°25'9,773"N			
	70°21'45,934"W	6°25'22,997"N			
	70°21'32,268"W	6°27'1,516"N			

1.6. Duration of the project activity/crediting period:

The purchase of the project area has been a step by step process. Land purchase started in 2002, in Cáceres, with about 279 ha purchased. By 2010, around 8,000 ha had been purchased and about 1,800 ha of eligible land had been planted. Asorpar Ltd. buys land together with investors; partnership contracts are available. Asorpar Ltd. plans to expand the project in Cravo Norte, eventually reaching a total project size of 11,000 ha of eligible land.

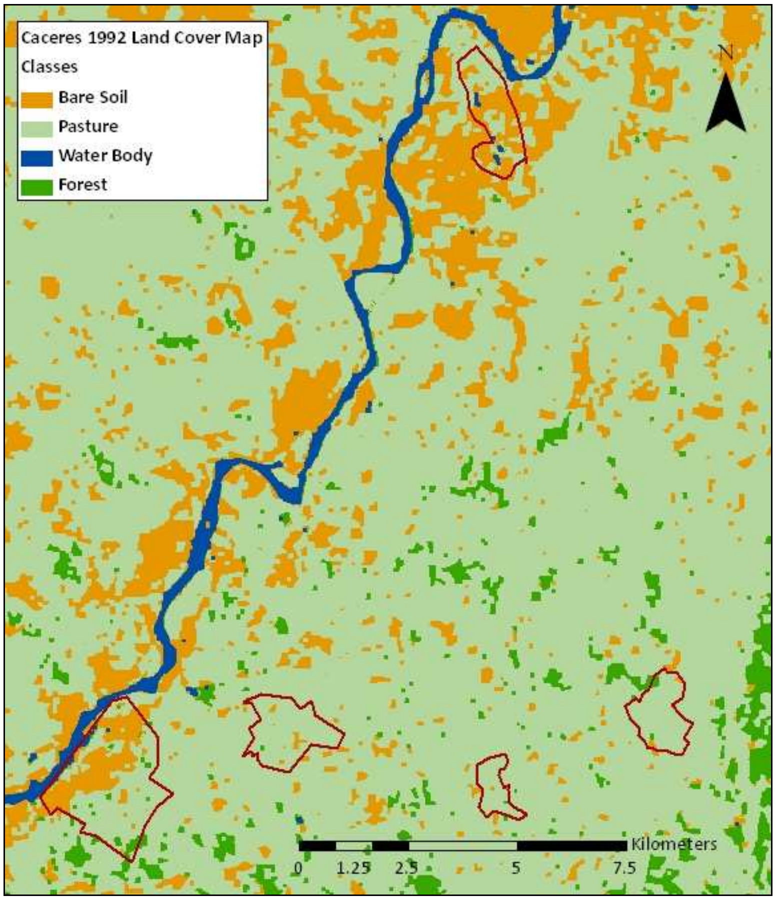
Construction start Cáceres: 2002
Construction start Arauca: 2008
Project duration: 30 years
Crediting period start date: 01.02.2002 (start of the plantation)

1.7. Conditions prior to project initiation:

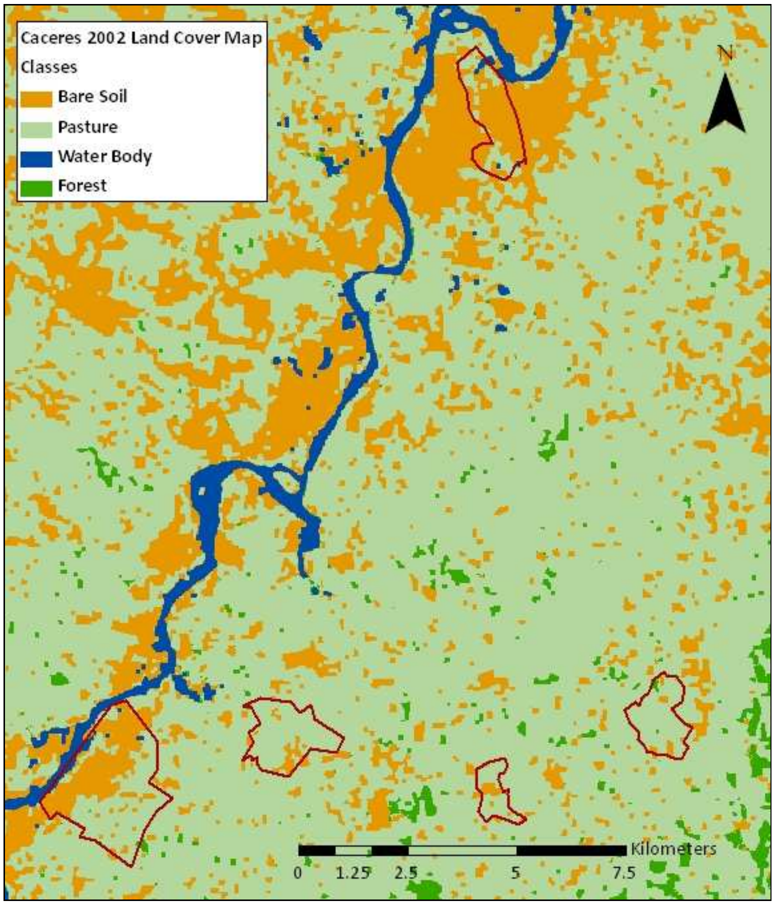
Land use

The project area of Cáceres (Antioquia) was previously exposed to extensive cattle grazing activities as well as some alluvial gold mining (in Cáceres 1,2,7, see multi-temporal assessment of land use changes, using satellite images). In addition, the project sites are located in areas of illegal Coca cultivation.[5]

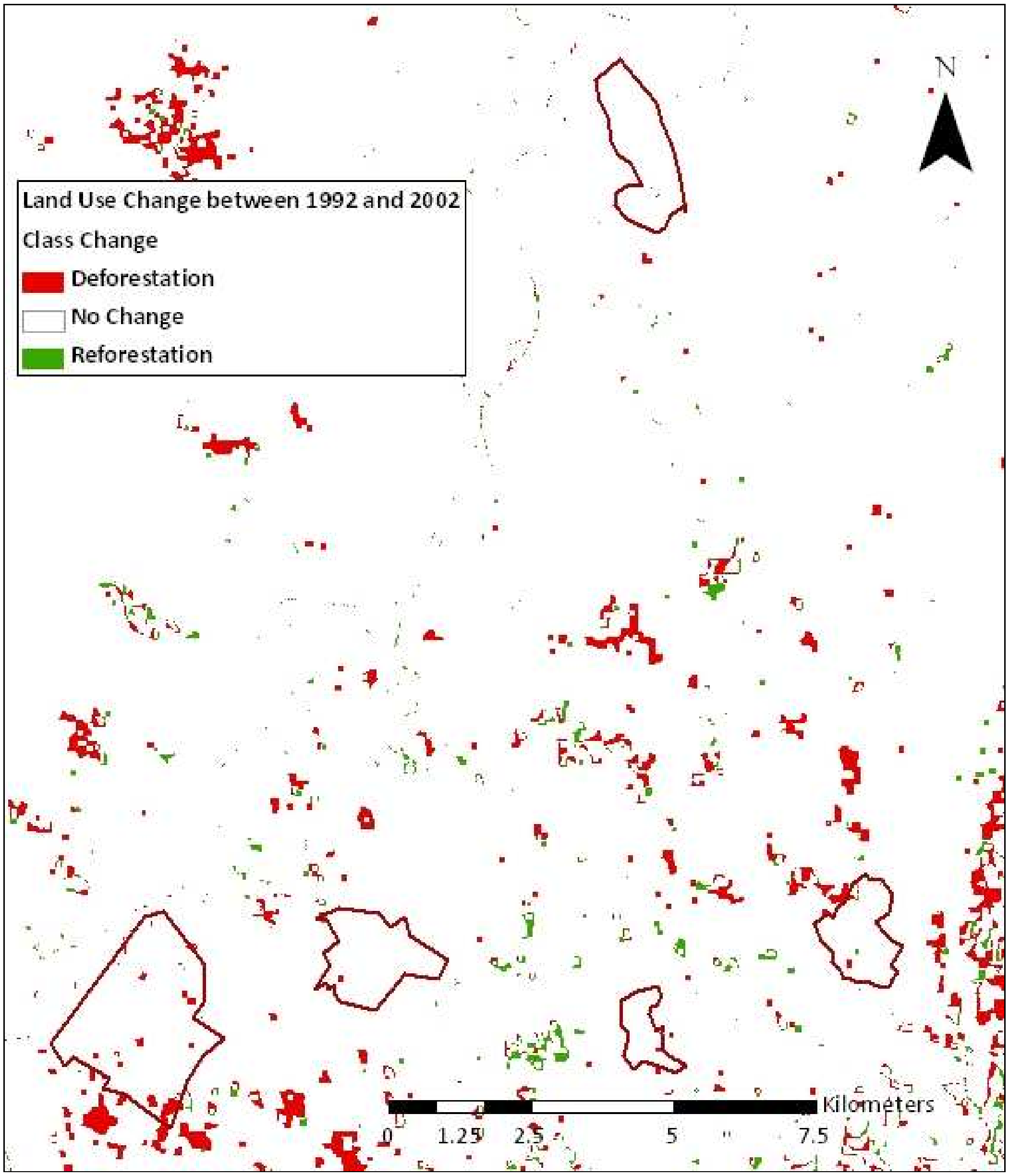
[5] http://www.pbs.org/wnet/wideangle/episodes/an-honest-citizen/map-colombia-cocaine-and-cash/colombia/536/



Map 5: 1992 Land cover classification map for Caceres



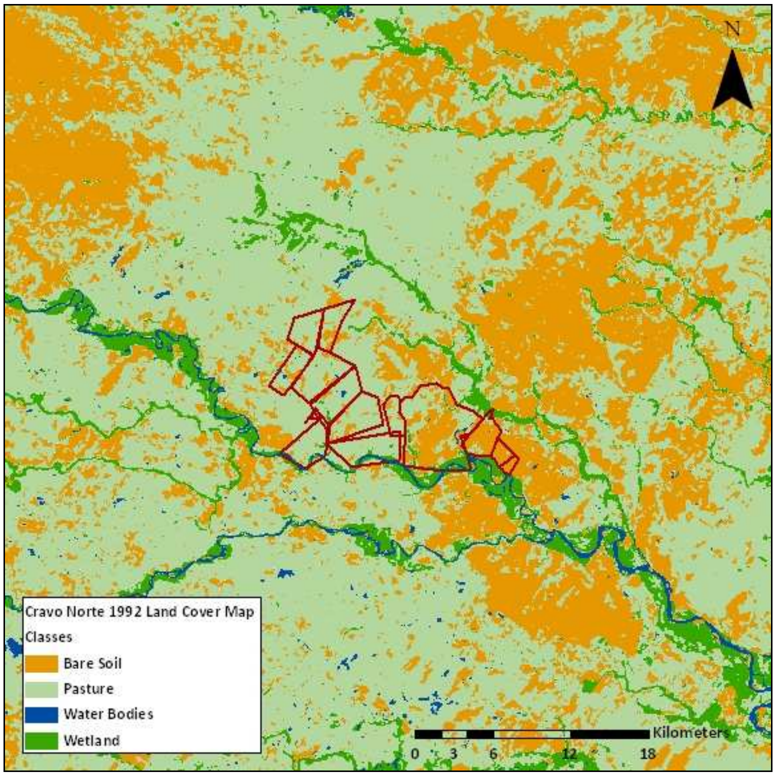
Map 6: 2002 Land cover classification map for Caceres



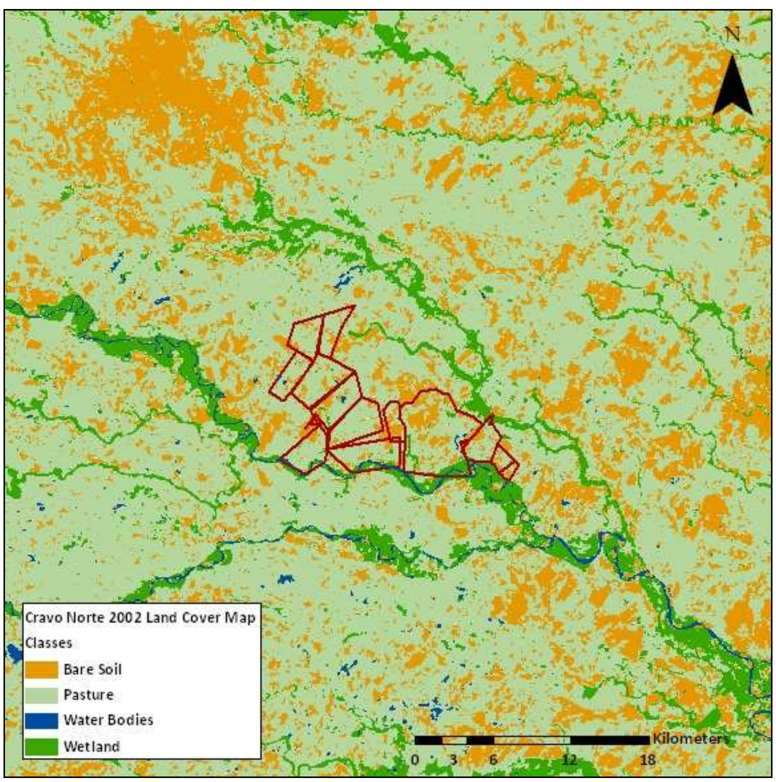
Map 6: Land cover change between 1992 and 2002 for Caceres

Cravo Norte (Arauca) was previously exposed to extensive cattle grazing activities. Livestock farming experienced a significant boost 40 years ago; its most prosperous period was 30-40 years ago.[6]

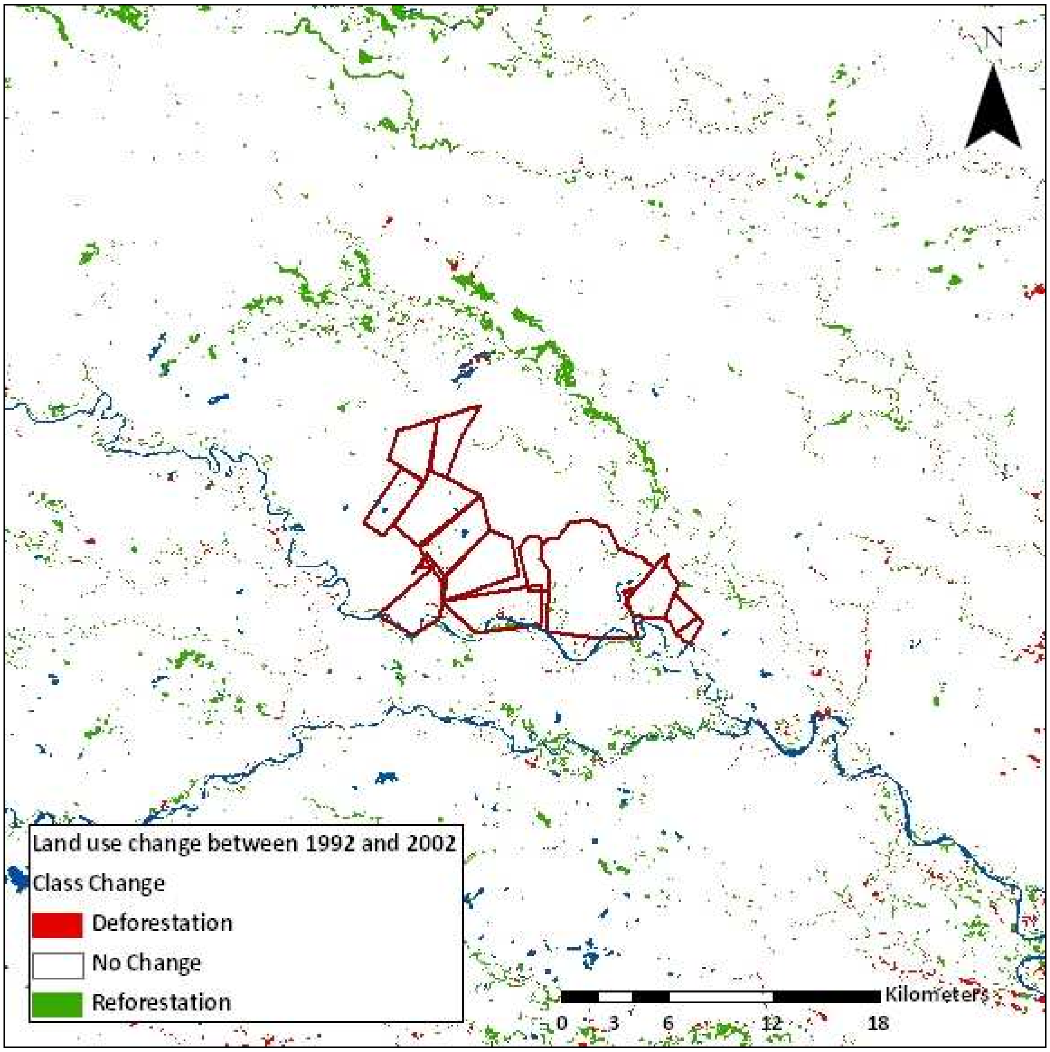
[6] Interview with local villagers of Cravo Norte, October 26th



Map 7: 1992 Land cover classification map for Cravo Norte



Map 8: 2002 Land cover classification map for Cravo Norte



Map 9: Land cover change between 1992 and 2002 for Cravo Norte

About 20 years ago, the country - and especially the project regions - began to suffer after the formation of the "Guerilla" and "Paramilitar" units that (among other offenses) began to collect protection rents and commit sexual offenses.[7,8,9,10,11,12] To date these problems remain prevalent and negatively impact social life, economic activities (such as displacement of locals[13]) and politics.

1.7.1. Antioquia (Cáceres)

[7] La violencia sexual en Colombia: un arma de guerra: http://revista-amauta.org/2009/10/mujeres-colombia-violencia-sexual-un-arma-de-guerra/#more-7214

[8] United Nations: Violence, Crime and Illegal Arms Trafficking in Colombia, 2006

[9] http://www.eltiempo.com/colombia/justicia/hasta-una-mina-de-oro-tenian-familiares-del-canciller-de-las-farc_7553169-1

[10] http://www.publimetro.com.mx/noticias/asesinan-a-funcionaria-de-fiscalia-colombiana-en-zona-de-conflicto/njcx!HKmVPTqeEBGai9wfBHNFZA/

[11] http://www.eltiempo.com/colombia/otraszonas/disminuyo-el-transito-por-paso-fronterizo-de-arauca-tras-advertencia-de-cancilleria_7601368-1

[12] http://www.ejercito.mil.co/?idcategoria=227945

[13] http://www.colombiassh.org/site/spip.php?article517

Climatology

The region experiences a summer season from November to March. The winter lasts from March to November. During the wet season rainfall reaches up to 82.3% of the annual total.[14, 15] The average temperature is 28 º C with varying fluctuations in the range of 4 º C. The highest temperature variations occur during the early hours of the day, with temperatures as low as 20 º C at dawn and as high as 32 º C at noon. Figure 1 shows the annual average temperature since 1990.

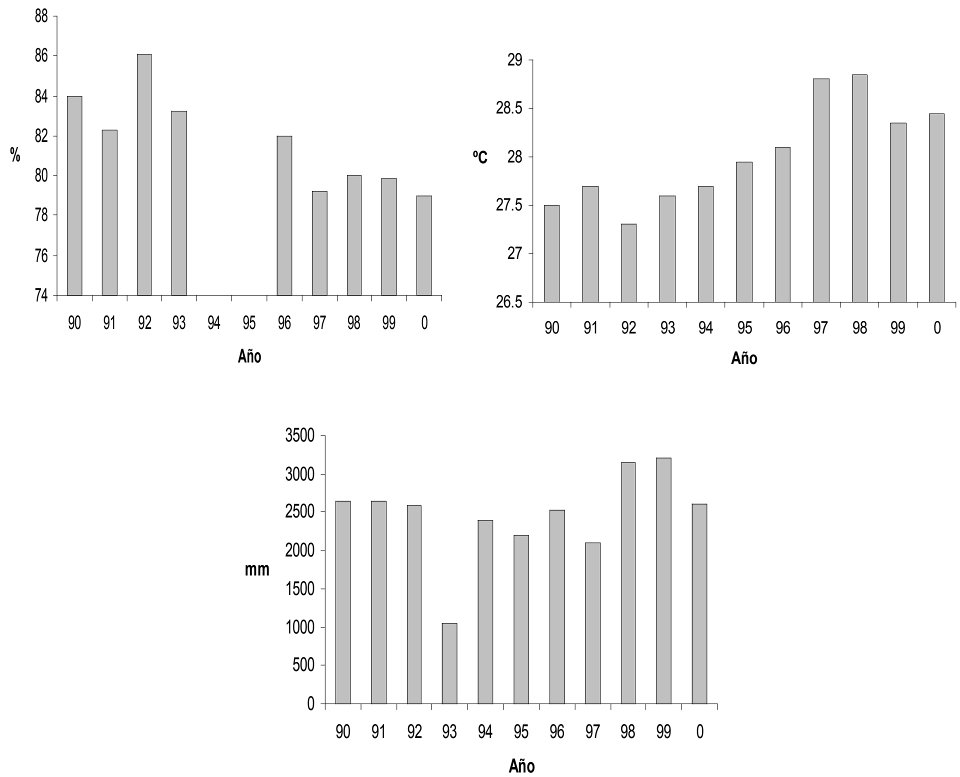


Figure 1: Hygrothermal features of the Caceres region during the period between 1990 and 2000. Annual distributions are plotted: relative humidity (left), temperature (middle) and precipitation (right).

Hydrology

The main sub- tributaries of the Cauca River (located within the territory) are the Man, Corrales and Tamaná rivers, and the Nicapá, Agua Linda and La Magdalena- streams (among others)—all providing water to the municipality and the small towns of Jardín and Puerto Bélgica.[16]

Life Zones

The Holdridge life zone classification scheme delineates three different life zones in Cáceres: tropical wet forest (BMH-T) which occupies 45% of the municipal area,

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[14] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[15] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.

[16] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.

very humid forest (BMH-PM) which occupies 5% and tropical rainforest (bh-T) which occupies 50% of the territory.[17]

Soils
The region is characterized by both ancient and recent geological terraces. Some are dissected. The relief is flat or slightly flat on top with some areas hilly to steeply inclined areas in the slopes and dissected parts. The slopes are short, flat, or convex plane, with an inclination not exceeding 25%.[18] Cáceres consists of soils located in the oldest terraces, situated in the high and intermediate levels of the terraces. These are moderately deep. Their fertility is limited by chemical factors or the presence of gravel in the profile, and they are generally well drained.[19] In general, there are soils from two textural families: 1) fine with clay loam, and 2) clay skeletal type (more than 50% of particles have diameters larger than 2 mm).

Down to about one meter of depth, layers of pebbles occur. Structural development is regular with dark colors on the surface and brown and yellowish-red colors in the subsoil, which may have spots in the lower horizons.[20] Fertility varies from low to very low; the reaction ranges from very strong to strongly acidic. The cation exchange capacity is between medium and low; total bases range from low to very low; the base saturation is medium to low; the organic carbon decreases regularly from high to very low; and phosphorus is low. Aluminum reaches toxic levels for plants near the surface.[21, 22]

Flora
Primary forests in these areas are very complex and trees can reach heights greater than 40 meters. Among the common trees are: Chagualó (*Clusia spp.*), Cedrillo (*Tapirira sp.*), Guásimo colorado (*Luehea seemanni*); Yarumo (*Cecropia spp.*), Chingalé (*Jacaranda sp.*), Carate (*Vismia sp.*), Algarrobo (*Hymenaea courbaril*), Paca (*Cespedesia macrophylla*), Hobo (*Spondias mombin*), Macondo (*Canavillesia planatifolia*), Cedar (*Cedrela odorata*), White silk-cotton tree (*Hura crepitans*), Olla de mono (*Lecythis sp.*), Caracolí (*Anacardium excelsum*) , Jagua (*Jenipa American*), Indio desnudo (*Bursera simaruba*), Balso (*Ochroma lagopus*), Sande (*Brosimun utile*), Abarco (*Cariniana pyriformis*) and Nogal (*Cordia alliodora*). Other representative species of the area are: *Bellucia pentamera*, *Croton billbergianus*, *Apeiba tibourbou*, *Ochoterenaea colombiana*, *Vismia billbergiana*, *Trichospermum galeottii*, *Trema micrantha*, *Goethalsia meiantha*, *Ochroma pyramidale*, *Miconia sp.*,

[17] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.
[18] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.
[19] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.
[20] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.
[21] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC.
[22] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

Schefflera morototoni, *Isertia haenkeana* and *Goupia glabra*.[23] Many of these species (and several others) are endangered (see Annex I).

Fauna

An inventory of birds in the area lists 69 species belonging to 24 families.[24] The greatest number of reported species is *Trochilidae* of the *Orochilidae* family. *Threnetes leucurus* is worth highlighting because it has not previously been reported in the area. The families *Pipridae* and *Formiicaridae* are also noteworthy, each comprising 10% of all local bird species. Of all species, 45% are insectivorous and 28% frugivorous. The most abundant species are *Pipra erythrocephala*, *Manacus vitellinus*, *Glyphorynchus spirurus*, *Psarocolius decumanus*, *Ictinia plumbea*, *Phaethornis superciliosus*, *Phaethornis longuemareus*, *Mirmeciza exsul*, and *Ortalis garrula*.[25]

The area has a strong mammal presence, including the Crab-eating Fox (*Cerdocyon thous*), Giant Anteater (*Myrmecophaga tridactyla*), Cottontop Tamarin (*Saguinus oedipus*), White-fronted Capuchin (*Cebus albifrons*), Central American Agouti (*Dasyprocta punctata*), and White-eared Opossum (*Didelphis albiventris*).[26] The municipality of Caceres reported at least one new amphibian frog species: *Colosethus cacerensis* of the *Dendrobatidae* family.[27]

Cuartas and Muñoz reported the following species of mammals within the project area[28]: *Caluromys derbianus, Chironectes minimus, Didelphis marsupialis, Marmosa robinsoni, Micoureus regina, Bradypus variegatus, Dasypus novemcinctus, Cyclopes didactylus, Tamandua mexicana, Centronycteris centralis, Saccopteryx bilineata, Saccopteryx canescens, Saccopteryx leptura, Noctilio albiventris, Noctilio leporinus, Mormoops megalophylla, Pteronotus davyi, Pteronotus gymnonotus, Pteronotus parnellii, Pteronotus personatus, Chrotopterus auritus, Glyphonycteris sylvestris, Lophostoma brasiliense, Glossophaga commissarisi, Carollia perspicillata, Atribeus cinereus, Centurio senex, Mesophylla macconnelli, Platyrrhinus helleri, Sturnira lilium, Uroderma bilobatum, Uroderma magnirostrum, Natalus stramineus, Thyroptera discifera, Lasiurus ega, Myotis albescens, Myotis nigricans, Eumops glaucinus, Molossus molossus, Nyctinomops aurispinosus, Nyctinomops macrotis,*

[23] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[24] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[25] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[26] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[27] RIVERO, J. y S. MARCO. 1995. Nuevos *Colosethus* (Amphibia: Dendrobatidae) del departamento de Antioquia, Colombia, con la descripción del renacuajo de *Colosethus fraterdanielli*. Rev. Ecol. Lat. Am. 2(1-3): 45-58

[28] CUARTAS, C. y J. MUÑOZ. 2003. Lista de mamíferos (Mammalia: Theria) del departamento de Antioquia, Colombia. Biota Colombiana 4(1): 65-78.

Saguinus leucopus, Alouatta seniculus, Aotus lemurinus, Ateles fusciceps, Conepatus semistriatus, Eira barbara, Potos flavus, Procyon cancrivorus, Sciurus granatensis, Heteromys anomalus, Oecomys bicolor, Oryzomys talamancae, Sigmodon hispidus, Zigodontomys brevicauda, Hydrochaeris hydrochaeris, Cuniculus paca, Echimys gymnurus, and Proechimis magdalenae. Many of these species (and others not listed) are endangered (see Annex I).

Socio-economic characteristics of Cáceres
The socio-economic characteristics of the region allow for a comparison of the project's benefits with the alternatives—important in order to assess the socio-economic benefits of the project compared to its baseline. The most common land uses in this region are extensive cattle ranching, mining, and subsistence agriculture.[29] High altitude agriculture is practiced by the inhabitants of the areas (above the level of the municipalities). In lowland areas not dedicated to cattle farming, small-scale mining occurs, which is supplemented by subsistence farming of maize, cassava, banana and rice for family consumption.[30]

The main production system centers on cattle: breeding, raising, and fattening (the complete cycle). The most common cattle are the Zebu breed, as well as commercial crossings of Holstein and Brown Swiss.[31] Because cattle farming is the most widespread economic activity in the region, the areas eligible for the establishment of the reforestation project are mostly areas previously used for this activity. Therefore, the main socio-economic alternative for the future baseline is cattle farming.

Mining has declined in the region in recent years, particularly in Caceres and Taraza. There are several reasons for the decline, but the major reason is the depletion of easily extractable deposits (exposed during floods). Bajo Cauca area accounts for 49% of the total gold production of the regional department. Gold mining in the municipalities of Cáceres and Taraza is primarily small-scale mining.[32]

The educational level of residents is very low. In general, children and women are more educated than the traditional male heads of the family. The average number of children per household is three. 50% of the population is under 14 years, which shows a significant population of children, demanding basic services like education, recreation and health.[33]

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[29] GONZÁLEZ F., Á. y A. CORTES. 1979. Suelos del departamento de Antioquia. Tomo I. Departamento de Antioquia y su aptitud de uso. Instituto Geográfico "Agustín Codazzi" (IGAC). Bogotá DC; Moscoso 2005.

[30] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Dep; artamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[31] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[32] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

[33] AGUDELO, S., N. ALVARADO, C. ÁLVAREZ, L. GAMARRA, L. GARCÍA, I. MAZO, A. RAMÍREZ, Z. TORO, J. CORREA, J. SANCHEZ, O. SÁENZ, H. RESTREPO, J. CARDONA y G. CONTRERAS. 2000. Estudios en Rastrojeras incentivadas del Municipio de Cáceres. Universidad Nacional de Colombia, Departamento de Ciencias Forestales. Corporación Autónoma Regional del Centro de Antioquia (CORANTIOQUIA).

1.7.2. Arauca (Cravo Norte)

Climatology

This area falls into the category of dry or seasonal grasslands, with annual alterations between a wet season with high availability of water in the soil (duration: 6-9 months) and another, more or less prolonged season characterized by a deficiency or decrease in water soil substrate (duration: 3-6 months). The annual rainfall record has a unimodal curve. [34] The highest rainfall occurs between April and November. December and March have low rainfall because the northeast winds—originating in the northern hemisphere during the period—prevent the formation of clouds in the region. Rainfall is typically intense. Consequently, soil erosion is common. The average annual precipitation is 1,532 mm.[35]The average annual temperature is 26.1 ° C. The maximum value (36.4 º C) occurs during March; the minimum value (18.6 º C) occurs during January.

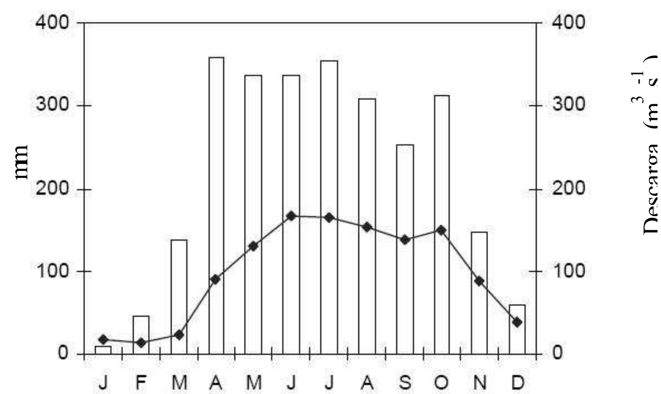

Figure 2: Annual rainfall (bars) and unloading (lines) in the Eastern Plains of Colombia, according to the average of seven seasons: Cabuyaro, La Plata, Margaritas, Nare, Puerto Gaitan, Puerto Lopez and Salados. The discharge data are from a station in the river Yucao, near the River Meta. (Source: CIAT Climate Database. From Veneklaas et al. 2005)

Hydrology

The hydrographic network is extensive. The river system empties into the west-easterly flowing Orinoco River, of which the rivers Arauca, Casanare, Meta, Vichada, Guaviare and Tomo are tributaries. These tributaries collect water from other tributaries in the department of Arauca: the Tocoragua, Tame, Cravo Norte, Ele, Lipa, San Miguel, and the Negro-Cimaruco. The El Medio and Cumare tributaries of the Casanare River are important means of transport in the region. [36]

Life zones

According to the Holdridge life zones classification scheme, the area corresponds with the tropical dry forest (bs-T) life zone, transitioning to wet tropical forest (bh-T).[37] These zones have a dominant grass layer and a discontinuous cover of trees

[34] RIPPSTEIN, G., G. ESCOBAR, F. MOTTA.(Eds.) 2001a. Agroecología y Biodiversidad de las sabanas de los llanos orientales de Colombia. Centro Internacional de Agricultura Tropical (CIAT).

[35] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)

[36] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)

[37] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)

(generally associated with river banks). Tropical savannas are among the ecosystems prevalent in South America, with a total area of approximately 250 million hectares.[38]

Geomorphology and Soils
Geomorphically this area is known as a flood plain. It extends from the foothills of the eastern cordillera of the Andes eastwards to and beyond the border with the Republic of Venezuela. The area consists of fluvial terraces and floodplains covered with savannah vegetation and forests in the plains of rivers and streams.[39]

Soils vary from very superficial to moderately deep. Soils are limited by stoniness. The primary texture is loamy sand, with quartz as the dominant material, mainly in the coarse fraction. Soils have moderate content of organic matter, moderate to low cation exchange capacity, and are low in calcium, magnesium, potassium and phosphorous. The active aluminum content is high, and fertility ranges from low to very low.[40] The soils of this region are not very productive. Normal plant growth is limited due to the harmful effects of soil acidity, low availability of phosphorus, and insufficient organic matter content.[41] Aluminum is the main component of the soil's exchangeable acidity and is one of the main factors contributing to poor plant growth. The pH value is below 5.5. This reduces crop growth along with toxic amounts of aluminum.[42]

Flora
The region has three main types of vegetation[43]: secondary forests, gallery forests, and natural savannahs. Secondary forests are located mainly in the hills, and the species of greatest importance are: Tuno (*Miconia scorpiaides*), Caucho (*Ficus sp.*), Balso (*Ochroma lagopus*) and Gualanday (*Jacaranda copaia*). The gallery forests are strips that are located along rivers and streams in small valleys that dissect in ancient terraces. These forests form narrow strips with little continuity.[44] Predominant species found in gallery forests are: Laurel baboso (*Ocotea sp.*), Cariaño (*Trattinickia aspera*), Palo blanco (*Clusia columnaris*), Palma cumare (*Astrocaryum vulgare*), Choapo (*Socratea exorrhiza*), Palo de piedra (*Licania hypoleuca*), Sangretoro (*Dialyanthera parviflia*), Guamo (*Swartzia sp.*), Anime (*Protium sp.*), Clavo de laguna (*Vosoohysia sp.*), Tuno (*Miconia scorpiaides*), Moriche (*Mauritia minor*), Saladillo (*Caraipa llanorum*), Planatone (*Thalia geniculata*), Nacedero (*Trichantera

[38] JIMÉNEZ, J. J., A. G. MORENO, T. DECAENS, P. LAVELLE, M. J. FISHER, R. J. THOMAS. 1998. Earthworms communities in native savannas and man-made pastures in the eastern plains of Colombia. Biol Fertil Soils. 28: 101-110
[39] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF), MINISTERIO DEL MEDIO AMBIENTE, ORGANIZACIÓN INTERNACIONAL DE MDERAS TROPICALES (OIMT). 1998. Guía para plantaciones forestales comerciales Orinoquía. Serie de documentación No. 38. Santafé de Bogotá.
[40] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF), MINISTERIO DEL MEDIO AMBIENTE, ORGANIZACIÓN INTERNACIONAL DE MDERAS TROPICALES (OIMT). 1998. Guía para plantaciones forestales comerciales Orinoquía. Serie de documentación No. 38. Santafé de Bogotá.
[41] JIMÉNEZ, J. J., A. G. MORENO, T. DECAENS, P. LAVELLE, M. J. FISHER, R. J. THOMAS. 1998. Earthworms communities in native savannas and man-made pastures in the eastern plains of Colombia. Biol Fertil Soils. 28: 101-110
[42] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF), MINISTERIO DEL MEDIO AMBIENTE, ORGANIZACIÓN INTERNACIONAL DE MDERAS TROPICALES (OIMT). 1998. Guía para plantaciones forestales comerciales Orinoquía. Serie de documentación No. 38. Santafé de Bogotá.
[43] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF), MINISTERIO DEL MEDIO AMBIENTE, ORGANIZACIÓN INTERNACIONAL DE MDERAS TROPICALES (OIMT). 1998. Guía para plantaciones forestales comerciales Orinoquía. Serie de documentación No. 38. Santafé de Bogotá.
[44] Veneklaas, E. J., A. Fajardo, S. Obregon, and J. LOZANO. "Gallery forest types and their environmental correlates in a Colombian savanna landscape." Ecography 28: 236-/252 (2005).

gigantea), Guáimaro (*Brosinum sp.*), Yarumo (*Cecropia sp.*), Laurel amarillo (*Aniba sp.*), among others. The natural savannas are found in low savanna areas on well drained pastoral terraces. Among the most common species in these areas are Hairy straw (*Trachipogon vestitus*), Fox-tail grass (*Andropogon bicornis*) and the Tote (*Rynchospora nervosa*). In many places the vegetation has been replaced by improved pasture for the establishment of livestock production systems, among them the Pointer grass (*Hyparrhenia rufa*) and Ruziziensis (*Brachiaria decumbens*).

Fauna

In the zone of the project area a variety of birds, mammals, fish and reptiles can be found (see Annex II). In general, the bird life of the department of Arauca has been studied little in terms of its ecological and bio-geographical aspects. Due to flat topography and river channels in this region drainage is ineffective. This results in large swampy areas that are ideal habitats for many bird species. The inventory, made by Rojas and Piragua, recorded 253 species belonging to 57 families and 18 orders. The Tyrannidae family was the most widely represented with 34 species. Other important families were Fringillidae with 16 species, Accipitridae with 15, Ardeidae and Icteridae with 12 each. There were also two species new to Colombia, the migratory *Satrapa icterophrys* and *Phelpsia inornata*. According to habitat types, 42% of the species live in the forest habit, 24% in the savanna and shrub habitat, 23.8% in aquatic habitats, and 10% are eutropical subseas. Of the 18 foraging guilds found, the one that presented the highest number of species of insects was the forest with 35%, followed in importance by omnivores and predators with 8.7% and 7.5% respectively.[45]

According to the national biodiversity report, the Orinoco region contains 101 species of mammals comprising 72 genera, 26 families and 9 orders. The most studied mammal unit in the area is *Chiroptera* (bats). The most important aquatic mammals in the region are *Inia geoffrensis*, *Trichechus manatus Pteronura brasiliensis*.[46]

With regard to fish populations, 608 species (spread over 44 families and 11 orders) are reported for the Orinoco River basin region. The most representative families are *Characidae, Prochilodontidae* and *Pimelodidae*. The most representative species are *Piaractus brachypomus*, *Colossoma macropomum*, *Brycon sibienthaleae*, *Pseudoplatystoma fasciatum* and *Prochilodus mariae*, which possess detailed biological studies.[47]

Although the area does not have detailed studies of the ecology and biology of reptiles, significant populations of Arrau turtle (*Podocnemis expansa*), Yellow-spotted River Turtle (*Podocnemis unifilis*), and four species of Crocodilia (*Crocodylia*): Orinoco Crocodile (*Crocodylus intermedius*), Smooth-fronted Caiman (*Paleosuchus trigonatus*), Musky Caiman (*P. palpebrosus*) and Spectacled Caiman (*Caiman sclerops*) have been reported. One of the most studied reptiles in the basin is the Plainsman alligator. This is for four reasons: it constitutes a flagship species, is

[45] ROJAS, R., and W. PIRAGUA. 2000. Afinidades biogeográficas y aspectos ecológicos de la avifauna de Caño Limón, Arauca

[46] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)

[47] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)

commercially important, is endemic, and is in a critical state for conservation.[48] Annex (II) lists endangered species.

Socio-economic characteristics of Cravo Norte
The most important economic activity in the region is extensive livestock farming, consisting mainly of cattle farming, encompassing both breeding and raising. Grass species peculiar to the region - *Axonopus purpussi*, *Lersia exandra*, and others - are the basic food items for cattle. The most important pasture species introduced in the area are *Brachiaria decumbens* and *B. midicola*.[49]

Agriculture is not economically significant in Cravo Norte Municipality because it is located in the plains of rivers and creeks and near or inside the gallery forest where soils have some degree of fertility and the transport of products is facilitated. There is no vocation or agricultural tradition. Subsistence farming of cassava, banana, maize, sugarcane and some fruits (apple, guava, papaya and citrus) predominate agricultural activities. There are also small crops of snuff.[50] As in Caceres, the main alternative socioeconomic baseline is extensive cattle farming, mainly because eligible areas for the project are established in areas dedicated to this use.

1.8. A description of how the project will achieve GHG emission reductions and/or removal enhancements:

The project will achieve GHG emission reductions through the sequestration of carbon in the woody (above and below ground) biomass of the reforested native species.

Asorpar's contract with the Colombian ministry of environment to secure the support of the Forestry Incentive Certificate (CIF)[51] makes the company responsible for preventing illegal mining activities or cattle farming. Based on the obligations of this contract any activity that is not related to commercial forestry plantation - such as gold mining or cattle farming – is illegal.

Forty-eight illegal gold mines have been closed in Colombia since President Juan Manuel Santos took office in August 2010.[52] But it can be assumed that in the absence of the project, extensive cattle farming on grasslands and limited gold mining operations will continue unabated and far less carbon will be sequestered. President Santos and his Environmental Minister, Beatriz Uribe Botero, are working toward the goal of regularizing the Colombian mining industry and converting legal mining into one of the principal engines of the Colombian economy. The mines that have been closed down by the Santos government are located in the Departments of Antioquia and Córdoba, however the fact that illegal mining are still a significant problem in Colombia is evidenced by the fact that illegal mining activities have been identified in 17 of the country's 32 departments. The big push by the government to crack down

[48] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)
[49] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)
[50] CORPORACIÓNAUTÓNOMA REGIONAL DE LA ORINOQUÍA (CORPORINOQUÍA). 2004. Plan de Acción 2004-2006. Yopal, Arauca. (http://corporinoquia.gov.co)
[51] For further explanaitions of the CIF please refer to section 1.10
[52] http://www.straitstimes.com/BreakingNews/World/Story/STIStory_594400.html

on illegal gold mining throughout the country serves to reinforce Asorpar's position and lower risk.[53]

For site names and hectares to be forested (area that is eligible) please refer to section 1.16. For estimated total carbon sequestration please refer to section 4.

1.9. Project technologies, products, services and the expected level of activity:

Technical procedures are explained in more detail in the book "Reforestation, a natural process". The book has been written in 2005 by Asorpar's technical manager Luis Gonzalo Moscoso Higuita and elaborates specifically on the management practices applied in Cáceres.

Employee Training

Asorpar trains its field employees comprehensively because reforestation is a generally unknown process in the project regions. Most workers have no prior knowledge of the reforestation process of the cultural labors of which it consists. Asorpar begins the training process with meetings to approach the local communities and potential workers in order to explain the project, the benefits of forest resources and soil management for the community and biodiversity, and to sensitize the community. The initinal training of staff is constantly accompanied by both the director of the project and field supervisors. Their involvement and knowledge sharing is important because no reforestations have been done previously in the project area on a significant scale.

The second step in the training process is to teach all employees each component of the cultural management of the reforestation plantation including seed collection, cleaning and storing, management of the nurseries, tree planting, maintenance and sustainable harvesting. These trainings include an overview as well as instruction on the specific activities in which the employees will engage. The training of workers is carried out in Asorpar's offices or on-site where the responsible person for the project lives. The duration of capacity building sessions is varied. Training is provided for at least one day but could also take several days in case of complex issues. Important is to assure that the participants gain capacity in silvicultural best practice and apply this new knowledge to obtain the needed experience in best practice silvicultural management.

The third step is continued training and field checks. Technical manager Luis Gonzalo Moscoso travels regularly to all farms and performs quality checks on the work being done. Usually the checks are carried out on a monthly basis. During these visits he holds meetings with the workers to help them improve their performance and does demonstrations in the field to make sure that quality and safety is maintained in the performance of all activities.

Technical manager Luis Gonzalo Moscoso carries out the majority of the training; however a select group of employees with many years of experience working with Asorpar also lead training sessions.

[53] http://www.americaeconomia.com/negocios-industrias/colombia-cierra-otras-18-minas-ilegales-de-explotacion-de-oro

Soil Samples[54]

Two types of samples are taken: one for characterization and chemical analysis and the other to determine the presence of symbiotic organisms.

- Mycorrhiza analysis: This determines the symbiotic organisms present in the roots of the selected species. To do this analysis, three soil samples are taken beneath each "candidate tree" (taken at a distance of four meters at the foot of the tree from the shaft in horizontal line and near the roots). The depth of the soil samples varies depending on the profile of the tree and soil. The samples are mixed to obtain one sample of approximately 1.5 kilograms of material, marked with the respective data (position, type of samples, tree number and date, among others). The samples are sent to a laboratory specialized in pathological analysis.
- Characterization and chemical analysis: To determine the requirements of the species with respect to soil conditions, a soil sample in horizontal line is taken following the contour lines at a distance of 4 meters from the trunk, or foot of each selected tree. Properly packed and marked, the sample is then sent to a soil laboratory for chemical and characterization analysis.

Soil samples have been taken in different zones of the project area, taking into consideration the different baseline conditions and types of herbs.

Selection criteria of tree species for reforestation[55]

The following parameters are taken into account in the selection of tree species:

- Growth characteristics
- Ecologic, economic and cultural values
- Easy acquisition of seeds
- Experiments with rare species carried out by the project owner
- Resistance to attacks of insects and diseases
- Value of the timber on the international timber market

Most of the seeds used for the project are directly collected by Asorpar Ltd.

Seed collection and handling[56]

When trees produce fruits, which in turn produce seeds, these require specific treatments according to the species. The project follows the procedure defined by Enrique Trujillo Navarrete (1989):

- ***Collection period:*** This refers to the time interval from the moment seeds acquire physiologic maturity and fall from the tree to the ground, to the moment they disappear by action of fauna, fungi or bacteria. The time interval is species dependent.
- ***Maturation period***: Even though most species mature during the dry season, there are some that do so during the rainy season. Others display a permanent maturation, with ripe and unripe fruit, flowers and buds all at the same time. In order to begin collecting seeds, it is essential to make a direct observation of fruits, to assure their ripeness. For this reason phenologic and fructifying

[54] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005
[55] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005
[56] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

controls are kept in each tree record. Given a number of variables, each species matures in a given time of the year according to variations in the climatologic conditions.

- ***Seed collection***: In order to collect the seeds it is necessary to evaluate the most adequate system for each species considering the size of the tree, the fructification habits, the type and density of the forest, seed dispersion and the size of the fruits.
- ***Extraction and cleansing of the seed***: The process after seed collection depends on the type of fruit. In gymnosperms, dry fruit can usually be found; the cones let the seeds fly out when they are ripe. In angiosperms, both fleshy and dry fruit can be found.
- ***Treatment of fleshy fruit***: In order to separate the pulp from the seed it is necessary to soak the fruit in water for a period of 24 to 48 hours (depending on the species) and then knead the pulp manually or through special mills. The clean seed is dried at surrounding temperature until the humidity content is low enough to allow safe storage.
- ***Treatment of dry fruits***: In the case of dry fruits, the process begins with the humidity reduction of the fruits or seeds. This can be done naturally using solar energy and air circulation or by means of artificial dryers with controlled temperature, relative humidity and the circulation of dry air. It is necessary to take into account that high temperature may become a critical factor.
- ***Cleansing***: Once the seeds are extracted, they may be contaminated by shells, pieces of leaves, wings and other undesirable material that reduces their quality. To cleanse the seeds, different manual techniques can be used, such as different caliber meshes, cleaners, air jets, sieves, ventilators, chutes, wire or perforated sheet metal screens, or by means of specialized machinery.
- ***Humidity control***: Once cleansed and classified, the seeds are planted or readied for storage. Humidity control refers to the maintenance of an adequate level for each species. Natural or controlled techniques can be used. This practice is of vital importance to preserve the viability of the seeds.

Asorpar Ltd. has a seed bank in their main office in Medellin with two refrigerated rooms with a hydro-thermograph which allows optimal conditions of the stored seeds.

Installation of a temporary tree nursery[57]

The temporary nursery consists of seedling beds and rows for growing. The name "temporary nurseries" refers to the fact that the useful life covers only the planting period. They are built on the site where the reforestation is going to be carried out and near water sources to enable the use of irrigation systems. They offer the following advantages:

- Lower transportation costs (inside and outside)
- Simplify adaptation of plant material
- Reduce mechanical damage of plant material due to lower transportation distances
- Generate employment and provide knowledge about reforestation and its handling from seed planting to plantation in the field
- Provide timely availability of seedlings, guaranteeing quality of transplantations as well as health and adequate morphology

[57] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

There are three ways to plant: 1) directly in the soil, 2) in plastic bags and then in soil, and 3) in seedling beds, then plastic bags, then in soils. In all three cases, it is important to minimize movement. In areas with steep ground, the nursery is built in terraces shape and the resulting soil of this construction is used to fill the plastic bags.

The seed germination is based on the following key processes:

- Seeds recently collected
- Selected seeds
- Adequate handling (germinator beds sterilization, humidity regulation, temperature, light pests and diseases control)

Picture 5: Styrofoam sheet for identification of the species, planting date and number of seedlings planted

Picture 6: Nursery installed on a terrace at Project Caceres I

<u>Substratum</u>[58]

The substratum to fill the bags is of primary importance for the development of the seedlings. The fertilizer is based in organic matter and is prepared to be added to the substratum for filling bags or containers and for fertilization during the plantation:

[58] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

Table 2: Composition of substratum

Element	Percentage of contents
Chicken manure	40%
Mushroom fertilizer	20,5%
Mycorrhiza	18%
Phosphoric rock	10%
Gypsum	7%
Magnesium sulfate	3%
Agrimins	1%
Humiplex 50G	0,5%

The highest content of this mix is organic matter. It provides the following advantages:

- Improves the physical, chemical and biological properties of the soil
- Improves the structure, ventilation and porosity of clay soil
- Increases water and nutrients retention capacity in sandy soil
- Increases the absorption and retention capacity of water in the field
- Stores nutrients due to the high level of cationic exchange and releases nutrients according to plant requirements
- Promotes root development of the plant
- Provides macro and micronutrients
- Increases the rhizogenic capacity of the plants
- Restores the biotic activity of the soil with the consequent increase of beneficial microorganisms

In preparing the substratum, solutions or mixtures with micro-organisms which are the main components of the soil are added. They constitute its living part and are responsible for dynamic transformation and development. The diverse amount of microorganisms found in a fraction of soil performs determinant functions in the transformation of organic and inorganic components which are incorporated.

According to Delgado–Higuera (1999), "…soil micro flora is composed of bacteria, actinomiceto, fungi, algae, virus and protozoa." Their most important functions in the transformation process are:

- Transformation of organic forms which the plant cannot take into inorganic forms that can be assimilated by the plants (mineralization)
- Making organic compounds soluble to facilitate their absorption by plants (e.g., oxidation of the mineral sulfur to sulfate and of ammoniac nitrogen to nitrate)
- Stimulating root development which increases nutrient assimilation, field capacity and plant development
- Antagonist reactions, control of parasitism and plant pathogens
- Improving the physical properties of soil

<u>Transplantation and transportation[59]</u>

[59] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

This is the cultural labor that requires great care, since a wrong transplantation in the nursery diminishes the growth of the plantation in the field. Special attention is given to the following tasks:

- The position of roots must be completely vertical, to avoid the goose neck (a bending of the root).
- The transplanted material must be selected for its uniformity, strength and health.
- Transplantation is done in the winter when the soil is wet and there is high rainfall. If there is insufficient water in the soil then it is necessary to water continuously to avoid mortality. This is usually after two to three month and when it has reached a height of 20 to 40 centimeters.
- Only the material that is to be transplanted immediately is pulled out from the nursery or seedling bed. Plant materials are not left in containers for a long time, not even overnight. While transplanting the material is kept in a container with water.
- When direct plantation is done the thinning and replanting are done in plastic bags where the seeds have not germinated.

Once the material has been selected, it is packed. During the packing and transporting stage (externally and internally) trees may suffer damage. To minimize damage, the following steps are suggested:

- Plastic boxes are advisable that: 1) do not get flooded during the rainy seasons, 2) do not get too hot under high temperature regimes, 3) let light go through, and 4) permit air circulation.
- Boxes or portable crates that generate waste or have to be discarded should not be used. These boxes are used as a control to measure how many seedlings are planted. They are measured twice: when they leave the nursery, and when they are empty.
- When the internal transportation is long and horse or mules are needed, neither beasts nor packed seedlings should suffer mistreatment.

To obtain efficient transportation of plant material, a horse mount commonly known as “angarilla” (panniers) has been designed to be used over the light pack saddle. It is tied to the harness and untied when animal is being unsaddled. The mounts are designed so that plastic boxes fit precisely inside them. The mounts are arranged and tied up with a single girth that fastens all three boxes (see Picture 7).

Picture 7: Note the comfort and versatility of the plastic boxes for internal transportation without damage to the seedlings.

Living fences[60]

In the project area "living fences" with fast growing and forage producing species are used. Three years after being planted, when the stakes have disappeared, the trees of the selected species will remain. By this time they will be more than 5 meters high, serving as a living fence that provides wood, tannin, fruits and shade. Such fences will improve the landscape, contribute to the biotic welfare (fauna and flora), act as a barrier against plagues and diseases, and fence in the lots. Because of this, it will not be necessary to invest more resources in building fences.

Picture 8: Living fence built with posts of species that sprout again, Project Cáceres II

Preparation of the land[61]

The general clearing is made by cutting the weeds manually (with short and long machetes). The residues originated by the clearing are scattered and distributed in a

[60] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

[61] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

uniform way over the area. Weeds are cut before the harvest time when their seeds are not yet mature, in order to diminish the proliferation of the species.

In the project area, the "tamanua" is used for the layout of the plantation. This is an instrument conditioned with a versatile design. It is light, easy to transport, and contains the necessary instruments to make a good layout (compass and level). The upper part of the tamanua is made of wood. The wood isolates the compass from the metallic surveying rod and prevents magnetic interference. The surveying rod is divided by a bolt. The compass and level are embedded (and protected) in wood. The cuts are made with a fine saw to assure greater precision. The depth of the crease permits the layout in slopes up to 45 degrees (100%).The horizontal hole, with the help of the surveying rods, serves for layout in level areas.

Picture 9: The Tamanua is adapted to make a layout with orientation and precision

Picture 10: Marking the quadrants in cross form

Picture 11: Marking the quadrants of the plantation area with slope correction by means of surveying rods

After the layout is done a contour cleaning (a square between 1 and 1.5 meters on each side) is carried out at each planting point. The objective is to give a survival advantage to young trees over weeds during the initial growth period.

Picture 12: Making of holes and mincing. Observe the contour cleaning completely free of weeds and sods. Notice the depth of the hole and the minced soil which is reutilized for the planting process

Fertilization and planting[62]

These two asks require a lot of care since they guarantee the survival and yield of the plantation. At this point, the soil analysis is taken into account, since this is what indicates which fertilizer and which amount must be used to guarantee the precision of the reforestation.

In general the soils subject to reforestation are acidic and deficient in organic matter. They are nutritionally unbalanced, with low cationic exchange capacity, and they contain few microorganisms due to the over compacting and excessive cultural practices (burning, tilling and fertilization among others). To prepare mixes rich in organic matter, various products are used including mushroom residues, chicken manure and pork manure, often with additives like humic acids, mycorrhiza and macro and micro nutrients. This system has given good results.

Planting may be done after homogenously mixing the fertilizers with the minced soil. Typically, seedlings come in plastic bags with sods. To obtain a good planting result, the following steps are advised:

- The plastic should be taken out with a sharp knife without breaking the sod. If it is broken, it is important to check and ensure that the main root remains straight at the moment of planting.
- At the moment of planting the tree should be planted straight with soil pressed around it. To prevent flooding, no air space or depression should be in the area of the hole.
- The container or plastic bag serves to keep a count on how many trees are planted; its final disposal should be in a safe place with other solid residues or recycling materials.
- The new selection of plant material should be made with criteria of lignifications, uniformity and health.
- If the planting is made on sunny days, the plant material should be very wet when carried to the field.
- Seedlings should not be covered above the neck of the root which must coincide with the lowest edge of the hole.
- Colombia has a good amount of rainfall and superficial and subterraneous waters. Therefore, it is important to plant during the rainy season. The water retainer is used in dry zones.
- Sometimes earth conditioners have been used. They cost more but almost guarantee survival, and they raise the production level of the plantation. These compounds are formed mainly by growth starters, water absorbent polymers, soluble mineral fertilizers, slow liberating mineral fertilizers, organic fertilizers and volcanic lava. They are applied under the sod of the seedling, in doses of 5 grams per seedling. In general, reforestations in which this conditioner has been applied show a better root development with healthier plants of abundant foliage and more resistant to diseases and droughts. The texture and structure of the soil conditioners permit planting in degraded, salty and poor soils. The use of them is like the acquisition of an insurance policy against climate change and associated unpredictable and changing weather patterns (e.g., heavy rainfall in an area formerly prone to droughts). The

[62] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

advantages of these products are useful almost anywhere, including desert zones.

- Continuous supervision by specialized personnel is vital to avoid errors that affect the development of forest plantations, and to prevent any shrinkage between the nurseries and the plantation sites.
- If the root system presents bending, it is necessary to discard this material.

Program of plantation and forest handling in degraded soils caused by alluvial gold mining - recovery -, Cáceres[63]

Gold exploitation in the Bajo Cauca region (Antioquia) resulted in serious damage to soil and vegetation via the use of bulldozers, backhoe and tractors, and minor tools like handbarrows, sieves, pails and pikes. In searching for gold, the workers mixed the organic layer with the lower substratum until they reached the rock bottom. All of the material was washed with water pressure pumps and then sent to a chute and a canoe-shaped sieve. The sieve contained the “azogue” (Mercury) which binds with picks up and decants the precious metal. When it enters the streams and ponds, mercury is toxic to fish and other aquatic life.

The polluted water - full of sediments and toxic mercury - eventually returns to the gutters, streams and river basins. After the completion of the gold extraction cycle, the gulleys, dumps and ponds remain contaminated.

Land recovery and restoration entails the following: 1) reconstruction of the topography, 2) filling of gullies, 3) ripping, and 4) fertilization and planting.

Picture 13: Gold exploitation in an open pit

[63] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

Picture 14: Washing of the substratum and passing it through the chute with mercury to catch gold

For the recovery of degraded soils by gold-mining, *Acacia mangium* plantations show good results. The species shows adaptability in severely degraded soil as is found in the Caceres project area. The abundant foliage falling to the ground introduces a great amount of biomass and organic matter into the soil, enriching the undergrowth and producing a micro-climate in which a great number of animal and plant species can thrive.

Picture 15: Ripping in the direction of the slope; note the lay out and depth of the furrows

<u>Maintenance and handling of plantations</u>

During the growth and development stage, clearing, maintenance, fertilization, pruning, thinning, and plant sanitary controls are done. Special emphasis is put on clearing because a great part of the future development depends on this task. Proper clearing reduces disease and plague attacks and acts as a method of fire control.

The aggressive weeds inhibit the growth of trees because they form a dense blanket over the ground. For example, the grass *Hyparrenia ruffa* has been known to invade entire areas after only 45 days of having been cut. Its growth is so exorbitant that its stems are double in length than those of the plantation plants.

In general, grasses that show exaggerated growth generate a microclimate that is unbearable for fauna, insects and other plants. In some of these grass plants sticky substances, fuzzy itching hairs and various dusts abound. The density of its rough and cutting leaves increases the temperature within the thicket, creating an environment of vapor or "fever." Some of them entangle and climb up the trees; they also consume a lot of nutrients.

In the first year after planting, clearing is done three, four or in some cases more times. In this way proliferation is minimal and weeds do not interfere with or cause the death of the planted species. When the clearings are prepared, sizing and clearing of contours must take place under supervision. After the seedlings become lignified shrub and surpass the weeds, the maintenance of clearings becomes less critical.

Pruning: Pruning consists of removing branches from the trees with the object of producing a final wood product of high quality without knots. Knots are the most common flaw in wood used for lumber. The pruning process increases the quality of the wood. In addition, pruning facilitates access to the plantation. Pruning is typically done at the end of the dry season. This is because the cut areas dry quickly and form smaller scars during the dry season. Relatedly, during the dry season there is less risk of plagues or diseases; it is also the time of the year when the trees have less foliage, making pruning easier in terms of logistics. It is foreseen that pruning is done in years 4 and 15 respectively.

Thinning: Thinning removes some of the smaller trees in order to concentrate the growth in the larger and healthier trees. This includes both the thinning of sick, bent, or otherwise undesirable trees as well as the removal of some straight, healthy trees that can be used for lumber processing. It is foreseen that the first thinning takes place in year 7, the second in year 12, and the third (and final) in year 20.

The scheduled final density is 375 trees per hectare. Since the initial density is 1,111 trees per hectare, the first thinning in year 7 will consist of the removal of 450 trees per hectare. The second will remove around 275 trees per hectare in order to reach a final density of 375.

Harvest: It is foreseen that the final harvest of native species is carried out in year 20. After thinning in years 7 and 12, at the time of the harvest there should be 375 trees per hectare. After the harvest the wood is sent to be milled and sold.

Fire protection: As outlined in the management plans, 4 meter firebreaks are maintained free of vegetation at strategic areas around all plantations. In general these firebreaks are located every 500m, from north to south and east to west. This varies slightly because the project actively makes use of the natural geography to improve fire-fighting ability. These procedures include using roads and rivers as firebreaks, and the high points as lookout stations. Furthermore, in Cáceres, the plantation is extremely close to the Cauca River. Thus, its water is available as a resource in case of a fire. In Arauca the plantations are dotted with estuaries which also provide a source of water for fire-fighting and act as natural firebreaks.

Related to the above, local community members are trained in fire-fighting techniques so that the entire community can mobilize in the event of a fire. The instruments used for fire-fighting include fire extinguishers and small motorized water pumps. Asorpar Ltd. has carried out extensive capacity building on fire awareness, how to prevent fires, and how to fight fires. These seminars typically focus on management of waste, maintenance of roads and firebreaks, the use of fire-fighting equipment, and the protocol to be followed in the event of a fire.

Collectively, these measures proved to be successful when a dry thunder storm caused a fire on the Macanilla plantation near Cravo Norte. The entire local community worked together to successfully put out the fire.

Safety: All workers on the plantations receive comprehensive training in the techniques of site preparation in the nursery, planting and maintenance. All field sites are provides with first aid kits, including antivenin (aka. antivenom) to treat venomous snake bites.

<u>Choice of species[64] / Species selected for the plantation in Cáceres and Cravo Norte</u>
Forest species for planting in the project area were selected according to the following factors: adaptability, volumetric efficiency, ecological and cultural value, availability of seeds, and resistance to pests and diseases. The final selection of the forest species was based on practical experience of Asorpar Ltd. Since 2002, Asorpar Ltd. has been reforesting land with 18 different species in Cáceres[65]:

- *Acacia mangium*
- *Cariniana pyriformis*
- *Cedrela odorata*
- *Cespedesia macrophylla*
- *Cordia gerascanthus*
- *Croton smithianus*
- *Didimopanax morototoni*
- *Dipteryx oleifera*
- *Enterolobium cyclocarpum*
- *Gmelina arborea*
- *Hevea sp*
- *Hymenaea courbaril*
- *Ochroma pyramidale*
- *Pochota quinata*
- *Schyzolobium parahyba*
- *Swietenia macrophylla*
- *Tabebuia rosea*
- *Tapirira guianensis*

Additionally, in Cravo Norte, the following species are planted:

- *Calophyllum mariae*
- *Copaifera pubiflora*
- *Cordia alliodora*
- *Cupania sp*
- *Guadua angustifolia*
- *Nectandra sp*

[64] Análisis de Elegibilidad de Tierras y Escenarios de Carbono en el Marco del Proyecto: "Restauración de Áreas Degradadas en los Nodos Ganaderos de Cáceres y Cravo Norte, Colombia", Carbono & Bosques, 2007.
[65] Considerable more native tree species can be found within the plantations, since the micro-climate condition created by the reforestation project allow natural regeneration from the already planted trees, the Gallery forest in Cravo Norte or form the selective trees that have been in the project area before the project start.

- *Pithecellobium sp*
- *Pseudosamanea guachepele*
- *Terminalia ivorensis*

1.10. Compliance with relevant local laws and regulations related to the project:

This evaluation of compliance with relevant local laws and regulations was compiled with the support of the attorney Juan Guillermo Molina. Juan Guillermo Molina is a partner in Asorpar Ltd. and an attorney with over 15 years experience with land-use law in Colombia. In addition to Mr. Molina's expertise, the registration of the projects with the Forestry Incentive Certificate (CIF) also certifies compliance with all local laws and regulations because the CIF is a government program that requires demonstrated compliance with all local laws.

The host country is the Republic of Colombia, which has ratified the Kyoto Protocol through the law 629 adopted on December 27th, 2000.

In order to consolidate the national forestry policy and as starting-up strategy, the government approved, in December 2000, the National Plan for Forestry Development (PNDF, for its initials in Spanish). The ultimate purpose of PNDF is to provide an impetus for stimulating action in the forestry sector.

The law 1021 from 2006 (General Forestry Law) adopts measures to encourage the development of plantation forestry. Forestry activities shall be able to compete on equal terms with other productive sectors, even within the international market.

The Forestry Incentive Certificate (CIF, for its initials in Spanish) was created by means of law 139 in 1994 and regulated by decree 1824 in 1994. The CIF is a direct contribution in cash made by the government so as to cover part of the establishment and maintenance expenses to be paid by those carrying out new commercial forestry plantation activities. Forestry plantation activities refer to the planting of one or more tree species in areas suitable for forest and with a commercial or production purpose.[66] The entire project applies for the CIF, and is therefore in line with all legal requirements needed in Colombia.

1.11. Identification of risks that may substantially affect the project's GHG emission reductions or removal enhancements:

The project owner and the technical manager have significant experience in the administration and practical implementation of reforestation plantations. Around two thirds of the land is already purchased, and the continuation of the planting is secured in the medium term. However, the mid- and long-term financial viability of the project depends on the carbon revenue stream.

To reduce the loss of permanence, the project will establish a permanent plantation on lands owned by the project developers and shareholders. Plantations will be managed

[66] Republic of Colombia, Ministry of Agriculture and Rural Development, resolution number 2009

by a team of experienced foresters. The contracts between Asorpar Ltd. and various investors envision reforestation as the only objective for land developement.

Fire

Beginning in 2009 all plantations younger than five years are additionally protected by an insurance policy that covers losses if the project is affected by fire. These are annual insurance policies that are renewed on a yearly basis for five years per plantation. Once the forest plantations reach five years of age, the risk of forest fire drops significantly. To continue to insure all plantations after the first five years of plantation establishment would be too expensive to justify based on the reduced forest fire risk.

Asorpar counts with one of the first insurance policies that cover fire losses in Colombia. Before 2009 it has not been possible to contract such insurance in Colombia. The insurance applies for the project area located in Cravo Norte. In Cáceres no fire insurance was contracted since the last planting activities have been realized in 2007 and plantations are believed to have a very limited fire risk in their advanced growth stage. Fire risk in Cáceres is low, because there is some considerable rainfall throughout the year. Furthermore slash and burn practices for agricultural reasons are not common practice in this area. Since the project start date there have been no problems with forest fires. Diversity of species planted reduces risk.

The climatic situation in Cravo Norte differs from the conditions found in Cáceres. Cravo Norte has a longer dry season. Therefore Asorpar is working intensively on the following three different strategies to lower forest fire risk:

1) Training and involvement of neighboring communities and the authorities shall motivate their participation in the process of fire control.
2) The project promotes the use of fire-resistant tree species. After a fire occurred in 2010 it was recognized that some species are almost completely immune to fire.
3) Convince investors about the importance of spending more money on the extension of the fire insurance.

As documented in the management plans, the plantation has been designed to minimize the risk of loss of permanence. Firebreaks have been created, a fire-fighting strategy has been developed, and outreach and fire-reduction strategies have been and continue to be carried out with landowners from surrounding properties to reduce the use and threat of fire.

Pest and disease

Pest and disease infestations will be managed and monitored based on the approach of the plan for control of pests and diseases. Asorpar's decision making about which species to use is driven by the need to protect against infestations of plagues and diseases. Asorpar plantations are modelled after native forests and the most important principal extracted from that model is diversity as a preventative measure. Different species attract or repel different insects and bacteria and thus a monoculture plantation is much more susceptible to being wiped out by a particular plague or disease. Asorpar uses a wide variety of native species and this diversity is excellent protection against plagues and diseases. Asorpar has never had one of its plantations devastated by plagues or diseases.

Political and social circumstances

Both project areas are under the influence of illegal armed forces - the Guerrilla and Paramilitaries. Since the full implementation of the National Democratic Safety Policy started, the Colombian government has recuperated some state and military control over the municipalities of Cáceres and Cravo Norte in which the plantations are being developed. This is creating better conditions to reactivate the socio-economic dynamics of these zones. The project shall form a part of these new socio-economic dynamics initiated in the area by the Colombian state, and is envisioned as a part of the Asorpar's guiding principle of "economic support to depressed areas through the generation of new sustainable and financially viable economic activities *in situ*." Specifically, the Asorpar project creates stable, long-term employment for community members.

Colombia divides governmental power into its legislatiation, jurisdiction, and executive. The country has a Civil Code with over a thousand articles and more than a thousand pages. Further the country possesses a Labor Code, Commercial Code, Penal Code, Administratiion Code, Tax Code and a Constitution. Colombia has a territorial division, and is subdivided into 32 Departments, which are subdivided into 1,029 Municipalities. Each local authority or municipal department has officers representing the three branches of governance.

Cravo Norte and Caceres have municipal councils that represent the legislative power (in charge of designing laws). They are responsible to determine whether the laws have been respected or violated. Regarding the executive branch, mayors are in charge to enforce the law, with the support of police inspectors and the regular police forces. Mayors, judges, members of assemblies and councils are obliged to enforce the law based on their constitutional mandate. If a public official violates existing law or abuses his position, other members of the public body are to make oblige him to comply with the law and correct his action. The law stipulates a set of measures that can be taken. These measures consist of penalties, fines, imprisonment and deposition. If citizens violate existing law, the mayor assures law enforcement and the restoration of order through the regular police force and police inspectors.

Colombia has an Army subordinated to the President of the Republic and the Minister of Defense. The Army has the task to defend the country against internal and external aggression. The security forces (Army and Police) ensure that citizens and authorities comply with existing Law in Colombia. In Colombia any politician (including the President and Senators) and any governmental official is judged and condemned when they are violating existing law. In the last four years, there have been more than 50 Congressmen condemned by the Supreme Court of Justice due to their involvement in paramilitary and drug-trafficking activities.[67]

In 2002, Alvaro Uribe was elected as President. The President of Colombia designed and implemented a national security strategy called the "Democratic Security and Defence Policy"[68]. This strategy includes not only military measures but also the legal strategy to combat terrorist organizations and drug cartels. Further this strategy embraces and encourages the coordination among all institutions within the Colombian Government. Five strategic objectives are synchronized to reach the general aim, which is the strengthening of law enforcement throughout the country and is accompanied by reinforcing democratic authority. The strategy's objectives are

[67] Interview note realized with the attorney Juan Guillermo Molina. His knowledge of the legal, military and political system was acquired by studying the Colombian Law.

[68] http://www.colombiaemb.nl/es/seguridad/resultados_politica_usa_diciembre1.pdf

as follows: consolidation of State control throughout Colombia, protection of the population, elimination of the illegal drug trade in Colombia, maintenance of a deterrent capability, and transparent and efficient management of governmental resources.[69] These five objectives are designed to specifically counter the widely active paramilitary and guerilla organizations in the country, the drug-traffic problem, and the crimes against the civilian population. Since 2002, Colombia has witnessed a dramatic improvement in its security environment.[70,71, 72]

In 2007 a governmental agency started to analyze the progress made by the Colombian State regarding territorial control and protection of vulnerable communities. The results have been presented in the “National Plan of Consolidation”.[73] The document serves as an essential step to guarantee the rights of citizens, as well as a prerequisite for promoting sustainable development. The policy of democratic security and defence (from 2002 to 2006) proved a successful strategy in the fight against illegal armed groups and drug trafficking activities, as well as the recovery of territorial control.
During the last year the government has taken important steps to fight against illegal armed groups and drug trafficking activities. The police performed simultaneous actions in different departments[74], among others in Antioquia, to avoid any movement of criminals. A large number of criminals have been captured and judicialized.[75]
The “Citizen Security plans” are part of the initatives of the “Regional Coordination Centre” of Bajo Cauca, where the project region Cáceres is located. The plans have been presented by the end of 2010 and are focused on preventing violence, promoting the culture of legality, coexistence and regional development.[76]
Up to 2009 more than 106,000 million Colombian pesos (60 M USD) have been invested in social actions in the department of Arauca. Families affected by displacement have received assistance through the “Emergency Humanitarian Assistance” such as the improvement of income generation or living conditions. Furthermore infrastructure, land protection, food security have been supported, as well as the eradication of illicit crops. In total 25 000 households have been involved within the seven departments of the municipality.[77]

Back in 2002, Colombia was a troubles country. Government forces were waging South America's longest-running armed conflict, some 40 years of fighting against left-wing insurgents and right-wing paramilitaries. Fueled by the drug cartels, the violence had escalated dramatically in the 1990s. Since 2003, homicides are down by 30 percent, kidnappings are down by 80 percent, and terrorist attacks went from 1,257 in 2003 to 347 by the end of 2008. Today, foreign direct investment jumped from $2

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[69] Presidency of Republic, Ministry of Defense, Democratic Security and Defense Policy, Bogota, 2003, p. 31
[70] http://www.edc.ca/english/docs/gcolombia_e.pdf
[71] http://www.vanguardia.com/historico/59703-presidente-uribe-defiende-la-seguridad-democratica-y-pide-darle-continuidad
[72] http://www.larepublica.com.uy/mundo/375203-uribe-defiende-la-politica-de-seguridad-democratica
[73] http://www.accionsocial.gov.co/documentos/Reporte_Eject_PNC_2010_Vf.pdf
[74] Antioquia, Sucre, Norte de Santander, Cesar, Casanare, Cauca, Bolívar, with special emphasis on the following three subregions: Bajo Cauca, Magdalena Medio and Urabá.
[75] http://www.acnur.org/biblioteca/pdf/7367.pdf
[76] http://www.elcolombiano.com/BancoConocimiento/P/planes_de_convivencia_en_bajo_cauca/planes_de_convivencia_en_bajo_cauca.asp
[77] http://www.competitividadyregiones.gov.co/regiones/publicaciones/hechos/arauca/CCG236_arauca(arauca).pdf

billion to between $8 and $10 billion a year, and the economy grew by more than 7 percent in 2007.[78]

Employment

Based on the company's experience, the full reforestation cycle of the ~11,000 ha will provide the opportunity to create a considerable number of employment opportunities that are directly related to the plantation management. These jobs are primarily in three different areas: plantation establishment, maintenance and harvesting. The establishment work happens in the first year of planting. The maintenance happens throughout the life of the plantation but spikes in years of pruning and thinning. Finally, the harvest takes place after the 20 year rotation period and then the following year a new plantation is re-established. However, because the start dates of the different project areas (and parcels) are staggered by several years, this cycle of employment creation is evened out.

The estimate of total job creation for the life of the project is based on a 283[79] day work year. The job creation on reforestation plantations implies a certain degree of seasonality, and ebb and flow based on the stages of the different project areas. This is because the planting for the different project areas is staggered, and because different stages require different amounts of work. Over the 30 years of the project the total jobs created per year fluctuate significantly. Therefore, Asorpar will rely on a core group of field staff and handle the peaks of work with additional hired labor. Over the project cycle it is assumed that the following average work forces (laborer per year) will be needed for the different areas: 85 (low=6 / high=265) for the plantation establishment; 223 (low=2 / high=538) for the plantation maintenance; and 767[80] (low=184 / high=2980) for the harvest activities. In addition to the positions described above, the project also contributes to the employment of 2 to 3 forestry engineers based in the central office in Medellín that work as support for Technical Manager Luis Gonzalo Moscoso.

Non-permanence risk analysis

The non-permanence risk analysis is based on the "Tool for AFOLU Non-Permanence Risk Analysis and Buffer Determination" of the Voluntary Carbon Standard. Based on both the general risk applicable to all project types and the project specific risk analysis performed below, the project falls into the "medium" risk category. In the case of ARR projects under the VCS, the buffer requirement for a project with "medium" risk category rating is 20 – 40% of the credits. In terms of "general" risks that apply to all AFOLU projects, three quarters of the risk factors have a low risk rating (nine risk factors fall in the low risk category and two factors are rated as medium risk). This is also the case for the project specific risks, where the majority of the risk factors have a low risk rating (seven risk factors apply for the low risk category and two factors are rated as medium risk). For these reasons, a 30% buffer is applied to the project.

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[78] http://www.atkearney.com/index.php/Publications/the-colombian-cleanup-eaxii-1.html?q=colombia

[79] The employment of one person for one year is based on a 365 day year with 52 Sundays, 15 Holidays and 15 Vacation days to total 283 man days per worker per year.

[80] This number just refers to the last 10 years of the 30 year project cycle since harvest occurs from year 20 onwards.

Table 3: Risk factors applicable to all project types

Risk Factor	Risk Rating	Comment
Project risk		
Risk of unclear land tenure and potential for disputes	Low	Please refer to the information provided under "Ownership type and user rights" in the Table 4 below.
Risk of financial failure	Low	Please refer to the information provided under "Financial capacity" in the Table 5 below.
Risk of technical failure	Medium	Please refer to the information provided under "Technical capability" in the Table 6 below.
Risk of management failure	Low	Please refer to the information provided under "Management capacity of project developer" in the Table 7 below below.
Economic risk		
Risk of rising land opportunity costs that cause reversal of sequestration and/or protection	Low	There are several factors that mitigate the risk of rising land opportunity costs that could cause the reversal of sequestration by the project: The land where the project will take place is private property. The plantation of native species requires a significant upfront investment, before a return on investment can be expected from timber harvest. The investors are unlikely to forfeit long-term financial returns from the plantation as they have invested their own capital in the project. The contracts between Asorpar Ltd. and various investors envision reforestation as the only objective for the development of the land. Asorpar's contract with the Colombian ministry of environment to secure the support of the Forestry Incentive Certificate (CIF) [81] makes the company responsible for preventing illegal mining activities or cattle farming. Based on the obligations of this contract any activity that is not related to commercial forestry plantation - such as gold mining or cattle farming – is illegal. For further detail, please refer to section 1.8 and to the information provided under "Future/current opportunity costs" in the Table 8 below.
Regulatory and social risk		
Risk of political instability	Low	The project is not overly vulnerable to political instability, mainly given the current political circumstances in Colombia. In the past several years, Colombia has experienced an economic, social and security transformation. With an increasing number of bilateral trade agreements, as well as stable and strong economic growth rates, the country has positioned itself as an attractive destination for foreign direct investment. It is assumed, that Colombian policies are

[81] For further explanaitions of the CIF please refer to section 1.10

		responsible for economic growth and a reduction in paramilitary violence. For more detail please refer to the elaborated information above (1.11: "Political and social circumstances").
Risk of social instability	Medium	Both project areas were under the influence of illegal armed forces - the Guerrilla and Paramilitaries. Since the full implementation of the National Democratic Safety Policy started, the Colombian government has recuperated some (in Caceres) / complete (Cravo Norte) state and military control over the municipalities of Cáceres and Cravo Norte in which the plantations are being developed. This is creating better conditions to reactivate the socio-economic dynamics of these zones. The project shall form a part of these new socio-economic dynamics initiated in the area by the Colombian state, and is envisioned as a part of the Asorpar's guiding principle of "economic support to depressed areas through the generation of new sustainable and financially viable economic activities *in situ*." Specifically, the Asorpar project creates stable, long-term employment for community members. For more detail please refer to the elaborated information above (1.11: "Political and social circumstances").
Natural disturbance risk		
Risk of devastating fire	Low	Please refer to the information provided under "Risk of fire" in the Table 9 below, and the elaborated information above (1.11 "Fire").
Risk of pest and disease attacks	Low	Please refer to the paragraph on "Pest and disease" above (1.11).
Risk of extreme weather events (e.g. floods, drought, winds)	Low	Cáceres: According to the *Instituto Geográfico Agustín Codazzi* (IGAC) of Colombia, and based on the historic data recorded for the period 1926 to 1999 and compiled by *Departamento Administrativo de Prevención, Atención y Recuperación de Desastres* (DAPARD) and *Instituto Colombiano de Geología y Minería* (Ingeominas)[82,83,84], the Municipality of Cáceres has an intermediate risk of being threatened by floods; 14 flooding events have been recorded during 1926 and 1999. In general the Andean Departments, Antioquia is one of them, have a certain associated risk level of sudden and slow floods but it has to be taken into account that these events are more common closer to the urban areas of the Municipality [85]. The Municipality of Cáceres is therefore threatened by an intermediate risk of extreme

[82] Instituto Geográfico Agustín Codazzi; Instituto Para El Desarrollo de Antioquia. 2007. Antioquia. Características geográficas / El Instituto. Bogotá: Imprenta Nacional de Colombia. 320 p., ils. Available at: http://www.antioquia.gov.co/antioquia-v1/organismos/planeacion/descargas/antioquia_caracteristicas_geograficas.pdf

[83] Escobar, G.d., Universidad Nacional de Colombia sede Medellín. 2007. Aspectos Geofísicos y Amenazas Naturales en los Andes de Colombia. Available at: http://www.galeon.com/geomecanica/andes-col.pdf

[84] Gobernación de Antioquia. 2009. Perfil de la Subregión del Bajo Cauca. Available at: http://www.antioquia.gov.co/antioquia-v1/organismos/planeacion/descargas/perfiles/perfilsubregional_bajo%20cauca.pdf

[85] Escobar, G.d., Universidad Nacional de Colombia sede Medellín. 2007. Aspectos Geofísicos y Amenazas Naturales en los Andes de Colombia. Available at: http://www.galeon.com/geomecanica/andes-col.pdf

		weather events (heavy rainfalls). However the risk for the project area is rather low to intermediate since it is not at the urban area of the Municipality. Cravo Norte: The Colombian Disaster Prevention System labelled areas within the country with risk levels of regional environmental threats, such as fires and floods.[86] According to that system Cravo Norte and thus the Department of Arauca is not located within a zone classified as being threatened by floods. Although the Department Arauca belongs to a region of Colombia that is threaten by floods and the second rainy season of the year 2010 was one of the heaviest ever registered in Colombia and provoked floods in six Municipalities of the Department of Arauca, the Municipality of Cravo Norte had not been affect[87,88]. This scenario proves that despite the precipitation events in the country the area considered within the project boundary of Cravo Norte presents a low risk of being threatened by floods. Conclusion: Since the project area of Cáseres presents only around 10% of the overall project area it is suggested to evaluate this risk variable with a low risk level.
Geological risk (e.g. volcanoes, earthquakes, landslides)	Low	Cáceres: According to the *Instituto Geográfico Agustín Codazi* (IGAC) of Colombia, and based on the historic data recorded for the period 1926 to 1999 and compiled by *Departamento Administrativo de Prevención, Atención y Recuperación de Desastres* (DAPARD) and *Instituto Colombiano de Geología y Minería* (Ingeominas)[89,90,91], the Municipality of Cáceres has a low risk of being threatened by landslides; five events have been recorded. Regarding seismic activities in the area an intermediate risk is recorded. Hence, the Municipality of Cáceres presents a low to intermediate risk in relation to threats of considered natural phenomena. Cravo Norte: The Colombian Disaster Prevention System

86 Dirección de Prevención y Atención de Desastres, Colombia. Mapas de Amenazas. Amenazas Regionales. Available at: http://www.sigpad.gov.co/sigpad/paginas_detalle.aspx?idp=213

87 United Nations for the Coordination of Humanitarian Affairs (OCHA Colombia). 2010. Inundaciones en Arauca. Informe de situación Nro 1. Available at: http://reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/VVOS-87DQ3F-informe_completo.pdf/$File/informe_completo.pdf

88 United Nations for the Coordination of Humanitarian Affairs (OCHA Colombia). 2010. Inundaciones en Arauca. Informe de situación Nro 2. Available at: http://reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/VVOS-87DQ3F-informe_completo.pdf/$File/informe_completo.pdf

89 IInstituto Geográfico Agustín Codazzi; Instituto Para El Desarrollo de Antioquia. 2007. Antioquia. Características geográficas / El Instituto. Bogotá: Imprenta Nacional de Colombia. 320 p., ils. Available at: http://www.antioquia.gov.co/antioquiav1/organismos/planeacion/descargas/antioquia_caracteristicas_geograficas.pdf

90 Escobar, G.d., Universidad Nacional de Colombia sede Medellín. 2007. Aspectos Geofísicos y Amenazas Naturales en los Andes de Colombia. Available at: http://www.galeon.com/geomecanica/andes-col.pdf

91 Gobernación de Antioquia. 2009. Perfil de la Subregión del Bajo Cauca. Available at: http://www.antioquia.gov.co/antioquia v1/organismos/planeacion/descargas/perfiles/perfilsubregional_bajo%20cauca.pdf

		labelled areas within the country with risk levels of regional environmental threats, such as volcanic activities. [92] According to that system Cravo Norte and thus the Department of Arauca is not located within a zone classified as being risky. This proves that the area considered within the project boundary of Cravo Norte presents a low risk. Conclusion: Since the project area of Cáseres presents only around 10% of the overall project area it is suggested to assign a low risk level to this variable.

Table 4: Risk factors applicable to the Asorpar reforestation project

Risk Factor	Risk Rating	Comment
Project longevity/ Commitment period		
Long-term commitment (i.e., many decades or unlimited) with no harvesting	Low	
Long-term commitment with no harvesting in politically unstable countries	Medium	
Long-term commitment with harvesting	Medium	The project specific case of Asorpar is not completely reflected in the listed commitment periods established by the VCS. The plantation is heterogeneous in terms of species, natural regeneration [93] and therefore age. This is the reason why the harvest will be done in a selective way, no clear-cutting will occur. Trees that have not reached their harvest volume remain on side and gaps are replanted. Therefore there will always remain trees on site for more than 30 years, although harvest cycles could vary. This large-scale plantation project, with more than 25 native species planted, is among the first of its kind in Colombia. Native species are mixed in the same area - not common practice in Colombia. No knowledge exist on native mixed tree plantations, consequently there is no experience on rotation periods. However, it is assumed that the rotation period is more than 25 years. Beside of the CIF, Colombia offers legal stability contracts to ensure forest investments. These

[92] Dirección de Prevención y Atención de Desastres, Colombia. Mapas de Amenazas. Amenazas Regionales. Available at: http://www.sigpad.gov.co/sigpad/paginas_detalle.aspx?idp=213

[93] The micro-climate condition created by the reforestation project allow natural regeneration from the already planted trees, the Gallery forest in Cravo Norte or form the selective trees that have been in the project area before the project start.

[3]Ministerio de Agricultura y Desarrollo Rural. 2009. Sector Forestal. Invierta en Colombia: http://www.inviertaencolombia.com.co/Adjuntos/089_Sector%20Forestal%202009-08-13.pdf

		contracts have been established to secure stable investment for national and international investments in Colombia. The duration of the legal stability contracts are 3-20 years.[94] Lots of projects of Asorpar's size apply for this contract to secure legal stability and at the same time to apply to get the CIF. Therefore financial calculations for reforestation projects are based on periods of maximum 20 years, a rotation period that is used as common practice in Colombia. This is why the rotation period identified for Asorpar within the forest management plans - that have been developed in order to apply for the CIF - is 20 years. The general lack of knowledge of native species implies uncertainty for the Colombian ministry of environment. Therefore it was necessary to present at least a common rotation period of 20 years in order to get the CIF. Furthermore, climatic conditions in Colombia imply that less time is needed to reach certain growth and productivity of tree species. 20 years comply therefore as a long-term commitment period, considering common rotation periods of common / exotic species of about 8 – 20 years.[95] The risk of anticipated logging and that the project lifetime would be less is low. Asorpar's contract with the Ministry of Agriculture and Rural Development to get the support of the CIF makes them responsible to prevent activities that are not related to commercial forestry plantation. Furthermore the participation contracts between Asorpar and investors only permit reforestation activities. In addition, Asorpar is a company devoted exclusively to forestry activities.
Medium-term commitment with harvesting	High	
Medium-term commitment (i.e., a few decades) with no harvesting	High	
Short-term commitment with or without harvesting	Fail	
Ownership type and user rights		
Established NGO or conservation agency owner; or owner-operated private land	Low	Asorpar Ltd. (Asesorías en Ornato Paisajismo y Reforestación, Ltda.) is a private company. The legal representative is Juan Guillermo Molina, the technical manager is Luis Gonzalo Moscoso.

[95] Ministerio de Agricultura y Desarrollo Rural. 2009. Sector Forestal. Invierta en Colombia, page 9: http://www.inviertaencolombia.com.co/Adjuntos/089_Sector%20Forestal%202009-08-13.pdf

		(see section **Error! Reference source not found.**) Partnership contracts between Asorpar and investors were signed and revenues from carbon credits will be distributed equally among the two parties; each group will receive 50%. The investor's stake in the initial investment totals up to 70%. Land is purchased and forest plantations are established from the investor's financial participation. While the group of investors represents the major share-holder, Asorpar is assuming 30% of the costs and is in charge of reforesting the purchased land. Once the project will receive the financial support from the CIF or carbon credits revenues, Asorpar will reimburse some of the initial costs to the group of investors. The ownership structure of the land and reforested trees will change with the reimbursement and both parts will hold an equitable share of 50%.
Rented or tenant-operated land	Medium	
Clear land tenure but disputed land use rights	High	
Uncertain tenure but with established user rights	High	
Uncertain land tenure and no established user rights	Fail	
Technical capability		
Proven technologies and ready access to relevant expertise	Low	
Technologies proven to be effective in other regions under similar soil and climate conditions, but lacking local experimental results and having limited access to relevant expertise	Medium	A project of this size with native species is among first of its kind in Colombia. Common practice is the plantation of Pinus. Furthermore Eucalyptus, Tectona, Cypress, Gmelina and Ceiba are planted (see 2.5, Step 3: Barrier Analysis; Technological Barrier). Natural forests serve as the models of the reforestation plantations. However, to test the planting strategy, forest species that were considered for planting in the project area were selected according to the following factors: adaptability, volumetric efficiency, ecological and cultural value, availability of seeds and resistance to pests and diseases. Furthermore the substantial previous project experience of Asorpar and Luis Gonzalo Moscoso is a key factor of the project (please refer to "Management capacity of project developer" for further details). The risk of Technical capability is therefore medium.
Financial capacity		

Financial backing from established financial institutions, NGOs and/or Governments	Low	Financing will be secured due to the sale of the carbon credits, even if there will be irregularities of the payments from the CIF.[96] The participation contracts that are signed between Asorpar and the investors elaborate on two key aspects of their contractual arrangement: revenues from carbon credits and from the CIF. These revenue streams provide a safeguard to investors to participate in the project and take considerable financial risk. The investor's stake in the initial investment totals up to 70%. Asorpar is assuming 30% of the costs and is in charge of reforesting the purchased land. Once the project receives the financial support from the CIF, Asorpar will reimburse some of the initial costs to the group of investors. Revenues from carbon credits will be distributed equally among the two parties; each group will receive 50%.
Long-term project funding not secured	Medium	
Management capacity of project developer		
Substantial previous project experience (≥ 5 projects) with on-site management team	Low	Reforestation is the core business of Asorpar. Asorpar Ltd. employs 4 engineers and two technicians who support the project. Also a group of over 20 indigenous people is working with them for 10 years; they are working as crew leaders for local employees. Asorpar has been involved in about 150 forest-related project activities and two carbon related projects in Colombia. Based on Asorpar's track record and experience, the company received a "certificate of registration" by the Colombian Chamber of Commerce. This certificate confirms Asorpar's credibility as a contract partner. The technical manager, partner and director, Luis Gonzalo Moscoso, has worked in forestry, environmental and landscaping area for a long time. He has the reputation of having designed and implemented outstanding projects, due to his gained knowledge in environmental and forestry management. He wrote the book "Reforestation, a natural process" in relation to the project in Cáceres. In this book he explains his idea of a forest management development that tries to balance human activities and nature. The book elaborates on the use of timber and non timber products, the technological adaptation, education

[96] Irregulataries of the payments from the CIF can cause problems of liquidity, because the guarantee on loans from investors is the payment from the CIF. For instance, the CIF was supposed to make a payment in January 2010 but failed to do so because they are prohibited by law from making any payments during electoral seasons. Because of this the payment will be delayed until June 2010 (or July if there is a runoff).

		and research that lead to the minimization and good use of residues, the recovery of degraded soils and the integrated water management. The book did win the EXPOFINCA national price (best book on agricultural, farming sector, forestry modality 2005). Swiss Carbon Value is responsible for the complete carbon asset development of the project. Swiss Carbon Value's forest carbon team specializes in reforestation, REDD/REDD+ and agroforestry projects, forest carbon accounting and satellite data analysis. The forest team has successfully managed - or is in the process to manage - about 10 carbon related projects. Swiss Carbon Value also has more than 20 registered and operating CDM, VCS, Gold Standard and Social Carbon projects, and a pipeline of more than 120 projects.
Limited project experience (<5 projects) with on-site management team	Medium	
Limited project experience (<5 projects) without on-site management team	High	
Future income		
Appropriate management plan, and financial analysis demonstrates that likely income stream(s) will finance future management activities (e.g., carbon finance to be used for project management, tending operations, etc.)	Low	Yes, in place. Financial analysis has been provided to the DOE.
Future costs and revenue stream(s) not documented	High	
Future/current opportunity costs		
Alternative land uses are unlikely to become attractive in the future	Low	The project land is owned by Asorpar Ltd. and investors. Partnership contracts are signed. The baseline of the project is extensive livestock farming and in Caceres in some areas gold mining. Intensive livestock farming would be generally more attractive. But it can be assumed that due to the problems probably raised by the guerrilla and the paramilitary the attractiveness of this alternative decreases. The area is under the influence of the illegal armed forces such as the guerrillas and paramilitaries. The proposed locations are considered as an internal conflict region of military intervention, so that labor options and economic dynamics in general have been very

		depressed and deeply impacted the social life of the inhabitants (see 2.5). For further detail please refer to the information provided under "Economic risk" in the Table 10 above.
Project is competing with other land uses likely to become more attractive in the future	High	
Endorsement of project or land-use activity by local population and local/ National political establishment		
Endorsement given and not likely to change in the future	Low	The project is supported by the government via subsidies obtained by the CIF. LSC in both project-sites has been done to explain locals the project, the outcome was very positive, overall acceptance reached. (see section 6). Furthermore a letter of no objections has been signed by Colombian DNA in 2007 (Ministerio de Ambiente, Vivienda, y Desarrollo Territorial)
Endorsement given but may be subject to change in the future	Medium	
No endorsement given	High	
Risk of Fire		
Low to medium fire return interval (>50 years) with best-practice fire prevention measures	Very Low	
Low to medium fire return interval (>50 years) without fire prevention measures	Low	
High fire return interval (<50 years) with best-practice fire prevention measures such as fuel removal, fire breaks, fire towers and fire fighting equipment	Low	Asorpar count with best-practice fire prevention measures such as: firebrakes, fire-resistant tree species and training and involvement of neighboring communities and the authorities on fire-control. Furthermore, in 2009 all plantations younger than five years are additionally protected by an insurance policy that covers losses if the project is affected by fire. Please refer to the paragraph on "Fire" above (1.11) and to section 1.9 "Maintenance and handling of plantations, Fire protection".
High fire return interval (<50 years) with adequate fire prevention measures in place	Medium	
High fire return interval (<50 years) with no significant fire prevention measures in place	High	

Three quarters of all risk factors have a low risk rating; the ratio is 16 to 4 (see Table 5 below).

Table 5: Summary of low, medium, high risk ratings

Total "Risk factors applicable to all project types"	
Risk rating: low	9
Risk rating: medium	2
Risk rating: high	-
Total "Risk factors applicable to the Asorpar reforestation project"	
Risk rating: low	7
Risk rating: medium	2
Risk rating: high	-
Total: "Risk factors applicable to all project types" & "Risk factors applicable to the Asorpar reforestation project"	
Risk rating: low	16
Risk rating: medium	4
Risk rating: high	-

Table 6 below provides the default buffer withholding ranges for ARR projects associated with low, medium and high non-permanence risk classes. Based on the guidance on risk factors the project falls into the medium risk class. Because of the fact that the risk is mainly classified as low, the project falls into the 30% buffer credits class.

Table 6: Default buffer withholding percentages for ARR projects

ARR Risk Class	Buffer Range
High	40-60%
Medium	20-**30**-40%
Low	10-20%

1.12. Demonstration to confirm that the project was not implemented to create GHG emissions primarily for the purpose of its subsequent removal or destruction.

The project activity is establishing a permanent plantation. The plantation is heterogeneous in terms of species, natural regeneration[97] and therefore age. This is the reason why the harvest will be done in a selective way, no clear-cutting will occur. Trees that have not reached their harvest volume remain on side and gaps are replanted. Therefore there will always remain trees on site for more than 30 years, although harvest cycles could vary.

1.13. Demonstration that the project has not created another form of environmental credit (for example renewable energy certificates).

[97] The micro-climate condition created by the reforestation project allow natural regeneration from the already planted trees, the Gallery forest in Cravo Norte or form the selective trees that have been in the project area before the project start.

[3]Ministerio de Agricultura y Desarrollo Rural. 2009. Sector Forestal. Invierta en Colombia: http://www.inviertaencolombia.com.co/Adjuntos/089_Sector%20Forestal%202009-08-13.pdf

The project is not seeking to generate any other environmental credits other than Voluntary Carbon Units.

1.14. Project rejected under other GHG programs (if applicable):

N / A

1.15. Project proponents roles and responsibilities, including contact information of the project proponent and other project participants:

Entity	Description	Function
Swiss Carbon Value Ltd. is a Zurich-based developer of CER and VER projects as well as provider of consultancy services. Ltd. Yougha von Laer: Forestry Project Manager Latin America South Pole Carbon México S. de R. L. de C.V. Campeche No. 290 4o Piso Hipódromo 06100, México D. F., México T +52 (55) 5564 6793 / 5531 9013 E y.vonlaer@southpolecarbon.com W http://www.southpolecarbon.com	Swiss Carbon Value Ltd. is a Zurich-based developer of CER and VER projects as well as provider of consultancy services.	Development of the documentation to register the project under the VCS
Asorpar Ltd., Calle 11a No. 43D-79 Medellin, Antioquia Colombia T +57 4 2661153 / +57 4 2661280 E asistente.asorparltda@hotmail.com	ASOPAR (Asesorías en Ornato Paisajismo y Reforestación, Ltda.) is a private company. The legal representative is Juan Guillermo Molina, the technical manager is Luis Gonzalo Moscoso.	Land owner, project developer

1.16. Any information relevant for the eligibility of the project and quantification of emission reductions or removal enhancements, including legislative, technical, economic, sectoral, social, environmental, geographic, site-specific and temporal information

<u>Eligibility</u>
Project areas are only eligible:

a. If the area had not been a forest for 10 years prior to the project start or since the 1st of January 1990.

This criterion must be proven by ground-truthing, satellite images, aerial photographs, official maps or land-use records.

The land eligibility assessment is comprised of two segments.

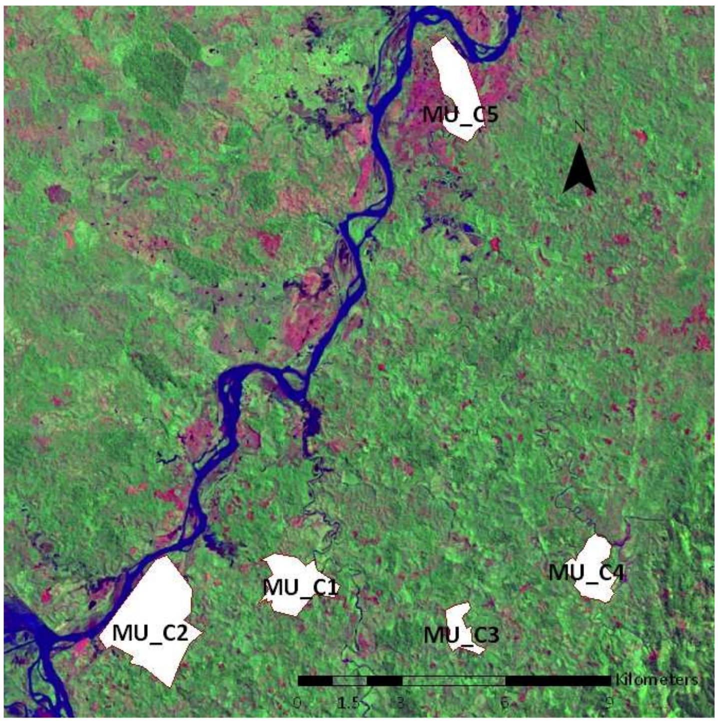
1. Assessment of land cover in 1992; 10 years prior to project start
2. Assessment of land cover in 2002; official project start date

Assessment of land cover at these two intervals will determine the land eligible for A/R activities. Lands where forest cover is detected are not eligible for A/R activities. Note that Colombia's national forest definition is; forest crown cover > 30%, forest area > 1ha and minimum tree height is 5m. The summation of forested areas detected in 1992 and 2002 will establish the total non-eligible land area within the project boundaries.

Project Area:

Table 7: Management Units of Caceres, Antioquia, Colombia

MU_C1	Caceres I
MU_C2	Caceres II
MU_C3	Caceres III
MU_C4	Caceres IV
MU_C5	Caceres VII

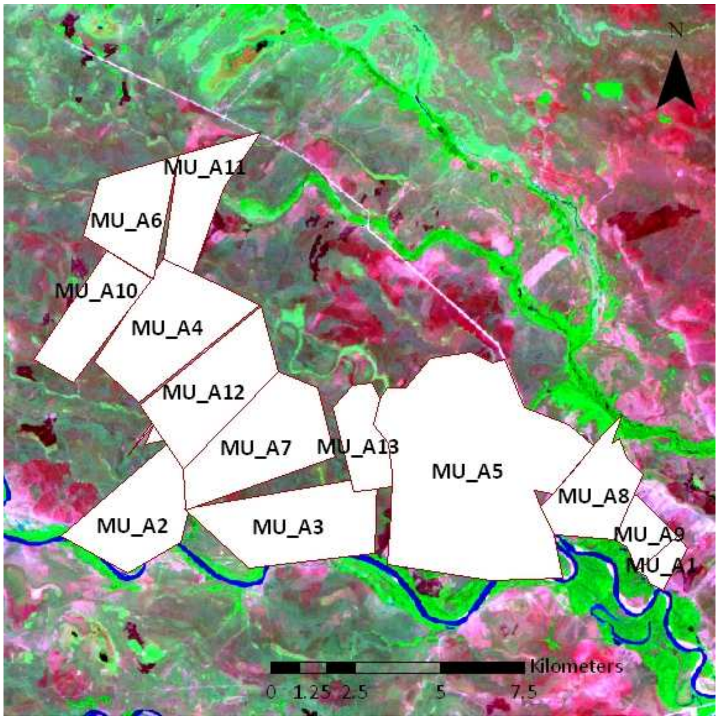


Map 10: Management Units for Caceres, Antioquia, Colombia

Table 8: Management Units of Cravo Norte, Arauca, Colombia

Cravo Norte, Aruaca, Colombia	
MU_A1	Betania
MU_A2	Chaparral
MU_A3	El Espejo
MU_A4	El Espiritu Santo
MU_A5	Finca 3213
MU_A6	La Magdalena
MU_A7	La Maria
MU_A8	Macanilla

MU_A9	Matecorozo
MU_A10	San Martin
MU_A11	Sol Naciente
MU_A12	La Trinidad
MU_A13	Berraquera



Map 11: Management Units for Cravo Norte, Arauca, Colombia

Assessment:
As aerial photos and official land use records were not readily available for the time period required, the analysis was completed exclusively with the use of Landsat optical imagery.

The Landsat Thematic Mapper (TM) is a sensor carried onboard Landsat 4-5 and has acquired images of the Earth nearly continuously from July 1982 to the present, with a 16-day repeat cycle. Landsat TM image data consist of seven spectral bands (band designations) with a spatial resolution of 30 meters for bands 1 to 5 and band 7. Spatial resolution for band 6 (thermal infrared) is 120 meters, but band 6 data are oversampled to 30 meter pixel size. The 1992 land eligibility segment was conducted using imagery from the Landsat TM sensor.

The Enhanced Thematic Mapper Plus (ETM+) instrument is a fixed "whisk-broom", eight-band, multispectral scanning radiometer capable of providing high-resolution imaging information of the Earth's surface. The Landsat ETM+ has been providing imagery since April 1999 but suffered a sensory failure in May 2003 which resulted in data gaps or the loss of approximately 25% of the data within each scene. Each ETM+ scene has an Instantaneous spatial resolution of 30 meters in bands 1-5 and 7 while band 6 has a spatial resolution of 60 meters and the panchromatic band 8 has a spatial resolution of 15 meters. Landsat 7 collects data in accordance with the World Wide

Reference System, which has catalogued the world's land mass into 57,784 scenes, each 183 km wide by 170 km long. The 2002 land eligibility segment was conducted using imagery from the Landsat ETM+ sensor.

Imagery:

Table 9: Imagery Caceres, Antioquia, Colombia

Sensor	Path	Row	Date
Landsat TM	9	55	10-Oct-90
Landsat ETM+	9	55	23-May-99

Table 10: Imagery Cravo Norte, Arauca, Colombia

Sensor	Path	Row	Date
Landsat TM	5	55	27-Feb-90
Landsat TM	5	56	27-Feb-90
Landsat TM	6	55	25-Mar-91
Landsat TM	6	56	25-Mar-91
Landsat ETM+	5	55	21-Dec-02
Landsat ETM+	5	56	2-Feb-02
Landsat ETM+	6	55	26-Jan-02
Landsat ETM+	6	56	5-Jan-01

All management units were classified into categories of Forest, Wetland, Pasture and Bare Soil according to procedures outlined in the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (*GPG-LULUCF*).

Images were selected according to their cloud coverage. The image mosaic for both Cravo Norte and Caceres had zero cloud coverage within the project boundary for each of the 1992 and 2002 assessments. As a result cumbersome cloud and shadow elimination and subsequent data loss was avoided in the analysis.

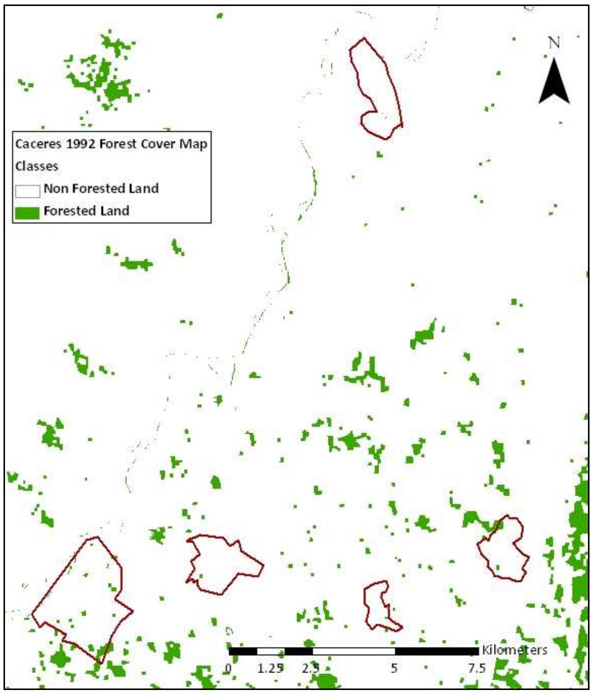
The images were geo-referenced and rectified so that they could be accurately compiled together and with auxiliary spatial data. Image composites were created with bands 7,4,2 to produce a natural colour representation of the project area. This facilitated earth feature identification.

The images were classified using the ERDAS unsupervised classification tool. This technique is not significantly different than performing a more traditional aerial photo interpretation. The computer recognizes and discriminates discrete spectral patterns within the image. The number of patterns or classes is set by the user; in this analysis 64 discrete classes were established. The user then labeled these spectral classes into the pre-established land cover classes. Since there was no specific ground base data such as plot or notes that could support the identification, the interpretation of the various earth features in multi-spectral satellite imagery was accomplished with cross reference to recent high resolution optical imagery from Google Earth.

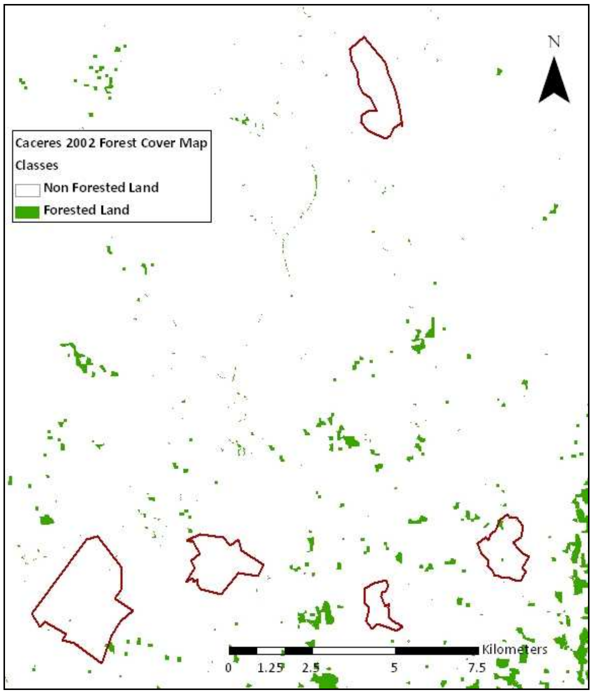
Once the classification was completed, a filter was performed to eliminate discrete land cover areas less than 1 hectare in size. This filter is performed not only to streamline the analysis but it has been acknowledged that small areas (< 1 ha) cannot be accurately identified at an optical resolution of 30m and thus their presence corresponds to classification error rather than small land cover regions.

The raster images from 1992 and 2002 were converted to vector form to facilitate comparison. From the land cover assessment, a land cover map and a forest cover map were generated from the project area for both 1992 and 2002.

Caceres Region:

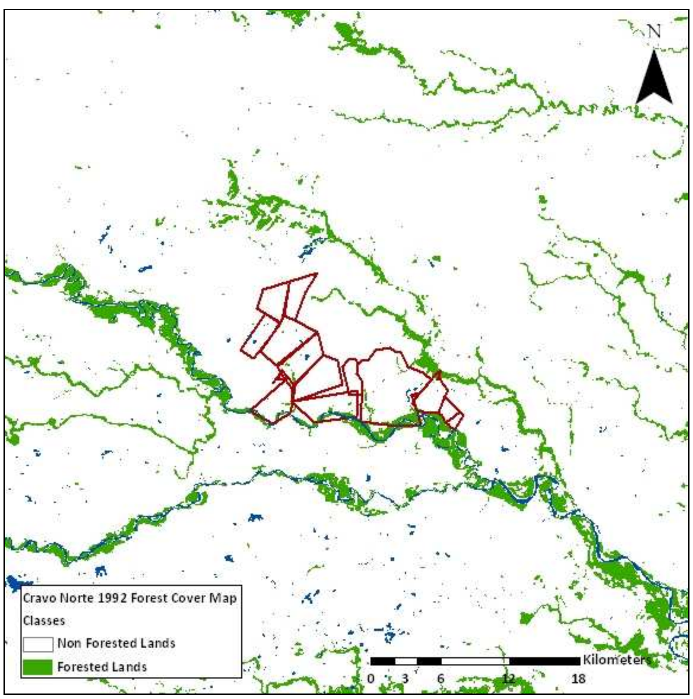


Map 12: Caceres Forest Cover for 1992

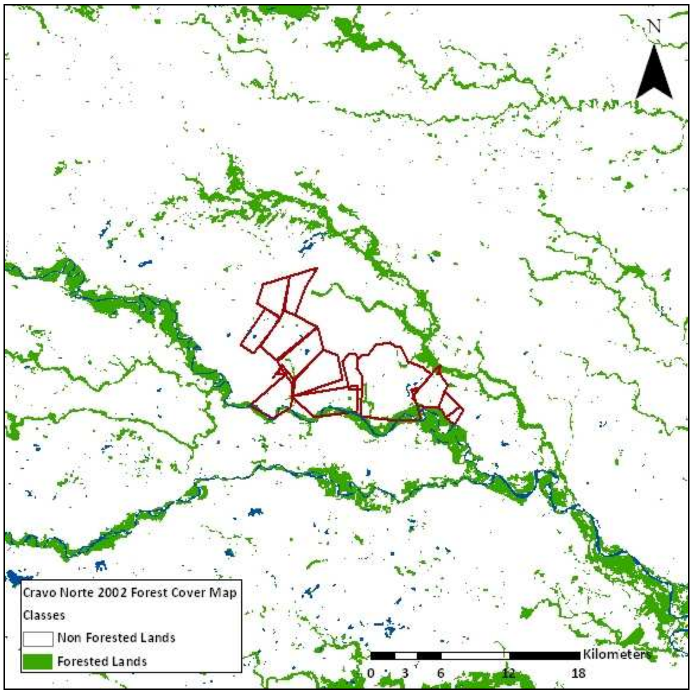


Map 13: Caceres Forest Cover for 2002

<u>Cravo Norte Region:</u>



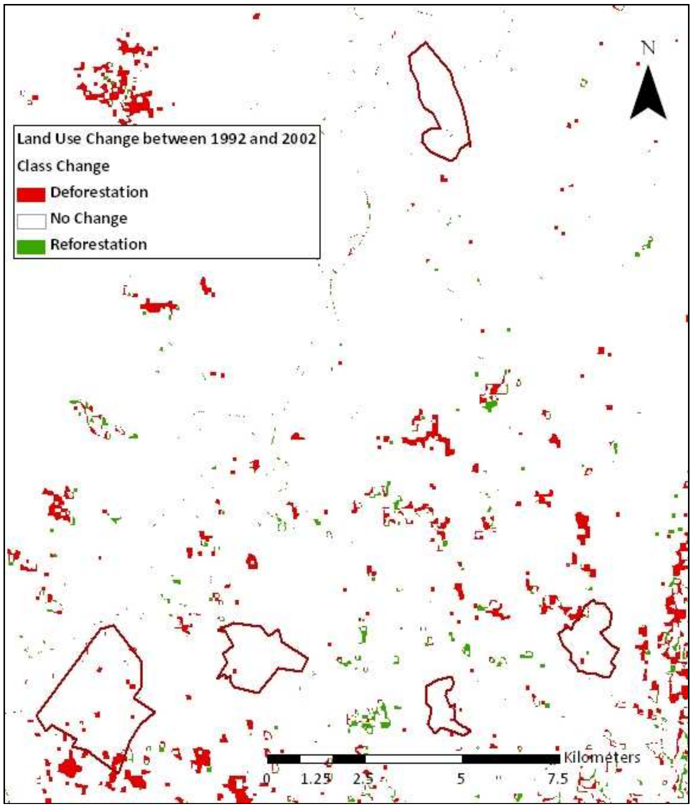
Map 14: Cravo Norte Forest Cover for 1992



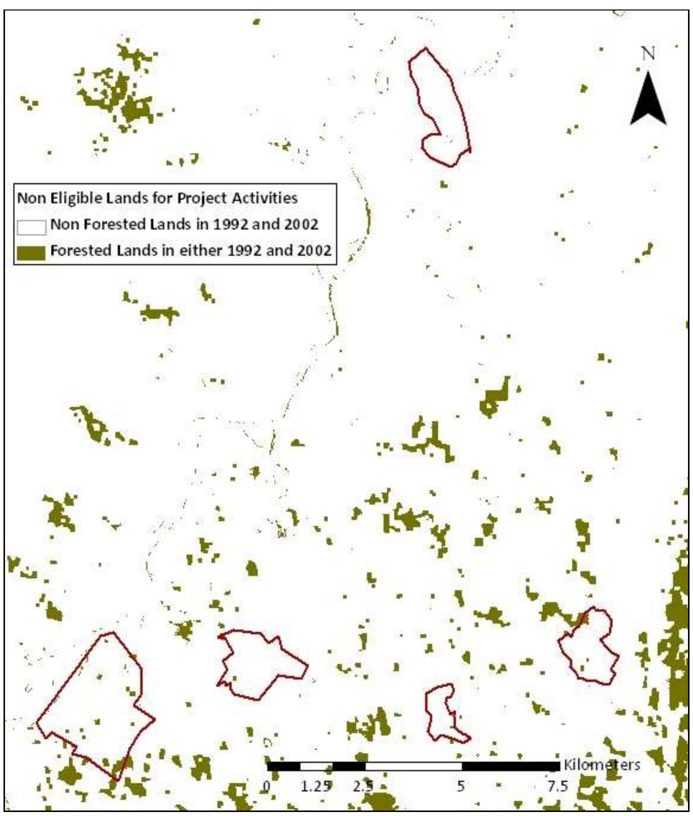
Map 15: Cravo Norte Forest Cover for 2002

The land cover assessments for 1992 and 2002 were compared via a 'union' and the combined areas with forest and wetlands were identified as non eligible lands for the project. The land eligibility assessment for each management unit is outlined below.

<u>Cáceres Region:</u>

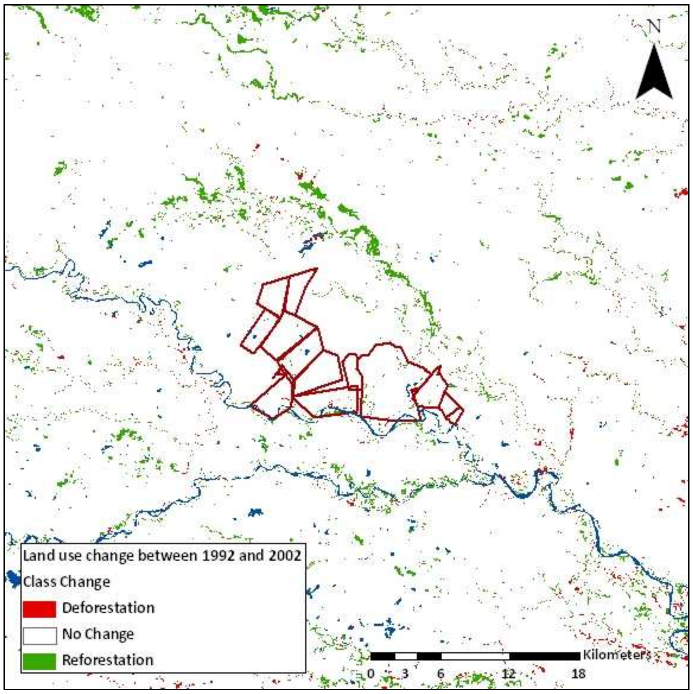


Map 16: Land Use Change between 1992 and 2002 for Cáceres

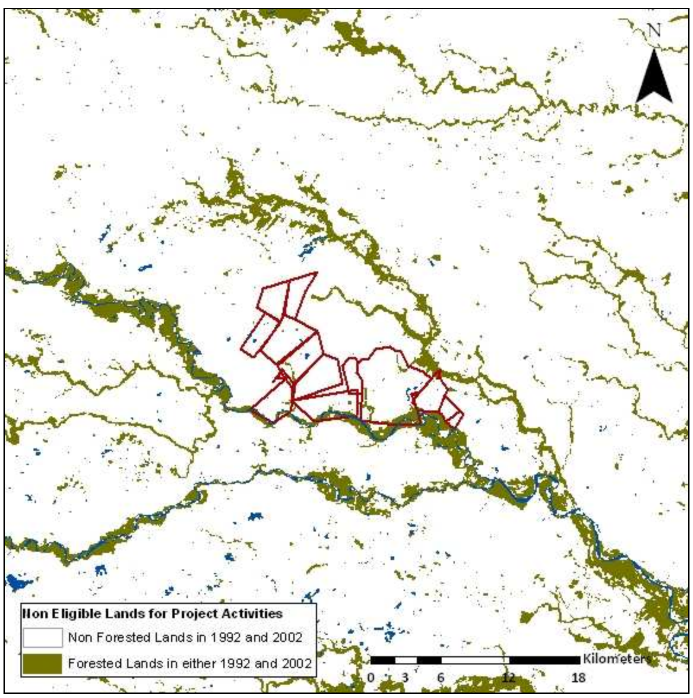


Map 17: Land Eligibility Assessment for Cáceres

<u>Cravo Norte Region:</u>



Map 18: Land Use Change between 1992 and 2002 for Cravo Norte



Map 19: Land Eligibility Assessment for Cravo Norte

The following tables quantitatively express the total land area eligible for project activities within each management unit.

Caceres Region:

Table 11: Caceres Region

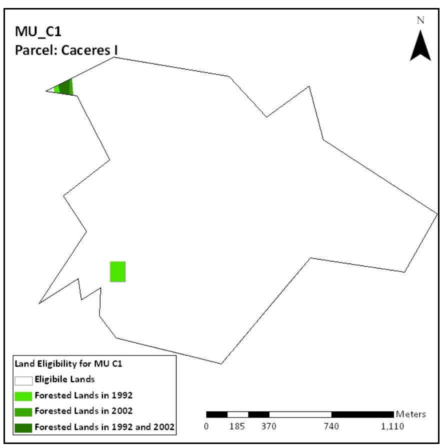
Management Unit	and Name	Total Area (ha)	Water (ha)	Non Forested Area 1992 (ha)	Forested Area 1992 (ha)	Non Forest Area 2002 (ha)	Forested Area 2002 (ha)	Forest Overlap Area (ha)	Total Forested Area (ha)	Total Eligible Area (ha)
MU_C1	Caceres I	242.576	0.000	240.924	1.652	241.984	0.593	0.458	1.786	240.790
MU_C2	Caceres II	596.446	0.000	568.574	27.871	594.850	1.595	1.059	28.408	568.038
MU_C3	Caceres III	86.769	0.000	85.959	0.810	86.769	0.000	0.000	0.810	85.959
MU_C4	Caceres IV	179.032	0.000	172.961	6.070	174.591	4.441	2.734	7.778	171.254
MU_C5	Caceres VII	252.436	0.000	252.194	0.242	252.431	0.005	0.000	0.247	252.189
	Total	1357.259							39.029	1318.230
	Percentage								2.876	97.124

Table 12: Cravo Norte Region

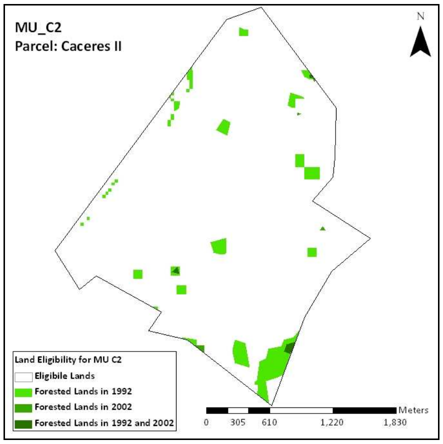
Management Unit	and Name	Total Area (ha)	Water (ha)	Non Forested Area 1992 (ha)	Forested Area 1992 (ha)	Non Forest Area 2002 (ha)	Forested Area 2002 (ha)	Forest Overlap Area (ha)	Total Forested Area (ha)	Total Eligible Area (ha)
MU_A1	Betania	103.274	0.001	103.125	0.150	103.206	0.068	0.055	0.163	103.111
MU_A2	Chaparral	809.485	33.388	767.926	74.947	772.638	70.235	59.789	85.393	724.092
MU_A3	El Espejo	973.534	47.637	914.707	106.463	885.434	135.737	89.707	152.493	821.040
MU_A4	El Espiritu Santo	971.630	4.007	971.072	4.565	968.501	7.136	4.531	7.170	964.460
MU_A5	Finca 3213	2935.532	65.419	2733.998	266.953	2695.146	305.805	255.287	317.471	2618.061
MU_A6	La Magdalena	601.171	0.000	601.171	0.000	601.171	0.000	0.000	0.000	601.171
MU_A7	La Maria	966.423	0.000	935.135	31.288	937.576	28.848	28.190	31.945	934.478
MU_A8	Macanilla	589.760	1.273	559.582	31.451	551.362	39.671	30.487	40.635	549.125
MU_A9	Matecorozo	202.768	0.000	196.634	6.134	194.873	7.895	5.690	8.339	194.429
MU_A10	San Martin	548.095	12.806	560.901	0.000	560.901	0.000	0.000	0.000	548.095
MU_A11	Sol Naciente	510.534	0.000	509.817	0.716	509.747	0.786	0.626	0.876	509.657
MU_A12	La Trinidad	848.865	13.303	828.824	33.344	830.360	31.808	27.398	37.754	811.111
MU_A13	Berraquera	370.181	0.000	370.181	0.000	369.997	0.184	0.000	0.184	369.997
	Total	10431.252							682.424	9748.828
	Percentage								6.542	93.458

Total Land Eligible for Project Activities in each Management Unit:

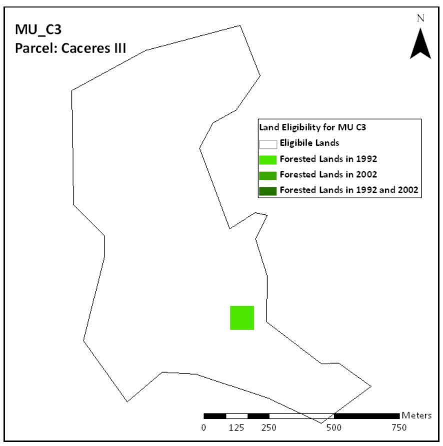
Cáceres:



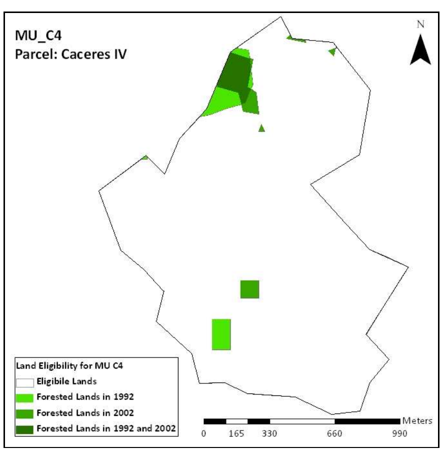
MU_C1
Total Land Area: 242.576 ha
Total Eligible Land: 240.790 ha



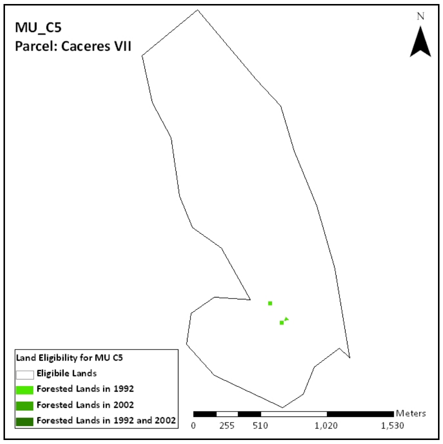
MU_C2
Total Land Area: 596.446 ha
Total Eligible Land: 568.038 ha



MU_C3
Total Land Area: 86.769 ha
Total Eligible Land: 85.959 ha

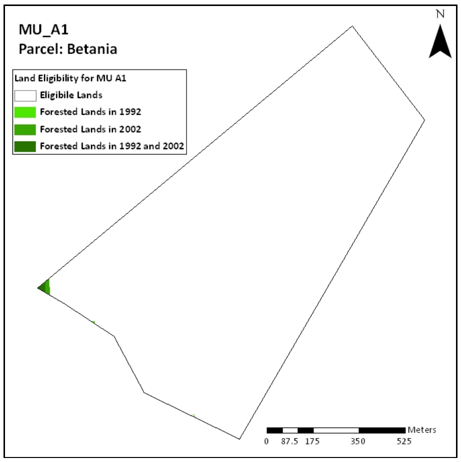


MU_C4
Total Land Area: 179.032 ha
Total Eligible Land: 171.254 ha

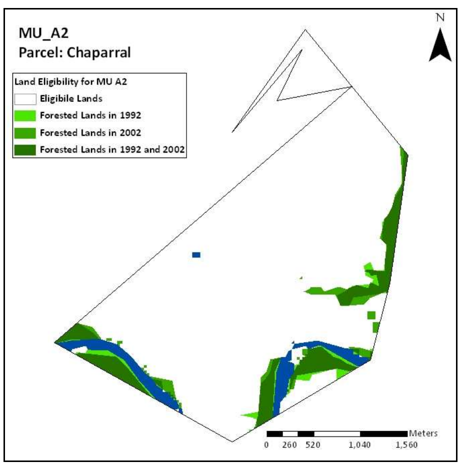


MU_C5
Total Land Area: 252.436 ha
Total Eligible Land: 252.189 ha

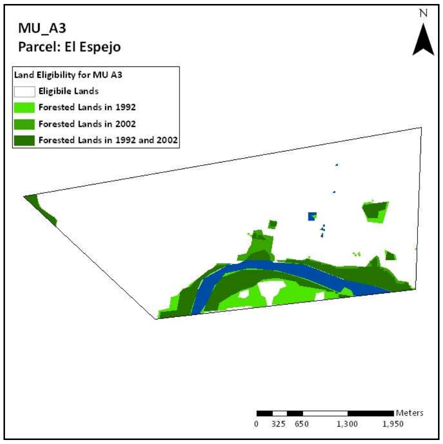
Cravo Norte



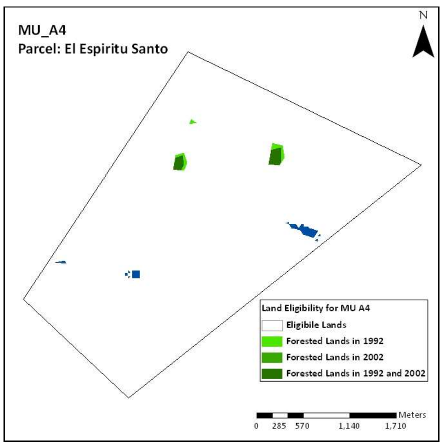
MU_A1
Total Land Area: 103.274 ha
Total Eligible Land: 103.111 ha



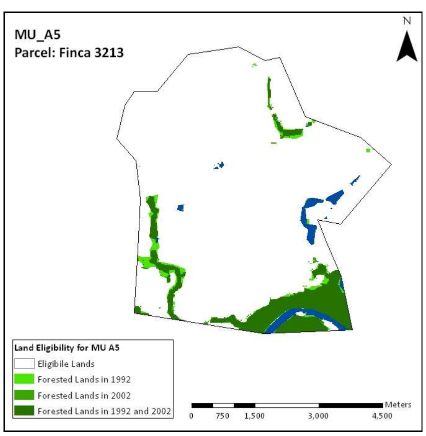
MU_A2
Total Land Area: 809.485 ha
Total Eligible Land: 724.092 ha



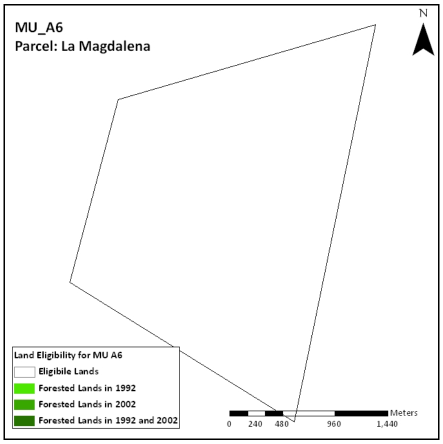
MU_A3
Total Land Area: 973.534 ha
Total Eligible Land: 821.040 ha



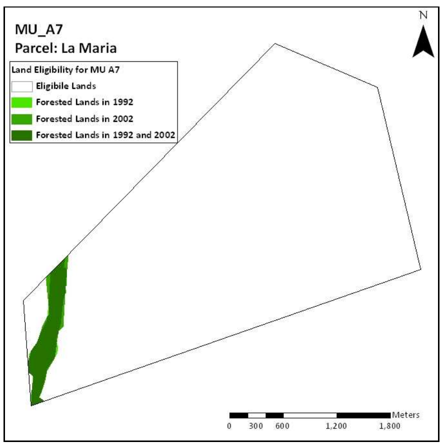
MU_A4
Total Land Area: 971.630 ha
Total Eligible Land: 964.460 ha



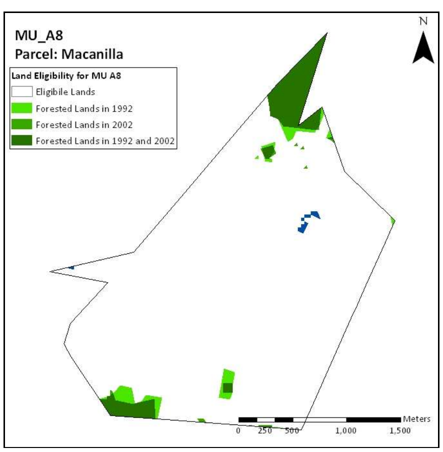
MU_A5
Total Land Area: 2935.532 ha
Total Eligible Land: 2618.061 ha



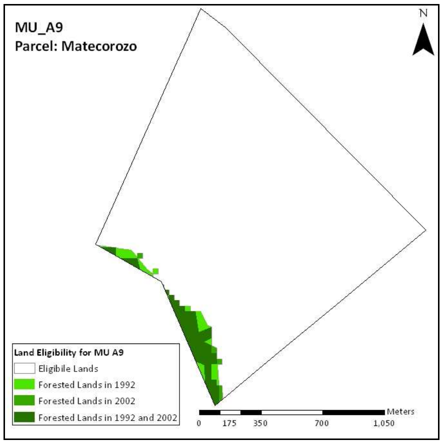
MU_A6
Total Land Area: 601.171 ha
Total Eligible Land: 601.171 ha



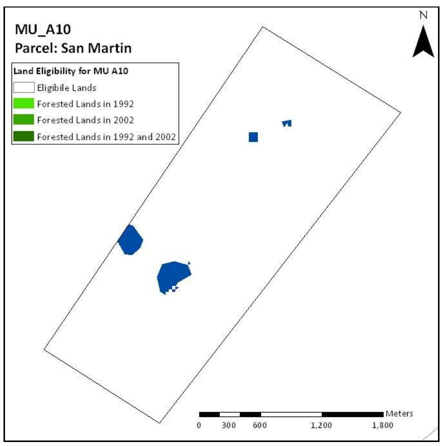
MU_A7
Total Land Area: 966.423 ha
Total Eligible Land: 934.478 ha



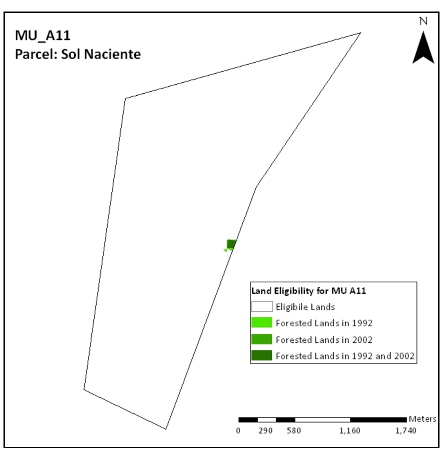
MU_A8
Total Land Area: 589.760 ha
Total Eligible Land: 549.125 ha



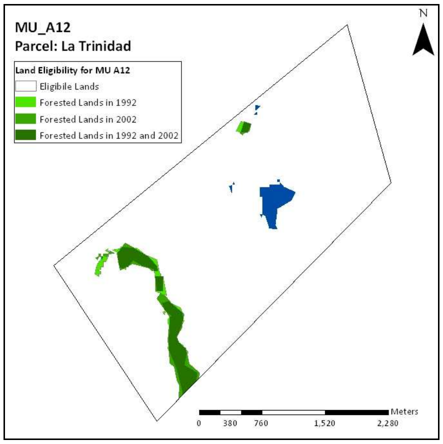
MU_A9
Total Land Area: 194.429 ha
Total Eligible Land: 202.768 ha



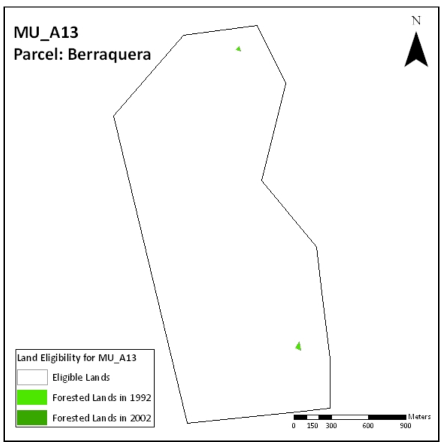
MU_A10
Total Land Area: 548.095 ha
Total Eligible Land: 548.095 ha



MU_A11
Total Land Area: 510.534 ha
Total Eligible Land: 509.657 ha



MU_A12
Total Land Area: 848.865 ha
Total Eligible Land: 811.111 ha



MU_A13
Total Land Area: 370.181ha
Total Eligible Land: 369.997 ha

1.17. List of commercially sensitive information (if applicable):

N / A

2. VCS Methodology:

2.1. Title and reference of the VCS methodology applied to the project activity and explanation of methodology choices:

The selected approved baseline and monitoring methodology is AR-AM0005: “Afforestation and Reforestation project activities implemented for industrial and/or commercial uses” - Version 03.

2.2. Justification of the choice of the methodology, and why it is applicable to the project activity:

The project activity is included in the categories of eligible projects defined in the selected methodology:

- Afforestation or reforestation activities undertaken to meet commercial or industrial needs on grasslands that are unmanaged or under extensive management, with low soil carbon content (compared to the expected soil carbon content under the project activity) because of soil degradation, or because climatic-edaphic conditions naturally lead to thin, infertile soils with low carbon content.

The methodology can be used for a project with one of two possible baseline land uses:

1. Maintenance of the present land use as unmanaged or extensively managed grassland, and
2. Afforestation or reforestation activity undertaken intermittently in small amounts in the periods before the A/R CDM project activity.

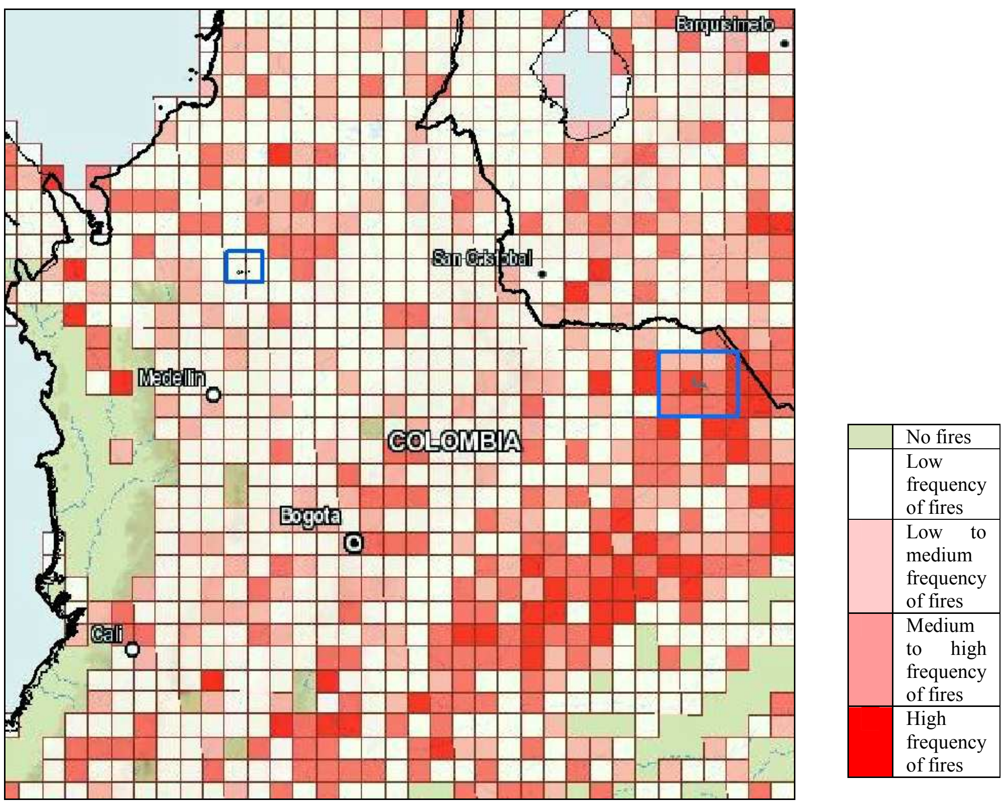
The first scenario is the baseline identified in the project area. The conditions under which the selected methodology is applicable to A/R CDM project activities are as follows:

- *Land cover within the project boundary is in steady state either as unmanaged or extensively managed grassland*. The project complies with this condition, with the exception of the areas in Caceres that were exposed to alluvial gold mining before project start. Gold mining leaves bare soils devoid of soil carbon and without any vegetation. n article from October 2010 published by the Colombian journal “Semana” clearly indicates that mining leaves a barren desert and nothing will grow for 100 years.[98] Therefore human intervention is needed to recover mining areas more rapidly. For further details on how Asorpar recovered mining areas please refer to section 1.9 (“Program of plantation and forest handling in degraded soils caused by alluvial gold mining - recovery -, Cáceres”).It is fair to assume that the carbon content in bare soils is less than in natural grassland vegetation. Therefore it is also reasonable to assume that the reforestation activity has higher carbon sequestration impact on bare soils than on grasslands. To include bare soils is therefore a conservative approach and does not contradict the applicability condition that land cover within the project boundary is grassland.It can be assumed that the maintenance of the present land use as unmanaged or extensively

[98] “Oro manchado de sangre”, Semana, 4th of October 2010: http://www.semana.com/noticias-nacion/oro-manchado-sangre/145430.aspx

managed grassland is going to continue because the socio-economic conditions that created them are still and will continue to be present. A multi-temporal assessment of land use changes, using satellite images, was developed, in order to prove the state of land cover since 1992.

- *Natural regeneration is not expected to occur in the project area because of the absence of seed sources or because land use practices do not permit the establishment of tree vegetation.* The project complies with this condition. In Cravo Norte gallery forests occur in some areas close to the plantation. Gallery forests are evergreen forests that form corridors along rivers or wetlands and project into landscapes that are otherwise only sparsely covered with trees, such as savannas, grasslands or deserts. Gallery forests are able to exist where the surrounding landscape does not support forests. The project takes place in a savanna area where the natural conditions cause almost no forest cover. Furthermore, the lands have been subjected to annual fires originating from anthropogenic activities, or natural causes.



Map 20: Fire frequency map for Colombia from 2003 to 2009 detected by daily MODIS imagery

In the case of Cáceres, part of the land is totally degraded from gold exploration (see 1.9: Program of plantation and forest handling in degraded soils caused by alluvial gold mining - recovery-, Cáceres). In other parts of Cáceres land has been deforested, especially in locations where extensive cattle farming is taking place.

During the time frame that coincides with the crediting period of the project activity (and relative to the baseline scenario) carbon stocks in soil - organic matter, litter and deadwood - will either remain in steady-state or decrease in the absence of the project activity (see multi-temporal assessment of land use changes). However, lower soil carbon under grassland compared to plantations or secondary forests can be expected.

- *Evidence (e.g. applicable scientific literature) has to be provided that the exclusion of soil organic carbon is conservative for the project.* In the absence of the project activity, the baseline is expected to remain unmanaged grasslands. Such grasslands under tropical conditions have less soil carbon compared to plantations. Therefore, not accounting for soil organic carbon is a conservative approach for the project case as it is expected to increase less in the absence of the project activity relative to the baseline.

- *Flooding irrigation is not permitted.* The project complies with this condition. There is no flooding irrigation contemplated in the project.

- *Soil drainage and disturbance are insignificant so that CO_2-GHG emissions from these types of activities can be neglected.* The project complies with this condition. These activities are not included in the project development.

- *The amount of nitrogen-fixing species (NFS) used in the A/R CDM project activity are not significant, so that GHG emissions from denitrification can be neglected in the estimation of actual net GHG removals by sinks*. According to EB report 42, paragraph 37 c), "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."

2.3. Identifying GHG sources, sinks and reservoirs for the baseline scenario and for the project:

The project follows the provisions of the baseline methodology selected to monitor the changes in the carbon biomass stocks above and below ground. Carbon stock changes in deadwood, litter, and soil pools are not monitored.

Table 13: 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
Litter	No	Conservative approach under applicability condition
Soil organic carbon	No	Conservative approach under applicability condition
Wood products	No	Conservative approach under applicability condition: no leakage is created by not including this carbon pool

A list of all GHG emissions from project operations being quantified and reported is provided in the table below.

Table 14: GHG emissions that are quantified and reported

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
3.3.12	Amount and type of fertilizer N applied per unit area during establishment	kg N/ha/yr	m	Annually	100%	For different tree species and/or management intensity
3.3.15	Amount and type of fertilizer N applied per unit area	kg N/ha/yr	m	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity
3.3.19	Volume thinned	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume removed is recorded and tracked
3.3.21	Volume harvested	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume harvested is recorded and tracked
3.3.22	Quantity of fossil fuels used in the forest management and operations	litre	m	Documented according to occurrence. Recorded for each verification	100%	
3.3.51	CO2 emissions due to disturbance	tCO_2/ha	e, c	Before each verification	100% of the area affected by disturbance	Data from field visits and observation
3.3.52	Diesel / gasoline consumption in A/R activities	litre	m	Annually	100% of the diesel / gasoline consumption	Fuel consumption per unit area for site preparation / harvesting
3.3.66	Amount of synthetic fertilizer N	tN/yr	c	Annual	100% of the applicable area	
3.3.68	Amount of organic fertilizer N	tN/yr	c	Annual	100% of the applicable area	
3.3.71	Direct N_2O emission of N input	tCO_2e/yr	c	Annual	100% of the applicable amount	

2.4. Description of how the baseline scenario is identified and description of the identified baseline scenario:

The approach 22 (C), “Changes in carbon stocks in the pools within the project boundary from the most likely land use at the time the project starts” was developed using a satellite image-based multi-temporal analysis of land use changes in the project areas for both plantations, verifying that cattle farming and gold mining are the primary, existing baseline scenarios in the project regions.

In compliance with the baseline methodology, the following steps were followed for the determination of the baseline scenario.

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

The project activity is carried out in two areas: Cáceres and Cravo Norte.

Cáceres: the previous land use was extensive livestock farming. That activity was favored by open grass vegetation (see maps in section 1.7). Gold mining is considered to be a feasible alternative in the region. Project proponents can prove through documentation that they received offers for the mining rights. However, it has to be noted that the offer is dated back to the year 2009. It is likely that the offered price could have been different in the year 2002. The alternative of gold mining, in general, refers to the opportunity to sell or rent land for the activity.

Cravo Norte: The previous land use was extensive livestock farming. That activity was favored by open grass vegetation due to climate-edaphic conditions (see maps in section 1.7). Similar lands, in the vicinity of Cáceres and Cravo Norte, have similar land cover and are not expected to be used for private, large scale native species plantations as alternative land use (see satellite image-based multi-temporal analysis).

Extensive livestock farming is carried out at the expense of forestry lands. This is because 35.1% of current land use is used for this activity while only 16.8% of the country's land area has livestock farming potential. In addition, while there is 12.7% of land with agriculture potential, only 4.6 % of it is used for this purpose. Likewise, there are 78.3 million hectares with forestry potential, but forests at the beginning of the last decade only reached 58.8 million hectares (see Table 15).

Table 15: Comparison between the current land use and the potential land use in Colombia[99]

Activity	Current land use (%)	Potential land use (%)
Agriculture	4.66	12.70
Livestock farming	35.11	16.80
Forest	49.00	68.50

Step 2: *Assessment of national and sector policies and legislation*

(a) Policies related to the creation of wood sources

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

The identified alternatives in Step 1, commercial or conservation-oriented reforestation activities, extensive cattle farming activities and legal gold mining, are entirely in compliance with applicable legal and regulatory requirements, both currently and in the foreseeable future (see also 1.10). No specific requirements, such as an environmental license or permit given by local or national authorities, are foreseen in the Colombian environmental regulations catalogue. All other regulation requirements for the commercial forestry activity, like accepted land use, taxes, labor regulation, land property, and all other legal aspects, are in full compliance.

In order to consolidate the national forestry policy, and as start-up strategy, the government approved the National Plan for Forestry Development (PNDF) in December 2000, so that the Ministry of Environment, the National Department of Planning, the Ministry of Agricultural and Rural Development, the Ministry of Economic Development and the Ministry of Foreign Trade can define a management scheme. This is done in a coordinated manner with regional autonomous corporations and other entities that are part of the national "environmental system." The ultimate purpose is to provide an impetus for the forestry sector.

[99] National Department of Planning of Colombia. 1993. Informe de Colombia Sector Forestal. Proyecto FAOGCP/ COL/019/NET. Segunda reunión regional de Directores de proyectos forestales. Quito, Ecuador.

The PNDF offers a strategic vision of national forestry management for the next 25 years, going beyond government tenures because it constitutes a state policy. The plan focuses on the participation of actors involved in forestry resources and ecosystems. In the plan, start-up strategies and programs are detailed. They are adapted to different needs of regions, conservation and recovery of ecosystems, and management and use of forestry ecosystems. An important aspect is the adoption of a chain of custody of commercial reforestation processes, industrial development and commercialization of forestry products. Likewise, the plan considers institutional and financial aspects required for its implementation.

The law 1021 from 2006 (General Forestry Law[100]) adopts measures to encourage the development of plantation forestry. Forestry activities shall be able to compete on equal terms with other productive sectors, even in the international market. With regard to industrial production, the State shall promote the development and modernization of the forestry sector so as to increase the competitiveness of the industry. Guarantees for investment are set forth, and the awarding of preferential loans for the sector is encouraged.

Currently, like the international community, the State is aware of environmental damage due to tree-felling processes. Increased awareness has led to the creation of new incentives to stimulate reforestation with productive purposes such as production-protection. The CIF was created by means of law 139 from 1994 and regulated by decree 1824 from 1994. The CIF is a direct contribution in cash made by the government so as to cover part of the establishment and maintenance expenses to be paid by those carrying out new commercial forestry plantations activities with one or more tree species developed in areas with forestry features for commercial or production purposes. Although incentives like the CIF exist, the timber market in Colombia remains small. No significant market for native species exists (see Step 3).

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

The timber market in Columbia, dominated by pine trees, is quite small. Pinus is the most favored tree species for plantation forestry (see 2.5, step 3a, Technological barrier). At the moment there is no significant market for native tree species in Colombia. Due to the lack of adequate infrastructure, and particularly in Cravo Norte, the transport of timber is very expensive. Transportation costs for extracted timber are considered to be above the industry's national and international average. Generally the preferred option for timber transportation is via rivers. Frequently, timber is shipped over the border to Venezuela (this is a natural route for transporting goods). However, the project owner considers this option (currently and at project start in Cravo Norte) unfeasible for political reasons.[101] Therefore, it is difficult for the proposed A/R project activity to compete on both the national and international markets.

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[100] National and/or sectoral land-use policies or regulations, which give comparative advantages to afforestation/reforestation activities and that have been implemented since the adoption by the COP of the CDM M&P (decision 17/CP.7, 11 November 2001), need not be taken into account in developing a baseline scenario (i.e. the baseline scenario could refer to a hypothetical situation without the national and/or sectoral policies or regulations being in place)"

[101] http://www.terra.com.co/noticias/articulo/html/acu23646-relaciones-entre-colombia-y-venezuela-marcadas-por-la-crisis.htm

Given the growing ecological pressure on natural forest resources due to increased timber demand, many industrialized nations have limited access to tropical wood imports originating from sustainable sources. It can be assumed that the availability of tropical timber has diminished, but demand has not. Availability on the international market has decreased because of rapid degradation of natural forests due to unsustainable management practices, and because industrialized countries have drafted and implemented legislation to hamper tropical timber trade from unsustainably-managed forest resources.

The proposed A/R project activity intends to supply a high demand international market with wood from sustainably-managed forestry plantations planted with native tree species.

Step 4: *Assessment of previous land use and project entity's land use practices within the project boundaries*

Project activities are carried out in two areas:

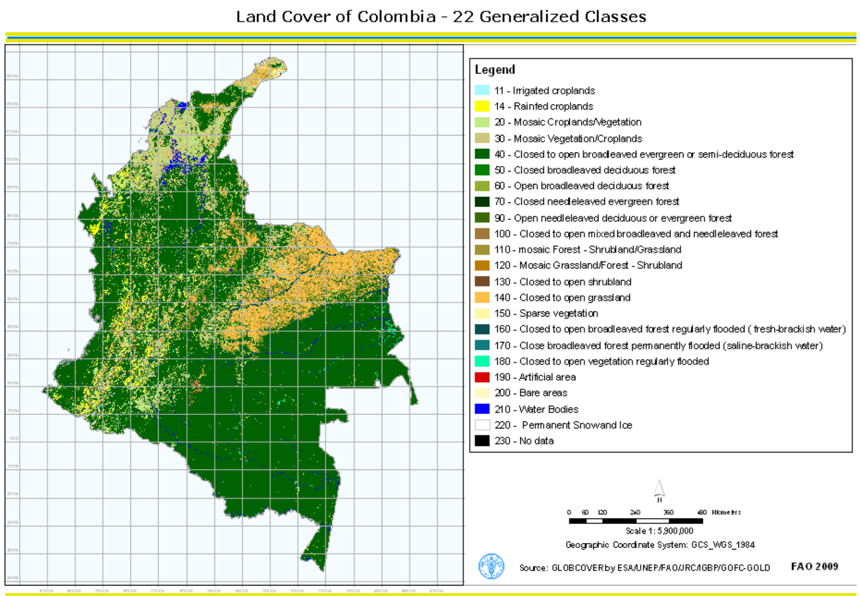
- Cravo Norte: the previous land use was extensive cattle farming, as can be seen from Maps 5 and 6. These lands were acquired to conduct forestry activities.
- Cáceres: The previous land use was extensive cattle farming with some gold mining activities, as illustrated in Maps 8 and 9.

For further information please see 1.16

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

According to data from territory maps and satellite study, as well as feedback given by stakeholders, the most favorable alternatives of land use with regard to current and potential land use are:

- Livestock farming activities in Cravo Norte and Cáceres
- Gold mining activities in Cáceres



Map 22: Land cover of Colombia, 2009[102]

Map 23: Image US2, land use in tropical Latin America[103]

[102] Food and Agriculture Organization of the United Nations. 2009: http://www.fao.org/geonetwork/srv/es/graphover.show?id=37154&fname=lc_Colombia.png&access=public
[103] Food and Agriculture Organization of the United Nations. 2000. Essential documents, statistics, maps and multimedia resources. www.fao.org/english/newsroom/extras/200506_deforestation/deforestation1.htm

Step 6: *Identification of the baseline scenario as the most likely land-use in the absence of the project activity*

The baseline scenario, in the absence of the project activity, would be extensive livestock farming, and in some areas in Cáceres gold mining. This land use is common practice around and within the project territories.

Extensive livestock farming has some negative environmental effects. Deforested areas are first used for agricultural purposes and later transformed to conduct extensive activities such as cattle farming. The decrease of the overall forest area is attributed to the expansion of livestock farming. The area suitable for cattle farming has already been exceeded. Consequently, it has reduced areas with a superior potential for other kinds of activities, such as forestry (see Table 15: Comparison between the current land use and the potential land use in Colombia in Step 1).

Please refer to 1.9 for gold mining (Program of plantation and forest handling in degraded soils caused by alluvial gold mining - recovery-, Cáceres).

The steps laid out in Baseline Methodology AR-AM0005 provide for the identification of the baseline scenario in a conservative and transparent manner. The elaboration of the analysis above, following the steps indicated in the methodology leaves only two possible baseline scenarios: extensive livestock grazing and, in limited areas in the Cáceres project area, alluvial gold mining. These are the only plausible baseline scenarios based on the guidance of the Baseline Methodology and are therefore the most conservative of the plausible baseline scenarios. Furthermore, these baseline scenarios will not lead to an overestimation of the carbon stock changes because there is no other baseline scenario in which the carbon stock would be higher. To the contrary, in the areas that were subject to gold mining, the baseline scenario selection is more likely to underestimate the carbon stock changes from reforestation because of the existence of bare soils (see section 2.2 for further discussion of the conservativeness of the gold mining baseline scenario).

2.5. Description of how the emissions of GHG by source in baseline scenario are reduced below those that would have occurred in the absence of the project activity (assessment and demonstration of ***additionality***):

The procedure to demonstrate additionality follows EB 35 Report Annex 17 with the A/R Methodological Tool "Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02). The following five basic 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:

- Step 0: Preliminary screening based on the starting date of the A/R project activity;
- Step 1: Identification of alternative land use scenarios to the A/R project activity;
- Step 2: Investment analysis to determine that the proposed project activity is not the most economically or financially attractive of the identified land use scenarios; or
- Step 3: Barriers analysis; and
- Step 4: Common practice analysis.

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

This step determines the land eligibility prior to the starting of the A/R CDM project activity. The land within the project boundary is defined as grassland (see also 2.4). As a result of the multi-temporal land use change analysis, developed using satellite images, the land proposed for the forestry activity was found in 97% in Caceres and 93% in Arauca to be eligible 1992 (see also 1.16).

The project activity started in 2002. Income from carbon sequestration is mentioned in the contracts of participation. First contracts were signed in January 2002 by the investors. In May 2007, the company "Carbono & Bosque" delivered an analysis of carbon sequestration potential and an eligibility study of the area. The project PIN was sent to the Colombian DNA on June 1, 2007. A Letter of No-Objection was obtained on June 5, 2007, because in the beginning it was planned to register the project under the CDM. Therefore it is stated in the letter that the project will claim carbon credits under the Kyoto protocol. After 2007 the project developer decided to register the project under the voluntary market scheme, because he expects a higher demand and better prices from buyers that are willing to mitigate voluntarily, in comparison to buyers acting in the compliance market. Demand for tCERs and lCERs from forest-related project activities under the CDM appears to be quite low. A reason for this limited demand is the rule that A/R projects can only claim temporary credits to assure permanence of emission reduction. After the crediting period of a forest-related project activity has ended, CERs have to be replaced by permanent CERs from project activities other than A/R. Furthermore, the EU Emission Trading System currently does not allow for A&R CERs to be used for compliance, further reducing demand.

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

<u>Sub-step 1a:</u> *Identify credible alternative land use scenarios to the proposed project activity*
See chapter 2.4, Step 2

<u>Sub-step 1b:</u> *Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations*
See 2.4(a)(b)

<u>Sub-step 1c:</u> *Selection of the baseline scenario*
See 2.4

<u>Step 2:</u> Investment analysis
N/A

<u>Step 3:</u> Barrier analysis

<u>Sub-step 3a:</u> *Identify barriers that would prevent the implementation of type of the proposed project activity*

Investment barrier

In 2002, the forestry plantations in Colombia occupied 231,912 hectares, equivalent to about 3% of the country's total forest cover. The Ministry of Agriculture (2005) concluded that the majority of wood and wood products are derived from the exploitation of natural forests, given that commercial reforestation is neither economically attractive nor consolidated as a profitable activity.

Silviculture and extraction of wood represents 0.14% of the national Gross Domestic Product (GDP). Only 1.2% of the GDP from agriculture, forestry, hunting and fishing include lumber and forestry products. This indicates that commercial forestry is a scarce activity relative to others in the sector (see Table). The very low level of economic activity in the commercial forestry sector is attributed to several factors, among them: low rates of return, the high number of intermediaries, the long production cycle, the long periods between cash flow disbursements, the high concentration of costs in the first years of production, the long wait for economic returns, and difficulties in obtaining credit for this type of activity (Ministry of Agriculture 2005).[104, 105,106]

Table 16: Participation of Agricultural Activities in the Gross Domestic Product (GDP) in Colombia, 2004. Source: DANE: http://www.agrocadenas.gov.co/forestal/Documentos/caracterizacion_forestal.pdf, page 31 Table 15.

Activity	2004
Coffee, without roasting	13.3%
Other agricultural products	45.8%
Live animals and animal products	36.7%
Lumber and forestry products	1.2%
Fish and other fish products	3.0%
GDP from agriculture, forestry, hunting and fishing	100%

There are no commercial bank lines of credit for long-term investments such as reforestation projects.[107] Banks perceive the investment risk for this type of project as very high due to market limitations, the lack of cash flow, and the long wait for a return on the investment.[108] There are multilateral banking credit sources, but processing is quite complex. Furthermore, they are intended mainly for institutions

[104] "Caracteristicas y estructura del sector Forestal-Madera-Muebles en Colombia. Una Mirada Global de su Estructura y Dinamica 1991-2005". Ministerio de Agricultura y Desarrollo Rural. 2005. page 32, section 7, para 2: http://books.google.com.mx/books?id=RDaAgeny6GAC&printsec=frontcover&dq=Caracteristicas+y+estructura+del+sector+Forestal-Madera-Muebles+en+Colombia&source=bl&ots=TZqrmy1huw&sig=zZoj7vxT7d1WCcd-cfy9GkjFafE&hl=es&ei=MnQOTMa9K4LOM8vR0dEM&sa=X&oi=book_result&ct=result&resnum=3&ved=0CB0Q6AEwAg#v=onepage&q&f=false

[105] see also Aldana, C. (2004): Sector forestal Colombiano; fuente de vida, trabajo y bienestar. Serie de documentación no. 50. Corporación nacional de Investigación y Fomento Forestal (CONIF), Bogotá, p. 42

[106] For the year that the Asorpar project began, 2002, credit lines for forestry investment were nonexistent. The high market risks and the long periods to wait for returns did not make for an attractive investment. The regulatory instability in the forest sector also limited attractiveness. (Rivera y Moreno, 2002; Espinal et al, 2005). These arguments are also presented in the "*Análisis del Mercado Crediticio para el Sector Forestal Colombiano*" developed by Juan Manuel Soto, (CONIF 2002), cited by Contreras, 2004: (http://www.fao.org/docrep/007/j4192s/j4192s00.htm#TopOfPage), who concludes that in Colombia we have no lines of credit that can be called forestry credit lines, with the exception of two very limited lines from the Banco Agrario (a state Bank) which specifically limit activities to "plantation and maintenance" and "harvest of trees" but are not focused to reforestation activities.

[107] Aldana, C. (2004): Sector forestal Colombiano; fuente de vida, trabajo y bienestar. Serie de documentación no. 50. Corporación nacional de Investigación y Fomento Forestal (CONIF), Bogotá. p. 26f, p. 49f

[108] "Estudio de tendencias y perspectivas del sector forestal en América Latina Documento de Trabajo. Informe Nacional Colombia". Available at: http://www.fao.org/docrep/007/j4192s/j4192s00.htm#TopOfPage

such as the Regional Autonomous Corporations (the entities in charge of managing environmental resources and policies in the various regions of Colombia) instead of private landowners.[109]

In comparison, ample lines of credit and financing sources exist for coffee growing and cattle farming (Banco Agrario) because of lower perceived risks, proven experience, and a steady cash flow. Cattle farming was subject to an important increase in government assisted financing through FINAGRO between 1998 and 2002, increasing from $153,500 million pesos to $221,300 million pesos. In contrast, the forestry sector received the smallest allocation in FINAGRO: $350 million pesos in 1998 and only $64 million pesos in 2002.[110]

Furthermore, because of internal social conflict, Colombia is perceived as a country with high risks for international investment, making access to international capital for long-term investments such as reforestation projects virtually impossible.[111, 112]

Although there is an incentive in Colombia allocated to reforestation activities, specifically the Forest Incentive Certificate (CIF: Certificado de Incentivo Forestal), the policies and procedures related to effectively obtaining this incentive are confusing and constantly changing. The delivery of CIF is highly uncertain because it becomes unavailable when the national government accounts go into deficit or when the government changes during the election period (avoidance of corruption). [113] Blanco's review of the programs to support environmental services (2005) reported three important problems with the CIF incentive program. First, the level of the incentive is relatively low in terms of the positive externalities generated by reforestation and the high opportunity cost associated with other uses of the land. Second, government deficits often abort the supply of the incentive, even when projects have been approved to receive it. [114] Third, high transactions costs of obtaining the incentive make it difficult to use. Some projects have waited for more than three years for approval.

An additional important investment barrier of Colombia is the interest rate of banks. In 2002, the interest rate was above 31%.

VERs generate the possibility to ***alleviate the investment barrier as the decisive barrier*** for this A/R VCS project activity by generating access to international capital due to advance (up front) payments for VERs. It is likely that such additional revenue streams will provide a guarantee to some banks to facilitate the granting of commercial loans.

Technological barriers

Technological barriers involve an array of shortcomings in the successful establishment of tree plantations using native species. In general, there is a shortage

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[109] Instituto de Investigación de Recursos Biológicos "Alexander von Humboldt". Estudio del Mercado Colombiano de Semillas Forestales. 2003

[110] IDEA 2003

[111] see also Aldana, C. (2004): Sector forestal Colombiano; fuente de vida, trabajo y bienestar. Serie de documentación no. 50. Corporación nacional de Investigación y Fomento Forestal (CONIF), Bogotá, p. 50

[112] http://www2.standardandpoors.com

[113] http://www.minagricultura.gov.co/02componentes/06com_03d_cif.aspx

[114] See footnote42 96 and http://www.minagricultura.gov.co/02componentes/06com_03d_cif.aspx;

of required input and management factors. Most of the reforestation programs have been carried out with exotic tree species, especially Pinus, Eucalyptus and to a lesser extent Tectona and Gmelina species.[115] There are three reasons for this: 1) the lack of scientific and technical knowledge of native species, 2) the perception that native species imply a longer investment time frame (not always true), and 3) the environmental challenges associated with native species. In 2009, in Antioquia, the majority of the reforestations have been carried out with Pinus, followed by Tectona, Acacia and Eucalyptus.[116] A 2007 publication of the Government of Antioquia lists the largest reforestation companies of the country. The plantations of these largest reforestation companies consist mainly of Pinus but Eucalyptus, Tectona, Cypress, Gmelina and Ceiba are also planted.[117] This information is congruent with data provided in 2009 by the Ministry of Agriculture and Rural Development et al.[118]

As of September 1999, the total reforested surface in Colombia for industrial purposes was 145,759 hectares, according to consolidated data by SITEP (not including areas of less than 10 hectares). The predominant tree species in commercial reforestation programs belonged to the following botanical families: *Pinaceae* (55.1%), *Myrtaceae* (18.6 %), *Cupresaceae* (7.00 %), and *Verbenaceae* (7.1 %). The most planted species was *Pinus patula* with an area of 53,197 hectares, equivalent to (36.5 %) of the country's total. These forests were located primarily in Antioquia, Caldas, Cauca and Quindio provinces. These above-mentioned species were followed by *Eucalyptus grandis,* the second most abundant species with 15,265 hectares or (10.4 %), *Pinus caribea* with 10,365 hectares or (7.11%), and *Cuppresus lusitanica*, with 9, 982 hectares or (6.25 %). Other important species that were planted included: *Gmelina arborea* with 5,083 hectares, *Tabebuia rosea* with 3,988 hectares, and *Tectona grandis* with 3,501 hectares.[119]

In the project area there is a lack of knowledge regarding native tree plantations, a lack of skills for producing high quality seedlings, a lack of adequate tree planting, and a lack of measures to prevent planted trees from being subject to fire, pest and diseases. This impairs, among other things, the ability to guarantee sources of quality seeds. This can be proven due to the fact that native tree plantations are not common practice in Colombia. The project owner has to recognize all these obstacles and has to overcome these technical barriers. Part of the capacity work could be financed by the income of the carbon credits.

Barriers due to prevailing practice

As discussed earlier (see the section on "Technological barriers") most reforestations have been carried out with exotic (not native) tree species. This large-scale plantation project, with around 25 native species, is among the first of its kind in Colombia.[120, 121] Native species are mixed in the same area - not common practice in Colombia.

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[115] Lucía Atehortúa Gárces Ph. D in REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

[116] Informacion obtained by the "Cadena forestal de Antioquia", 2009

[117] "Reforestacion", una publicacion de la Gobernación de Antioquia, Medellin, October 2007

[118] Forestry Sector, Invest in Colombia. Ministry of Agriculture and Rural Development, National Federation for the Lumber Industry; National Forestry Investigation Center; Colombian Corporation of Agricultural Investigation. Bogotá, July 2009, page 15

[119] REFORESTATION A NATURAL PROCESS, Luis Gonzalo Moscoso Higuita, 2005

[120] "Reforestacion", una publicacion de la Gobernación de Antioquia, Medellin, October 2007

[121] Forestry Sector, Invest in Colombia. Ministry of Agriculture and Rural Development, National Federation for the Lumber Industry; National Forestry Investigation Center; Colombian Corporation of Agricultural

Common practice is a plantation of Pinus, Eucalyptus, Tectona, Cypress, Gmelina and Ceiba. The VCS carbon credit project will help to increase the general acceptance and the knowledge of native species (see "Technological barriers").

Civil unrest and instability barrier
In the past, the economic dynamics of both project areas have been impacted by armed conflicts between the Autodefensas Unidas de Colombia (AUC, United Self-Defence Forces of Colombia), the Colombian regular armed forces, the F.A.R.C.-E.P. (Fuerzas Armadas Revolucionarias de Colombia - Ejército del Pueblo), and other Guerrilla groups such as the Ejercicio Nacional de Liberación (ELN, National Liberation Army). At the time the project started, the AUC had a very strong presence in the Cáceres plantation area, and the FARC had a very strong presence in the Aracua plantation area.[122] Since the proposed locations are in an internal conflict region, both labor options and economic dynamics have been very depressed, and the social life of the local inhabitants has been deeply and negatively impacted.

The project will generate tax income for both local and national authorities. The economic situation today is the same as at the beginning of the project. That is, there are no economic activities available in the area that can provide labour and tax sources. A major reason for this is that both commercial agriculture and cattle farming have been widely abandoned by landowners due to blackmailing and kidnapping threats and actions by illegally armed groups. Most landowners decided to reduce economic activity on their lands, opting for unmanaged cattle farming to keep their property within a basic administrative and technical management stage. The reason is the avoidance of forcible displacements.[123]

In such a volatile environment it can be assumed, that any reforestation investment project that seeks to increase sustainable economic activity (as proposed by Asorpar Ltd.) without embeddedness in an international context, would be even more difficult to implement. Registering the project under an international standard will give the project more social acceptance among the impacted communities and local authorities. It will also lead to more safety with respect to armed conflict and forcible displacements. Social acceptance will be attained via the project's environmental benefits, new job creation and tax generation. The project will lend support to the Colombian government's policy of economic reactivation of armed conflict areas.

The project was conceived from its beginning as a carbon capture reforestation project. Asorpar Ltd. assumed the inherent internal socio-economic conflict risks of the regions, [124] given the possibility of having the project registered under an international standard.

Investigation. Bogotá, July 2009, page 15

[122] See e.g. http://worldmeets.us/images/FARC_map.gif or http://globalguerrillas.typepad.com/globalguerrillas/2005/09/journal_a_map_t.html or http://farm3.static.flickr.com/2015/2144612941_e9c041129c.jpg?v=0

[123] http://www.colombiassh.org/site/spip.php?article517

[124] http://www.scribd.com/doc/8579058/Paramilitarismo-de-Estado-en-Colombia; http://lacocalocacompany.blogcindario.com/2008/06/02225-mas-de-4-000-hectareas-de-coca-de-los-paramilitares-fueron-erradicadas-manualmente-en-antioquia-co.html; http://www.analitica.com/archivo/vam1997.05/semop27.htm;

Barriers relating to markets, transport and storage; unregulated and informal markets for timber, non-timber products and services prevent the transmission of effective information to project participants

One of the barriers in Arauca is the lack of infrastructure. The region is isolated and remote. The transportation costs for extracted timber are above industry averages. Generally, the preferred option of timber transportation is via rivers. Common procedure is shipping over the border to Venezuela (this is a natural route for transporting goods). However, the project owner considers this option as currently unfeasible for political reasons.[125] The supply of fertilizers, seeds, etc. is considered to be very expensive and difficult due to the lack of roads in the project region. There is no infrastructure of paved roads, rails or waterways (e.g., rivers). Therefore the PO has to invest in infrastructure such as water supply.

Due to a significant lack of infrastructure in Cravo Norte (and in Columbia in general), the transport of the timber is very expensive. Therefore it is difficult to compete on the national and international markets. Furthermore, the timber-market of Colombia is quite small, not sufficiently developed, dominated by pine trees, and prices are low. [126, 127]

<u>Sub-step 3b:</u> *Show that the identified barriers would not prevent the implementation of at least one of the alternative land use scenarios (except the proposed project activity)*

As explained in sub-step 3a above, the establishment of plantations with native species is limited by investment barrier, technological barrier, barriers due to prevailing practice, civil unrest and instability barrier and barriers relating to markets, transport and storage.

The table below illustrates which of the alternatives outlined in 2.4 are facing what barriers (a tick in the box means this alternative is facing this barrier). Details of each barrier are provided in step 3a above.

Alternative	Barrier				
	Investment	Technological	Prevailing practice	Civil unrest and instability	Markets, transport and storage
Extensive livestock farming					
Gold mining				X	
Reforestation with native species	X	X	X	X	X

[125] http://www.terra.com.co/noticias/articulo/html/acu23646-relaciones-entre-colombia-y-venezuela-marcadas-por-la-crisis.htm

[126] La cadena forestal y madera en Colombia, 1991-2005, page 15. Ministerio de Agricultura y Desarrollo Rural Observatorio Agrocadenas Colombia, Bogota, March 2005. http://201.234.78.28:8080/dspace/bitstream/123456789/875/1/20051121663_caracterizacion_forestal.pdf

[127] Interview with the project owner, 2010

Extensive livestock farming does not face any mentioned barrier. Ample lines of credit and financing sources exist for cattle farming (Banco Agrario) because of lower perceived risks, proven experience, and a steady cash flow (for further detail please refer to Step 3a: Barrier analysis). Extensive livestock farming is a prevailing practice in the project area (please refer to section 2.4). However, in its current form it has only limited appeal for illegally armed groups to intervene. Most of the meat production is directed to self-supply but nevertheless in Colombia exists well established market access where meat could be sold.

Gold Mining does only face the civil unrest and instability barrier because of its high economic attractiveness. Gold mining is a prevailing practice in Colombia and in the project area Cáceres (please refer to section 2.4). Technology is proved and because of its high economic attractiveness there is no barrier to obtain investment. Actually there is lot of demand of gold in the international market.

Reforestation with native species: The impact of all barriers has been discussed in detail in Step 3: Barrier analysis.

Step 4: Common practice analysis

Due to the large and low cost supply of wood and wood products from the abundant natural forests throughout the country, commercial reforestation is not commonly practiced in Colombia. Reforestation began in the 1940's at a very low scale and has never played a major role in the sector. Even though government plans and programs have promoted reforestation, this activity only registers 9,494 hectares per year, which is only 41% of the planning targets for the year 2000. [128]

In the 2000 report on the Financial Condition of the State (CORPOCALDAS), it was reported that only 1,900 hectares of new forest had been established between 1994 and 2000 (approximately 271 ha per year in the entire department).

This project is an initiative which differs substantially from the common practice, due to the fact that native species will be planted (see 2.5, Step 3: Barrier analysis, technological barriers).

Impact of VCS registration

The approval and registration of the proposed A/R VCS project activity will alleviate economic/financial hurdles and other identified barriers. The proposed A/R VCS project activity will generate the following benefits:

Additional income stream: Reducing the investment risks and cost of implementation of the project activity, by the provision of VERs as an additional, consistent, early, cash-flow stream (after CIF funding ran out and before first income from timber sales).

Diversification: Income from VERs depends only on reaching the growth objectives. Income from wood products depends both on reaching growth objectives and on a

[128] Supporting documentation for Bill 264 of 2004 shows that from 2000 to 2002 28,482 ha were planted in the entire country with CIF, which produces a reforestation rate of 9,494 ha per year.

viable market in the future, including viable and affordable transportation. The cost of the latter is uncertain, and thus the VERs are the only income of the project that can be estimated and expected with a reasonably low market risk. Therefore, without the VCS registration, the reforestation investment and the financial, social and environmental benefits that will accrue as a result will not be possible.

3. Monitoring:

3.1. Title and reference of the VCS methodology (which includes the monitoring requirements) applied to the project activity and explanation of methodology choices:

CDM approved afforestation and reforestation baseline methodology AR-AM0005 "Afforestation and reforestation project activities implemented for industrial and/or commercial uses" (Version 03)

3.2. Monitoring, including estimation, modelling, measurement or calculation approaches:

Monitoring entails the utilization of all information related to project development to estimate VERs at the end of an accreditation period. Monitoring activities include gathering information directly from the field and from indirect sources. Further, monitoring involves making the required calculations and estimations to assess if the project is being developed according to the PD and management plans, with the final aim to determinate GHG removals and leakage.

Continuous monitoring of the project sites (e.g., monitoring site preparation and planting) will be done. Continuous monitoring of forest management will also take place (e.g., monitoring re-planting, pruning, thinning, harvesting, and areas affected by disturbances).

Monitoring of survival rate will be done during the early stage of the forest establishment, covering the 1-3 year period after the planting activity. After year 3 it is impossible to replant because of competitive reasons. Monitoring of firebreaks in Cravo Norte will be done during the establishment and maintenance phases. Cáceres doesn't have artificial firebreaks because there are many roads and streams that function as natural firebreaks. The use of fossil fuels and fertilizer, if applied, will be monitored continuously each year.

The monitoring of the project and strata boundaries will be done before verification takes place. Part of this monitoring process is further the installation of permanent sample plots to monitor trees growth according to the forest management plan. The recollected data within the sample plots will serve another main monitoring purpose: the determination and verification of GHG removals.

Monitoring of leakage will be neglected, as no significant grazing and fuel-wood collection takes place according to the assumed baseline scenario.

Monitoring will be conducted by a professional team consisting of a forestry engineer as coordinator, technical assistants and the General Manager (GM). The coordinator will report directly to the GM.

All monitoring activities will be implemented using developed Standard Operational Procedures (SOPs) for data collection. Personnel will be trained to ensure data quality.

3.3. Data and parameters monitored / Selecting relevant GHG sources, sinks and reservoirs for monitoring or estimating GHG emissions and removals:

The data in the table below form part of the monitoring and are based on the requirements of the methodology. Data in the grey cells are not monitored, due to their insignificance or the fact that these practices do not occur in the project scenario.

Table 17: Data and parameters to be monitored

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
3.3.01	Stratum	Alpha numeric	d, m	Before project, or during the project	100%	GPS is used to identify coordinates of the boundary; used to geo-reference forest establishment activities
3.3.02	Sub-Stratum	Alpha numeric	d, m	Before project, or during the project	100%	GPS is used to identify coordinates of the boundary; used to geo-reference forest establishment activities
3.3.03	Area of stratum and sub-stratum	ha	d, m	Before project, or during the project	100%	Calculated from the points collected by GPS
3.3.04	Area of historic A/R	ha	c	Annual	100%	N/A
3.3.05	Site and soil preparation			Documented according to occurrence	100%	Site and soil preparation does neither involve slash and burn nor the removal of biomass for the planting area.
3.3.06	Biomass stock per unit area before slash and burn	t d.m./ha	c	Documented according to occurrence	100%	N/A; Slash and burn does not occur
3.3.07	Area planted per stratum	ha	c	Before project validation	100%	Spatial extent of the planted determined by the use of GPS
3.3.08	Stratum and sub-stratum composition		m	Before project validation	100%	Each stratum has special geophysical conditions. It is further differentiated by year of establishment, species planted and planting density
3.3.09	Number of trees survived	Numeric	m, c	After planting season	In temporary sample plots	Sampling survey: total number of seedlings
3.3.10	Survival rate	%	c	After planting season	In temporary sample plots	From the sampling survey: ratio of counted versus expected seedlings
3.3.11	Area of fire line and firebreaks	ha	c	During the establishment and maintenance	100%	Measured for different stratums
3.3.12	Amount and type of fertilizer N	kg N/ha/yr	m	Annually	100%	For different tree species and/or management

	applied per unit area during establishment					intensity
3.3.13	Area of land where N was applied during establishment	ha/yr	m	Annually	100%	For different tree species and/or management intensity
3.3.14	Area of weeding	ha	m	Documented according to occurrence. Recorded for each verification	100%	It will be recorded, which parcels (strata and/or sub-strata) received treatment
3.3.15	Amount and type of fertilizer N applied per unit area	kg N/ha/yr	m	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity
3.3.16	Area of land where N was applied	ha/yr	m	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity
3.3.17	Area of pruning	ha	m	Documented according to occurrence. Recorded for each verification	100%	Biomass will remain in the plantation
3.3.18	Area of thinning	ha	m	Documented according to occurrence. Recorded for each verification	100%	The areas are stored in the GIS database and in management (silviculture) maps to update the thinning schedule
3.3.19	Volume thinned	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume removed is recorded and tracked
3.3.20	Area of harvest	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	The spatial location of mature blocks is reported in GIS. The harvested areas are stored in the GIS database and in management (silviculture) maps to update the harvesting schedule
3.3.21	Volume harvested	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume harvested is recorded and tracked
3.3.22	Quantity of fossil fuels used in the forest management and operations	litre	m	Documented according to occurrence. Recorded for each verification	100%	
3.3.23	Area affected by disturbance (e.g. pest, diseases, fire)	ha	e, m	Documented according to occurrence. Recorded for each verification	100%	Date from field visits and observation. The area will be measured and mapped. The damage will be assessed and the area will be monitored to see

						how the vegetation develops/ recovers
3.3.24	Volume lost due to disturbance event	m^3	e	Documented according to occurrence. Recorded for each verification	100%	Will be estimated on the basis of last inventory data
3.3.25	Area re-growth after disturbance	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	Will be calculated from ground surveys
3.3.26	Area and location of fire-breaks	ha	m, c	Recorded for each verification	100%	Will be calculated from ground surveys
3.3.27	Area replanted or re-sowed	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	The area replanted will be remeasured and mapped
3.3.28	Composition of re-planted or re-sowed area		m	Before project verification	100%	Differentiated by year of establishment, species planted and planting density
3.3.29	Sample plot	Alpha numeric	m	Before first verification	100%	Plot ID will be assigned to each permanent sample plot
3.3.30	Location of the plot	GPS coordinates	m	Before each verification	100%	Field data or GPS coordinates to locate a plot in project boundary
3.3.31	Year of A/R	Year	m	Before each verification	100%	Year of planting is recorded in the monitoring plan
3.3.32	Tree species		d	Before each verification	100% within the PSP	Arranged in PDD
3.3.33	Number of trees	Number	m	Before each verification	100% within the PSP	Counted in plot measurement
3.3.34	Diameter at breast height (DBH)	cm	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval
3.3.35	Tree height	m	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval
3.3.36	Merchantable volume	m^3	c, e	Before each verification	100% within the PSP of min DBH class	Merchantable volume will be extrapolated to strata and/or sub-strata
3.3.37	Wood density	t d.m./m^3	d			N/A; Literature values
3.3.38	Biomass expansion factor (BEF)/species	Dimensionless	d			N/A; IPCC literature values
3.3.39	Root-to-shoot ratio	Dimensionless	d			N/A; IPCC literature values
3.3.40	Carbon fraction	tC/t. d.m.	d			N/A, IPCC default factor (0.5)
3.3.41	CO_2-e conversion factor	tCO_2/tC	d			N/A, IPCC default factor (3.667)
3.3.42	C stock in above ground biomass per stratum	tC	c	Before each verification	100% of samples of the stratum	Calculated
3.3.43	C stock in below ground biomass per	tC	c	Before each verification	100% of samples of the stratum	Calculated

	stratum					
3.3.44	C stock change above ground biomass per stratum	tC/yr	c	Before each verification	100% of samples of the stratum	Calculated
3.3.45	CO_2 stock in above ground biomass per stratum	tCO_2	c	Before each verification	100% of samples of the stratum	Calculated
3.3.46	CO_2 stock in below ground biomass per stratum	tCO_2	c	Before each verification	100% of samples of the stratum	Calculated
3.3.47	CO_2 stock change above ground biomass per stratum	tCO_2/yr	c	Before each verification	100% of samples of the stratum	Calculated
3.3.48	Grassland removed due to A/R per stratum	ha	e	Prior to project	Estimation of 100% of grassland area identified before the project implementation	N/A, insignificant. Area of grassland converted to forests
3.3.49	CO2 emissions due to grassland removal	tCO_2/ha	e, c	Prior to project	Estimation of 100% of grassland area identified before the project implementation	N/A, insignificant. Area of grassland converted to forests
3.3.50	Area affected by disturbance	ha	e	Before each verification	100% of the area affected by disturbance	Data from field visits and observation
3.3.51	CO2 emissions due to disturbance	tCO_2/ha	e, c	Before each verification	100% of the area affected by disturbance	Data from field visits and observation
3.3.52	Diesel / gasoline consumption in A/R activities	litre	m	Annually	100% of the diesel / gasoline consumption	Fuel consumption per unit area for site preparation / harvesting
3.3.53	Emission factor for diesel	kg/litre	d	At start of the project		N/A; National inventory, IPCC default value
3.3.54	Emission factor for gasoline	kg/litre	d	At start of the project		N/A; National inventory, IPCC default value
3.3.55	Area burnt	ha	m	Annual	100% of the applicable area	N/A; Measured for strata and sub-strata
3.3.56	Mean biomass per unit area	t d.m./ha	m	Annual	100% of the applicable area	Sample survey for different strata and sub-strata
3.3.58	Proportion of biomass burnt	Ratio	m	Annual	100% of the applicable area	N/A; Sampling survey after slash and burn
3.3.59	Biomass combustion efficiency	Ratio	d	Before the project		N/A; IPCC default value (0.5)
3.3.60	C/N ratio	Ratio	d	Before the project		N/A; IPCC default value (0.01)
3.3.61	N_2O emission from biomass burn	tCO_2e/yr	c	Before each verification	100% of the applicable area	N/A
3.3.62	CH_4 emission from biomass burn	tCO_2e/yr	c	Before each verification	100% of the applicable area	N/A
3.3.63	Total GHG emission from biomass burn	tCO_2e/yr	c	Before each verification	100% of the applicable area	N/A
3.3.64	Area of land fertilized	ha/yr	m	Annual	100% of the applicable area	Species & management
3.3.65	Amount of synthetic fertilizer N per ha	kg N/ha/yr	m	Annual	100% of the applicable area	N/A, 95-99% is organic fertilizer
3.3.66	Amount of	tN/yr	c	Annual	100% of the	

	synthetic fertilizer N				applicable area	
3.3.67	Volatile fraction of NH_3 & NO_x for fertilizers	Ratio	d	At the start of the project		N/A; IPCC default value (0.1)
3.3.68	Amount of organic fertilizer N	tN/yr	c	Annual	100% of the applicable area	
3.3.69	Volatile fraction of NH_3 & NO_x of organic fertilizers	Ratio	d	At the start of the project		N/A; IPCC default value (0.2)
3.3.70	Emission factor for emission from N input	N_2O N-input	d	Before monitoring		N/A; IPCC default value (1.25%)
3.3.71	Direct N_2O emission of N input	tCO_2e/yr	c	Annual	100% of the applicable amount	

The data in the table below identify project relevant GHG sources, sinks and reservoirs.

Table 18: Relevant GHG sources, sinks and reservoirs

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	Controlled, Related, or Affected by the project.
3.3.05	Site and soil preparation			Documented according to occurrence	100%	Site and soil preparation does neither involve slash and burn nor the removal of biomass for the planting area	Controlled and Related
3.3.07	Area planted per stratum	ha	c	Before project validation	100%	Spatial extent of the planted determined by the use of GPS	Controlled, Related, and Affected
3.3.09	Number of trees survived	Numeric	m, c	After planting season	In temporary sample plots	Sampling survey: total number of seedlings	Controlled
3.3.10	Survival rate	%	c	After planting season	In temporary sample plots	From the sampling survey: ratio of counted versus expected seedlings	Controlled
3.3.11	Area of fire line and firebreaks	ha	c	During the establishment and maintenance	100%	Measured for different stratums	Controlled, Related, and Affected
3.3.12	Amount and type of fertilizer N applied per unit area during establishment	kg N/ha/yr	m	Annually	100%	For different tree species and/or management intensity	Controlled and Related
3.3.15	Amount and type of fertilizer N applied per unit area	kg N/ha/yr	m	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity	Controlled and Related
3.3.19	Volume thinned	m^3	m, c	Documented according to occurrence.	100%	The volume removed is recorded and	Controlled and Related

				Recorded for each verification		tracked	
3.3.21	Volume harvested	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume harvested is recorded and tracked	Controlled and Related
3.3.22	Quantity of fossil fuels used in the forest management and operations	litre	m	Documented according to occurrence. Recorded for each verification	100%		Controlled and Related
3.3.24	Volume lost due to disturbance event	m^3	e	Documented according to occurrence. Recorded for each verification	100%	Will be estimated on the basis of last inventory data	Controlled
3.3.25	Area re-growth after disturbance	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	Will be calculated from ground surveys	Controlled
3.3.27	Area replanted or re-sowed	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	The area replanted will be remeasured and mapped	Controlled and Related
3.3.32	Tree species		d	Before each verification	100% within the PSP	Arranged in PDD	Controlled and Related
3.3.33	Number of trees	Number	m	Before each verification	100% within the PSP	Counted in plot measurement	Controlled and Related
3.3.34	Diameter at breast height (DBH)	cm	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval	Controlled
3.3.35	Tree height	m	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval	Controlled
3.3.36	Merchantable volume	m^3	c, e	Before each verification	100% within the PSP of min DBH class	Merchantable volume will be extrapolated to strata and/or sub-strata	Controlled
3.3.51	CO2 emissions due to disturbance	tCO_2/ha	e, c	Before each verification	100% of the area affected by disturbance	Data from field visits and observation	Controlled
3.3.52	Diesel / gasoline consumption in A/R activities	litre	m	Annually	100% of the diesel / gasoline consumption	Fuel consumption per unit area for site preparation / harvesting	Controlled and Related
3.3.56	Mean biomass per unit area	t d.m./ha	m	Annual	100% of the applicable area	Sample survey for different strata and sub-strata	Controlled, Related, and Affected
3.3.66	Amount of synthetic fertilizer N	tN/yr	c	Annual	100% of the applicable area		Controlled and Related
3.3.68	Amount of organic fertilizer N	tN/yr	c	Annual	100% of the applicable area		Controlled and Related
3.3.71	Direct N_2O emission of N input	tCO_2e/yr	c	Annual	100% of the applicable amount		Controlled and Related

3.4. Description of the monitoring plan

See 10 Monitoring Plan.

4. GHG Emission Reductions:

4.1. Explanation of methodological choice:

A/R activities are undertaken to produce timber for commercialization on grasslands that are either unmanaged or under extensive management. The grasslands display low soil carbon content (compared to the expected soil carbon content under the project activity) because of soil degradation, current management practices and natural conditions. In the case of Cáceres, previous gold mining severely altered and damaged the soil structure. In Cravo Norte, extensive livestock farming and natural climatic-edaphic conditions led to thin and infertile soils with low carbon content. Project activities will not displace grazing animals outside the project area. No other “pre-project activities” are taking place in the project area, and there haven’t been pre-existing A/R project activities (see 9.1, Step 7). For these reasons, this project is fully applicable to the methodology AR-AM0005 Version 03.

4.2. Quantifying GHG emissions and/or removals for the baseline scenario:

The approved methodology recommends estimating changes in carbon stocks in the living biomass of unmanaged grasslands based on land use categories identified in the baseline scenario: 1) maintenance of grassland in its present state and 2) the A/R implemented at a specified pre-project rate or a combination of both. Since no pre-project A/R activity has occurred, the latter won’t be considered. The carbon stock changes in living biomass of grassland (above and below ground) under the baseline scenario are calculated according to the formula below, as recommended in the methodology AR-AM0003 Version 03.

The land use under the baseline scenario is grassland. Added will be the case of Cáceres with areas of alluvial gold mining. Since the grassland will be maintained in its state, the methodology assumes the carbon pools to be in a steady state. Hence, the sum of the carbon stock changes of the living biomass in the grassland, for any year t, is considered to be zero. However, in some parts within the project boundary scattered shrubs and isolated trees are encountered. Since all isolated trees and shrubs won’t be removed within the project boundaries, there won’t be GHG emissions from the removal of the woody baseline vegetation. The same can be said for grass vegetation due to site preparation practices. Further, in accordance with the guidance contained in paragraph 35 of EB 42 meeting report, GHG emissions from the removal (loss) of herbaceous vegetation as a component of non-tree biomass are neglected. Accordingly, the *ex ante* baseline net GHG removals by sinks are set to zero.

where:

$\Delta C_{BSL,t}$ Sum of carbon stock changes in living biomass of grassland (above- and below-ground biomass) under the baseline scenario; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{GLB,t}$ Sum of carbon stock changes in living biomass of grassland (above- and below-ground biomass) under the baseline scenario – maintenance of grassland in its state; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{ARB,t}$ Sum of carbon stock changes in living biomass of trees (above- and below-ground biomass) under the baseline scenario with A/R activities implemented during the pre-project period; tonnes CO_2-e yr^{-1} in year *t*

T Ranges from 1 to end of crediting period; years

4.3. Quantifying GHG emissions and/or removals for the project:

4.3.1. Ex ante actual net GHG removal by sinks

The *ex ante* estimation of actual net GHG removal by sinks in the project activity are based on the carbon stock change in both above and below ground biomass. The estimation is calculated according to the formula below, as recommended in the methodology AR-AM0005 Version 03. The changes in carbon stocks in the living biomass pool are estimated based on the changes in carbon stocks of the living biomass of trees (gain and losses) minus increase in emissions of GHG with the project activity boundary.

where:

C_{ACTUAL} Actual net greenhouse gas removals by sinks; tonnes 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*; tonnes CO_2-e yr^{-1} in year *t*

$GHG_{E,t}$ GHG emissions by sources within the project boundary as a result of the implementation of the A/R project activity; tonnes CO_2-e yr^{-1} in year *t*

T Ranges from 1 to end of crediting period; years

I Stratum *i* (I = total number of strata)

J Species *j* (J = total number of species)

K Substratum *k* (K = total number of substrata)

Table 19: Ex ante project actual net GHG removals by sinks

		C_{ACTUAL}	$\Delta C_{ijk,t}$	$GHG_{E,t}$
Year of project	Year	Actual net GHG removals by sinks (tCO_2e)	Change in tree carbon stocks (tCO_2e)	GHG emissions by sources (tCO_2e)
1	2002	1,772	1,969	197
2	2003	10,034	11,149	1,115
3	2004	24,616	27,351	2,735
4	2005	43,783	48,648	4,865
5	2006	66,166	73,518	7,352
6	2007	90,558	100,620	10,062
7	2008	117,461	130,513	13,051
8	2009	147,336	163,707	16,371
9	2010	179,544	199,493	19,949
10	2011	213,876	237,640	23,764
11	2012	254,440	282,711	28,271
12	2013	308,427	342,697	34,270
13	2014	382,448	424,942	42,494
14	2015	480,973	534,414	53,441
15	2016	605,881	673,201	67,320
16	2017	755,988	839,986	83,999
17	2018	927,598	1,030,664	103,066
18	2019	1,115,469	1,239,410	123,941
19	2020	1,311,403	1,457,115	145,711
20	2021	1,507,617	1,675,130	167,513
21	2022	1,500,001	1,666,668	166,667
22	2023	1,688,295	1,875,883	187,588
23	2024	1,848,600	2,054,000	205,400
24	2025	1,979,780	2,199,756	219,976
25	2026	2,145,617	2,384,019	238,402
26	2027	2,224,284	2,471,427	247,143
27	2028	2,272,014	2,524,460	252,446
28	2029	2,375,733	2,639,703	263,970
29	2030	2,505,423	2,783,803	278,380
30	2031	2,389,921	2,655,467	265,547

4.3.1.1. Tree carbon stock changes over time

The carbon stock changes in living biomass of trees (above and below ground biomass) in the project scenario are calculated according the formula below as recommended in the methodology AR-AM0005 Version 03.

where:

$\Delta C_{ijk,t}$ Average annual change in carbon stock in living biomass of trees in the project scenario for stratum *i*, species *j*, sub-stratum *k*; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{AB,ijk,t}$ Average annual change in carbon stock in above-ground biomass for stratum *i*, species *j*, sub-stratum *k*; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{BB,ijk,t}$ Average annual change in carbon stock in below-ground biomass for stratum *i*, species *j*, sub-stratum *k*; tonnes CO_2-e yr^{-1} in year *t*

T Ranges from 1 to end of crediting period; years

I Stratum *i* (I = total number of strata)

J Species *j* (J = total number of species)

K Substratum *k* (K = total number of substrata)

The generic approach in the *ex ante* estimation of carbon stocks is as follows:

1. Step: Calculation of the commercial tree volume
2. Step: Calculation of the commercial tree biomass
3. Step: Calculation of the above-ground tree biomass
4. Step: Calculation of the below-ground tree biomass
5. Step: Calculation of the total tree biomass
6. Step: Calculation of the tree carbon sequestered
7. Step: Calculation of the tree CO2-e sequestered
8. Step: Extrapolation to hectare, sub-strata, strata and total project area values

Step 1:

Timber yield estimations are usually predicted by fitting a suitable mathematical equation to the data. The equation should calculate future yields under conditions resembling those of the original data set.[129] Usually, available data play an important role when adapting the most suitable model to the different characteristics that can occur on one site. However, since the plantations are not yet or recently established, and no growth and yield trials exist for most of the native species and mixed stands proposed by Asorpar Ltd., the data base is considered to be insufficient to use to adjust growth models adequately for *ex ante* estimation. Hence, the project relies predominantly on general information available about the growth performance of the selected tree species.

Against this background, the growth model developed by Gadow and Murray (1993) was used for *ex ante* yield estimations. The model resembles a generalized yield model for various tree species and age-class based timber resource projection. The model is applicable to situations where data of MAI_{max} and t_{max} are available. Following this method, aggregate estimates of the mean annual increment (MAI) are calculated based on experience, historical data and literature values. As tree growth is not linear, such MAI estimates have to be used in conjunction with a reference age, at which MAI culminates, designated as t_{max}. The MAI at this age is defined as MAI_{max}. The growth function presented below is derived from the Chapman-Richards growth model, which is often used to develop growth models for $D_i(t)$, $H(t)$ and $V(t)$.[130]

where

[129] Gadow, K. v. and Murray D., M., 1993: A Flexible Model for Regional Timber Forecasting. Southern Journal for Applied Forestry Research 17 (2): pp. 112-115

[130] Clutter, J.L., Fortson, J.C., Pienaar, L.V., Brister, G.H. and Bailey, R.L., 1983: Timber management: a qualitative approach. John Wiley & Sons, New York. P. 333

$V_{(t)}$	Timber yield in time t; m³ in year *t*
A	Scaling factor for the size of the variable; m³ in year *t*
K	Parameter that scales the time axis; dimensionless
M	Parameter that scales the time axis; dimensionless
T	Time after planting; year

The variable *t* represents time after planting. The parameter *A* is a scaling factor for the size of the variable. It can also be described as a measure of final saturation or maximum size of an organism, and calibrates the growth model. The units of *A* are the same as of the variable itself. The parameter *k* scales the time axis and is given as the inverse of time. The parameter t_0 is the point at which the model variable is greater than or equal to zero. The fourth parameter *m* offers further flexibility concerning the shape of the growth curve, and together with the parameter *k* determines the form and orientation of a growth model with respect to the time axis.[131]

Step 2:
The species specific basic wood densities (D; t d.m./m³) were retrieved from the literature to convert the commercial tree volume into tree biomass. The values obtained for the tree species are listed in the table below. If not marked differently, the values refer to the wood density database of the World Agroforestry Centre[132]. Following a conservative approach, the lowest value of the range is applied in the calculation.

Table 20: Basic wood densities

Scientific name	Family	Common name	Basic wood density	Source
			t d.m/m³	
Acacia mangium	Mimosaceae	Acacia	L=0.45 / M=0.53 / H=0.69	
Cariniana pyriformis	Lecythidaceae	Abarco	L=0.48 / H=0.839	
Cedrela odorata	Meliaceae	Cedro	L=0.41 / H=0.525	
Cespedesia macrophylla	Ochnaceae	Paco	M=0.63	133
Cordia gerascanthus	Boraginaceae	Solera	M=0.74 / M=0.897	
Croton smithianus	Euphorbiaceae	Guacamayo	M=0.51	134
Didimopanax morototoni	Araliaceae	Tortolito	M=0.41 / M=0.58	
Dipteryx oleifera	Fabaceae	Almendro/Choibá	M=0.85	135
Enterolobium cyclocarpum	Leguminosea	Piñon	L=0.35 / M=0.46 / H=0.6	
Gmelina arborea	Verbenaceae	Melina	L=0.4 / M=0.48 / H=0.56	
Hevea sp	Euphorbiaceae	Caucho	L=0.55 / M=0.61 / H=0.7	
Hymenaea courbaril	Leguminosea	Algarrobo	M=0.73	
Ochroma pyramidale	Bombacaceae	Balso	L=0.096 / M=0.19 / H=0.24	
Pochota quinata[136]	Bombacaceae	Ceiba	L=0.35 / M=0.48 / H=0.55	
Schyzolobium parahyba	Leguminosea	Tambor	L=0.24 / H=0.479	
Swietenia macrophylla	Meliaceae	Caoba	L=0.485 / M=0.61 / H=0.84	
Tabebuia rosea	Bignoniaceae	Roble	L=0.48 / H=0.609	
Tapirira guianensis	Anacardiaceae	Fresno	M=0.5	

Species where no specific basic wood densities could be identified from the literature, a conservative value of 0.3 has been applied.

131 Gadow, K. v., 2004: Waldstruktur und Wachstum und Forsteinrichtung – Steuerung und Analyse der Waldentwicklung. Translation: Forest structure and growth, and forest management - control and analysis of forest development. Universitätsdrucke Göttingen.
132 World Agroforestry Centre http://www.worldagroforestrycentre.org/sea/Products/AFDbases/WD/
133 Reyes, G., Brown, S., Chapman, J. and Lugo, A.E. (1992), Wood densities of tropical tree species
134 Since a specific basic wood density could not be found the lowest "Medium" value from 7 Species of the same Genus was chosen from the World Agroforestry Centre http://www.worldagroforestrycentre.org/sea/Products/AFDbases/WD/
135 Laboratorio de Tecnología de la Madera (1986). Descirpción Anatómica y Propiedades Físico-mecánicas de 10 maderas Nicaragüenses. Managua (p.126). Cited in http://www.unalmed.edu.co/~lpforest/PDF/Choiba.pdf
136 Listed on the World Agroforestry Centre webpage as *Bombacopsis quinata*.

Step 3:
The above-ground tree biomass is calculated using the Biomass Expansion Factor (BEF; dimensionless). Since species specific parameters for the project sites and the region were not available, the project participants use for all tree species a default value from the GPG LULUCF 2003[137]. The **BEFs** given in Table 3A.1.10 of the GPG LULUCF represent averages for average growing stock or age. The project participants are using the BEF for the climate zone "Tropical" and forest type "Broadleaf": 3.4 (2.0-9.0). The lowest range value (2.0) is used to maintain a conservative approach.

Step 4:
The below-ground tree biomass is calculated using the Root-Shoot-Ratio (R; dimensionless). Since species specific parameters for the project sites and the region were not available the project participants use for all tree species a default value from the GPG LULUCF 2003[138]. The **Rs** given in Table 3A.1.8 of the GPG LULUCF represent an average below-ground to above-ground biomass ratio (t d.m./t d.m.). The project participants are using the R for the climate zone "Tropical/Sub-tropical" and vegetation type "Secondary tropical/sub-tropical forest": 0.42 (0.14-0.83). The lowest range value (0.14) is used to maintain a conservative approach.

Step 5:
The total tree biomass is then calculated by adding the above and below-ground biomass from steps 3 and 4.

Step 6:
The tree carbon sequestered is than calculated by applying the Carbon Fraction (CF; tC/t d.m.) default value of 0.5 to the total tree biomass.

Step 7:
The factor of 3.667 (44/12) is applied to convert the tree carbon sequestered to tree CO2-e sequestered.

Step 8:
The final step is to extrapolate the obtained species specific values to hectare, sub-strata, strata and total project area values, considering the relative tree species distribution in the reference areas.

Table 21: Ex ante calculation of carbon stock in living biomass of trees in the project scenario

Year of project	Year	Total AB+BB Carbon (tCO_2e)
1	2002	1,969
2	2003	11,149
3	2004	27,351
4	2005	48,648
5	2006	73,518
6	2007	100,620
7	2008	130,513
8	2009	163,707

[137] IPCC (2003), GPG for LULUCF. Edited by Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F. and retrieved from http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.html
[138] IPCC (2003), GPG for LULUCF. Edited by Penman, J., Gytarsky, M., Hiraishi, T., Krug, T., Kruger, D., Pipatti, R., Buendia, L., Miwa, K., Ngara, T., Tanabe, K. and Wagner, F. and retrieved from http://www.ipcc-nggip.iges.or.jp/public/gpglulucf/gpglulucf_contents.html

9	2010	199,493
10	2011	237,640
11	2012	282,711
12	2013	342,697
13	2014	424,942
14	2015	534,414
15	2016	673,201
16	2017	839,986
17	2018	1,030,664
18	2019	1,239,410
19	2020	1,457,115
20	2021	1,675,130
21	2022	1,666,668
22	2023	1,875,883
23	2024	2,054,000
24	2025	2,199,756
25	2026	2,384,019
26	2027	2,471,427
27	2028	2,524,460
28	2029	2,639,703
29	2030	2,783,803
30	2031	2,655,467

4.3.1.2. GHG emissions by sources increased as result of project activity

GHG emissions as a result of project activities will be calculated according to the approved methodology. The project takes into account the increase in emissions of GHG gases resulting from use of fossil fuel, biomass loss and the use of fertilizer. Fossil fuel combustion, for instance, occurs during thinning and harvesting activities, but the methodology excludes transportation fuel.

where:

$GHG_{E,t}$	Annual GHG emissions as result of the implementation of the A/R project activity within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{FuelBurn,t}$	CO_2 emissions from combustion of fossil fuels within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{BiomassLoss,t}$	GHG emissions from the loss of biomass in site preparation and conversion to A/R within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{Non-CO2,BiomassBurn,t}$	Non-CO2 emission as a result of biomass burning within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years

The project participants assume that a small amount of GHG emissions will result from site preparation and plantation management activities. However, the proposed A/R project activity does not engage in any burning practices during site preparation. Further, conversion of herbaceous vegetation can be neglected, and the loss of GHG sequestered in woody biomass will not occur since trees and shrubs will not be removed.

However, for the project participants, it is a difficult task to estimate ex ante GHG emissions with a high degree of accuracy. To maintain a conservative approach for the ex-ante calculation, the proposed A/R project activity applies a default 10% project GHG emission value based on the CO2-e stock in living biomass of trees in the project scenario However, this value will probably be adjusted during the verification process.

Table 22: Sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of an A/R project activity

Year of project	Year	$GHG_{E,t}$	$GHG_{E,t}$: %[139]
1	2002	197	10 %
2	2003	1,115	10 %
3	2004	2,735	10 %
4	2005	4,865	10 %
5	2006	7,352	10 %
6	2007	10,062	10 %
7	2008	13,051	10 %
8	2009	16,371	10 %
9	2010	19,949	10 %
10	2011	23,764	10 %
11	2012	28,271	10 %
12	2013	34,270	10 %
13	2014	42,494	10 %
14	2015	53,441	10 %
15	2016	67,320	10 %
16	2017	83,999	10 %
17	2018	103,066	10 %
18	2019	123,941	10 %
19	2020	145,711	10 %
20	2021	167,513	10 %
21	2022	166,667	10 %
22	2023	187,588	10 %
23	2024	205,400	10 %
24	2025	219,976	10 %
25	2026	238,402	10 %
26	2027	247,143	10 %
27	2028	252,446	10 %
28	2029	263,970	10 %
29	2030	278,380	10 %
30	2031	265,547	10 %

4.3.2. Leakage

See 9 Baseline Report (Step 8), and 10 Monitoring (7. Monitoring leakage).

The methodology AR-AM0005 considers two sources of leakage:

$$LK_t = LK_{Displacement\_grazing,t} + LK_{Fuelwood,t}$$

where:

LK_t	Increase of GHG emissions outside the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$LK_{Displacement\_grazing,t}$	Increase of GHG emissions outside the project boundary resulting from displacement of grazing activities; tonnes CO_2-e yr^{-1} in year *t*
$LK_{Fuelwood,t}$	Increase of GHG emissions outside the project boundary resulting from displacement of fuel wood collection; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years

However, the displacement of grazing activities to other grasslands (without overgrazing) does not result in leakage. Generally it is assumed that grazing activities continue to be executed in an extensive manner within the project boundaries and commercial animal farming is not present. Hence, leakage from displacement of grazing activities is considered to be zero:

Further, there is no collection of firewood in the baseline scenario of the project area. Therefore, this variable is set to zero:

[139] Project emissions are estimated to be a percentage of the estimated accumulated tCO2e sequestered through the A/R project activity.

$LK_{Fuelwood} = 0$

Based on both contemplations, the A/R project activity considers leakage to be zero:

$LK = 0$

4.4. Quantifying GHG emission reductions and removal enhancements for the GHG project:

The general equation used for determination of net anthropogenic GHG removals by sinks is as follows:

$$C_{AR,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - LK_t$$

where:

$C_{AR,t}$	Net anthropogenic GHG removals by sinks; tonnes CO_2-e yr^{-1} in year *t*
$\Delta C_{ACTUAL,t}$	Actual net GHG removals by sinks; tonnes CO_2-e yr^{-1} in year *t*
$\Delta C_{BSL,t}$	Baseline net GHG removals by sinks; tonnes CO_2-e yr^{-1} in year *t*
LK_t	Leakage; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years

Table 23: Calculation of net anthropogenic GHG removals by sinks (tonnes of CO_2e)
Summary of results obtained in Sections 4.2.2, 4.3.1, and 4.3.2.

		C_{AR}	ΔC_{ACTUAL}	ΔC_{BSL}	LK
Year of project	Year	Estimation of net anthropogenic GHG removals by sinks (tCO_2e)	Estimation of actual net GHG removals by sinks (tCO_2e)	Estimation of baseline net GHG removals by sinks (tCO_2e)	Estimation of leakage (tCO_2e)
1	2002	1,772	1,772	0	0
2	2003	10,034	10,034	0	0
3	2004	24,616	24,616	0	0
4	2005	43,783	43,783	0	0
5	2006	66,166	66,166	0	0
6	2007	90,558	90,558	0	0
7	2008	117,461	117,461	0	0
8	2009	147,336	147,336	0	0
9	2010	179,544	179,544	0	0
10	2011	213,876	213,876	0	0
11	2012	254,440	254,440	0	0
12	2013	308,427	308,427	0	0
13	2014	382,448	382,448	0	0
14	2015	480,973	480,973	0	0
15	2016	605,881	605,881	0	0
16	2017	755,988	755,988	0	0
17	2018	927,598	927,598	0	0
18	2019	1,115,469	1,115,469	0	0
19	2020	1,311,403	1,311,403	0	0
20	2021	1,507,617	1,507,617	0	0
21	2022	1,500,001	1,500,001	0	0
22	2023	1,688,295	1,688,295	0	0
23	2024	1,848,600	1,848,600	0	0
24	2025	1,979,780	1,979,780	0	0
25	2026	2,145,617	2,145,617	0	0
26	2027	2,224,284	2,224,284	0	0
27	2028	2,272,014	2,272,014	0	0
28	2029	2,375,733	2,375,733	0	0
29	2030	2,505,423	2,505,423	0	0
30	2031	2,389,921	2,389,921	0	0

The complete excel sheet for the carbon sequestration calculation has been provided to the DOE for revision.

5. Environmental Impact:

In Colombia no environmental impact assessment was required for reforestation projects with a project start date in 2002.

In accordance with the National Biodiversity Policy ("the Policy"), it is understood that the value of biological diversity is derived from maintaining the environmental services that biodiversity provides, and ensuring the intelligent use of the available options for sustainable management.

The reforestation projects intend to: 1) impact biodiversity in a positive manner, 2) use all components of biodiversity in a sustainable way, and 3) contribute to the socio-economic development of the regions where the projects are located.

The reforestation projects combat several of the most important causes of biodiversity loss in Colombia, such as:

- **The overexploitation of species in order to supply the industry and the timber market.** This has a serious negative impact on biodiversity in Colombia. The development of the forestry projects—which are being established with commercial objectives—will meet a portion of the market's needs via legal means. At the same time, they will help reduce pressure on native forests. In addition, the projects will include restoration of degraded native forests, which is an additional benefit that will not be counted as emission reduction activity.
- **Pollution** is a direct cause of biodiversity loss. Specifically, the Policy considers that pollution caused by the intensive use of pesticides and fertilizers has led to alterations in river basins, with associated losses to the diversity of flora and fauna in affected ecosystems that have not yet been calculated. In accordance with the Policy, the use of agrochemicals in the project is minimal; organic fertilizer is used, internal transport is mainly done by animals without using polluting vehicles, septic tanks are constructed for the wastewater management, "living fences" with fast growing and forage producing species are used, conservation practices of neighboring forests are applied and native species of the region are planted.This will help to mitigate the impacts that could arise as a result of this practice.

- Finally, the project owner recognizes carbon sequestration as one of the most important environmental services associated with forest plantations. In this regard, the development of the project has a direct mitigating effect on the problem of **climate change**, which is now considered to be one of the principal causes of biodiversity loss in Colombia.

The project will be carried out in accordance with the three strategies of the National Biodiversity Policy: **conserve, understand, and utilize**, as follows:

- **Conserve.** The project's activities include rehabilitation of areas degraded by grazing and gold mining. The project will alleviate destructive pressure on intact natural forest resources.

- **Understand.** The project will serve as an exemplary model for a newly designed bi-national study program, "Tropical Forestry Science", a cooperation between Universidad de Medellin, Colombia, and Georg-August-University of Göttingen, Germany. In addition to the education of employees in the project areas, it is foreseen that the project will include guided tours of school classes for educational purposes in Cáceres, since in this zone it is very important to show alternative activities with respect to Coca cultivation and gold mining.
- **Utilize.** The proper utilization of resources is taken into consideration. The plantations are being established for a commercial purpose. They will be managed sustainably, and low-impact machinery will be used.

Finally, the project activities contribute to the regulation of hydrological cycles, the production of oxygen, and climate regulation—benefits considered as essential ecosystem services in the National Biodiversity Policy.

The project is in accordance with the National Biodiversity Policy, the Forest Policy, and the National Forestry Development Plan.

The project is being developed in consistency with the National Development Plan, since it includes actions for the prevention of forest fires and the generation of plant matter for the restoration and rehabilitation of forests. Also, the project contributes to the mitigation of climate change, which is in line with the goal of "environmental management that promotes sustainable development."

Asorpar Ltd. was created with multiple objectives. The main objective is to promote native species plantations, since almost no experience exists in establishing and maintaining this type of plantation in the target zones. The project is accompanied by the elimination of periodic burning; the creation of efficient and controlled spaces for the correct preparation of materials to be used in the field; the formulation of technical datasheets; the creation of efficient operational and environmental procedures for each of the operation's sub-processes; the rational use of chemicals and other external sources of nutrition for the prevention of pests and diseases; waste-management; and the continuous training of staff involved in the development of the project.

6. Stakeholders comments:

The stakeholders' consultation process was undertaken in October 2009. The goals were to discover and assess opinions and views about the project, and to obtain locals' comments through a questionnaire and an open discussion after its implementation. It is possible that interested parties can maintain the communication with the project owners by email.[140]

The project owners sought to include stakeholders from all walks of life in the feedback process. To achieve this goal, relevant stakeholders were identified and invited according to the following broad stakeholder categories:

- Entities with local, regional and national leadership.
- NGOs that are dedicated and interested in the environment.
- Representatives of local government and government authorities, in particular the relevant environmental authorities. They are responsible for rural development. With State acceptance Asorpar obtains additional publicity and ligitimacy for their project.
- Umatas (Unidad municipal de asistencia técnica agropecuaria) have been invited as the responsible environmental agency at the municipal level.
- Representatives of educational institutions.
- Representatives of industry associations.
- Project investors, local business people, and others. These stakeholders shall be informed and motivated to invest and to continue with their investment in the respective sector.
- Indigenous communities and inhabitants of nearby villages and towns were also invited. These stakeholders are addressed since they are an important source of labor force for the project. Their support and identification with the project is critical for its successful implementation.
- Police and military authorities were invited since their presence is essential to protect the project activities.

Stakeholders were identified with the help of civil servants from the city hall, by a telephonebook/internet search, and Asorpar's contact list.

Stakeholders from these categories were invited to the Local Stakeholder Consultations in both Cáceres (Antioquia) and Cravo Norte (Arauca) in October 2009. The meeting in Cáceres attended 39 stakeholders and in Cravo Norte 44 stakeholders.

In regard to the communities' perception of the project impacts, questions have focused on:

- Air quality
- Water quality and quantity
- Soil quality
- Biodiversity
- Contribution to employment creation in the formal sector
- Human and institutional capacity
- Availability of land

[140] Email addresses have been mentioned in the written invitation and during the consultation.

Stakeholders were identified and invited via email two weeks before the consultation took place. Below is listed a brief summary of conclusions from the stakeholder consultation that took place in Cravo Norte, Arauca, October 26th, 2010, and in Cáceres, Antioquia, October 29th, 2010.

Cravo Norte, Arauca:
In general, local people were impressed with the project. One important project benefit for them was the generation of employment. However it was controversially discussed whether the amount of created employment will remain constant once the trees have been planted. It was pointed out by the project implementers that maintenance activities such as pruning, thinning and maintenance of fences etc. will require more or less the same amount of labor throughout the life cycle of the project. In addition it was argued that the potential exists that more jobs will be created in the processing timber industry once timber can be harvested. During the consultation stakeholders pointed out that sufficient people are available to work in the plantations and that the project will motivate young locals to study. Further, locals understood that benefits will accrue via capacity building that will accompany the project activity.

Since the local stakeholders were quite enthusiastic about the proposed project activity, they asked how they can get access to such mechanisms and create similar project initiatives on their own land. They highlighted that they have limited possibilities to initiate similar project activities but such a project can be easily implemented by a company like Asorpar Ltd. The most important barrier from their perspective is the lack of income generation between the initial investment stage (plantation establishment) and the first timber harvest.

In general, there is plenty of land available for reforestation projects, but conflicts with the “Guerillas” are still present, which makes long-term investments insecure and thus unattractive for most individuals. This trend is reaffirmed by the fact that subsidies made available of reforestation activities by the Colombian State (such as the CIF) were requested to such a limited extend that funds were eventually returned to the Federal Government.

Cáceres, Antioquia:
The general positive impression of the proposed project, as perceived in Cravo Norte, also holds true for the stakeholder consultation in Cáceres. Locals there emphasized the project’s potential to improve degraded soils that resulted from unsustainable mining practices. Beyond question, a significant amount of land has been heavily degraded and no longer permits the generation of sufficient income from livestock farming. Stakeholders commented that livestock farming doesn’t generate as much employment in comparison to a reforestation project.

The proposed project area is heavily impacted by conflicts and violence through the “Paramilitary” units active in the region. This situation is more severe in areas that have potential for gold mining. The project activity represents an alternative to undesired land use practices such as the cultivation of Coca and the degradation of soils by mining activities. Although there is enough land available for reforestation projects, stakeholders mentioned that 90 % of the land is controlled by the “Paramilitary,” thus limiting their ability to develop their land in a sustainable (alternative) way. So far locals have depended on help from the government. People perceive a potential change that might go along with such a proposed project activity, and so the mayor expressed the idea to organize guided tours for school classes for educational purposes in Cáceres, demonstrating that alternatives exist to Coca cultivation and gold mining.

7. Schedule:

Chronological plan for the date of initiating project activities, date of terminating the project, frequency of monitoring and reporting and the project period, including relevant project activities in each step of the GHG project cycle.

The following schedule summarizes the chronological plan of the project distinguishing actions related with carbon issues.

Table 24: Tentative Chronological plan

Activity	Category	Sub-Category	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
Carbon cycle																																
	Start date		x																													
	Previous consideration		x																													
	LoA							x																								
	Eligibility study							x																								
	Validation										x																					
	Registration											x																				
	Monitoring										x						x					x					x					x
	Verification											x					x					x					x					x
	End date																															x
Planting																																
	1. Sub-Stratum	1/C1	x																				x									
	2. Sub-Stratum	2/C1+2/C2	x																				x									
	3. Sub-Stratum	1/C2	x																				x									
	4. Sub-Stratum	1/C3			x																				x							
	5. Sub-Stratum	1/C4				x																				x						
	6. Sub-Stratum	1/C7						x																				x				
	7. Sub-Stratum	1/A1+A2 Macanilla							x																				x			
	8. Sub-Stratum	3/A5+A6MataDeCorozo								x																				x		
	9. Sub-Stratum	5/A9Betania+A10LaBerraquera+A11SolNaciente+A12MatadeCorozo+A13Macanilla										x																				x
	10. Sub-Stratum	6/A14SolNaciente+A15LaMagdalena											x																			
	11. Sub-Stratum	7/A16SanMartin+A17LaMagdalena												x																		
	12. Sub-Stratum	8/A18SanMartin+A19LaMaría													x																	
	13. Sub-Stratum	9/A20LaMaría+A21LaTrinidad														x																
	14. Sub-Stratum	10/A23LaTrinidad+A22ElEspirituSanto															x															
	15. Sub-Stratum	11/A24ElEspirituSanto																x														
	16. Sub-Stratum	12/A25ElEspejo																	x													
	17. Sub-Stratum	13/A26ElGranChaparral+A27Nucleo											x																			
	18. Sub-Stratum	14/A28ElGranChaparral+A29Nucleo												x																		
	19. Sub-Stratum	15/A30ElGranChaparral+A31Nucleo													x																	
	20. Sub-Stratum	16/A32ElGranChaparral+A33Nucleo														x																
	21. Sub-Stratum	17/A34ElGranChaparral+A35Nucleo															x															
Thinning																																
	1. Sub-Stratum	1/C1							x					x															x			
	2. Sub-Stratum	2/C1+2/C2							x					x															x			
	3. Sub-Stratum	1/C2							x					x															x			
	4. Sub-Stratum	1/C3									x					x															x	
	5. Sub-Stratum	1/C4										x					x															x
	6. Sub-Stratum	1/C7												x					x													
	7. Sub-Stratum	1/A1+A2 Macanilla													x					x												
	8. Sub-Stratum	3/A5+A6MataDeCorozo														x					x											
	9. Sub-Stratum	5/A9Betania+A10LaBerraquera+A11SolNaciente+A12MatadeCorozo+A13Macanilla																x					x									
	10. Sub-Stratum	6/A14SolNaciente+A15LaMagdalena																	x					x								
	11. Sub-Stratum	7/A16SanMartin+A17LaMagdalena																		x					x							
	12. Sub-Stratum	8/A18SanMartin+A19LaMaría																			x					x						
	13. Sub-Stratum	9/A20LaMaría+A21LaTrinidad																				x					x					
	14. Sub-Stratum	10/A23LaTrinidad+A22ElEspirituSanto																					x					x				
	15. Sub-Stratum	11/A24ElEspirituSanto																						x					x			
	16. Sub-Stratum	12/A25ElEspejo																							x					x		
	17. Sub-Stratum	13/A26ElGranChaparral+A27Nucleo																	x					x								
	18. Sub-Stratum	14/A28ElGranChaparral+A29Nucleo																		x					x							
	19. Sub-Stratum	15/A30ElGranChaparral+A31Nucleo																			x					x						
	20. Sub-Stratum	16/A32ElGranChaparral+A33Nucleo																				x					x					
	21. Sub-Stratum	17/A34ElGranChaparral+A35Nucleo																					x					x				
Harvesting																																
	1. Sub-Stratum	1/C1																				x										
	2. Sub-Stratum	2/C1+2/C2																				x										
	3. Sub-Stratum	1/C2																				x										
	4. Sub-Stratum	1/C3																						x								
	5. Sub-Stratum	1/C4																							x							
	6. Sub-Stratum	1/C7																									x					
	7. Sub-Stratum	1/A1+A2 Macanilla																										x				
	8. Sub-Stratum	3/A5+A6MataDeCorozo																											x			
	9. Sub-Stratum	5/A9Betania+A10LaBerraquera+A11SolNaciente+A12MatadeCorozo+A13Macanilla																													x	
	10. Sub-Stratum	6/A14SolNaciente+A15LaMagdalena																														x
	11. Sub-Stratum	7/A16SanMartin+A17LaMagdalena																														
	12. Sub-Stratum	8/A18SanMartin+A19LaMaría																														
	13. Sub-Stratum	9/A20LaMaría+A21LaTrinidad																														
	14. Sub-Stratum	10/A23LaTrinidad+A22ElEspirituSanto																														
	15. Sub-Stratum	11/A24ElEspirituSanto																														
	16. Sub-Stratum	12/A25ElEspejo																														
	17. Sub-Stratum	13/A26ElGranChaparral+A27Nucleo																														x
	18. Sub-Stratum	14/A28ElGranChaparral+A29Nucleo																														
	19. Sub-Stratum	15/A30ElGranChaparral+A31Nucleo																														
	20. Sub-Stratum	16/A32ElGranChaparral+A33Nucleo																														
	21. Sub-Stratum	17/A34ElGranChaparral+A35Nucleo																														

8. Ownership:

8.1. Proof of Title:

The lands are private property of Asorpar Ltd. and the investors. A copy of the titles is available for the company hired for validation process.

8.2. Projects that reduce GHG emissions from activities that participate in an emissions trading program (if applicable):

N/A

9. Baseline Report:

9.1. Baseline Methods

The steps followed for this evaluation were:

Step 1: Delineation of project boundary
The boundaries of the project area were established by means of geo-referenced topographical mapping with global positioning system (GPS). The information was entered into a geographic information system (GIS).

Step 2: Evaluation of the eligibility of the delimited area
Land eligibility was evaluated through a multi-temporal satellite image analysis which was described in Section 4. The determination of eligible areas was done based on LandSat images with the support of GeoEye imagery, processed with ERDAS and Arc View, mainly working with a visual interpretation methodology. The results allow us to know the area and perimeter of each vegetal cover. In eligible areas, we can also distinguish between workable and non -workable areas.

The land cover (forest-nonforest) classification was based on satellite images in a two stage process:

- Landsat images (30 x 30 m of resolution), years 1992 and 2002 were interpreted with the same criteria in order to make it comparable between them and make it applicable to standard requirement. The result of this work was a map and a quantification of pasture areas for both years.
- TruEarth Image (15 x 15 m of resolution), year 2010 was used as a support image in order to a more accurate view of the area that was useful to distinguish eligible but now workable areas.

Materials used

i. Satellite images:

Cravo Norte, Aruaca, Colombia

Sensor	Path	Row	Date
Landsat TM	5	55	27-Feb-90
Landsat TM	5	56	27-Feb-90
Landsat TM	6	55	25-Mar-91
Landsat TM	6	56	25-Mar-91
Landsat ETM+	5	55	21-Dec-02
Landsat ETM+	5	56	2-Feb-02
Landsat ETM+	6	55	26-Jan-02
Landsat ETM+	6	56	5-Jan-01

Caceres, Antioquia, Colombia

Sensor	Path	Row	Date
Landsat TM	9	55	10-Oct-90
Landsat ETM+	9	55	23-May-99

- TruEarth Imagery (2010)

ii. Software:
- ERDAS Imagine 9.2
- Arc View GIS 3.3

Satellite images were translated to a GEOTIFF format and corrected with ERDAS software package. A true colour image was created through a composition using bands 7, 4 and 2. As images were not cloudless, image mosaics were created and in some instances cloud masks were generated in order to mitigate regions of uncertainty.

Each image or image mosaic was then automatically classified into 64 classes using the unsupervised classification tool in ERDAS. These 64 classes were then subjected to manual classification and creation of shapefile polygons based on the interpretation of shapes, textures, sizes, and the experience of local experts. This process generated a land cover classification map and subsequently a forest cover map for the region for 1992 and 2002. Forest cover comparison between dates enabled assessment of project land eligibility (please see 1.16).

Step 3: Stratification
The *ex ante* stratification based on the baseline is as followed:
Cáceres: Grassland for extensive cattle farming; gold mining
Cravo Norte: flooded land in the rainy season; not flooded land

Step 4: Assessment of baseline scenario
For the identification and evaluation of the more viable reference scenario, approximation 22 (C) is used:
"Changes in carbon stocks in the pools within the project boundary from the most likely land-use at the time the project starts." As a result, the more viable scenario identified is extensive cattle farming over unmanaged native pasture and in some parts in Cáceres gold mining. Prior to the project start no afforestation or reforestation activities were undertaken.

Step 5: Historical land use/cover changes
Please refer to 2.4 Description of how the baseline scenario is identified and description of the identified baseline scenario.

Step 6: Selection of carbon pools
The methodology provides for estimation of carbon stock changes in the living (above and below ground) biomass pools of A/R CDM project activities implemented on grasslands. The exclusion of deadwood, litter, and soil organic carbon is conservative considering the net increase in carbon accumulated in these pools over the crediting period, in comparison to the baseline scenario.

Step 7: Estimation of the baseline net GHG removals by sinks
The approved methodology recommends estimating changes in carbon stocks in the living biomass of unmanaged grasslands based on land use categories identified in the baseline scenario: maintenance of grassland in its present state and the A/R implemented at a specified pre-project rate or a combination of both.

The land use under the baseline scenario is grassland and additional in Cáceres gold mining. In some parts are scattered shrubs and isolated trees. In accordance with guidance contained in paragraph 35 of EB 42 meeting report, GHG emissions due to removal (loss) of herbaceous vegetation as a component of non-tree biomass are neglected in this methodology. Hence, all references to GHG emission from removal of non-tree/ pre-existing vegetation (biomass) do not include GHG emissions from removal of herbaceous vegetation. Since all isolated trees and shrubs within the project area boundaries are not removed, there will be no GHG emissions due to removal of the woody baseline vegetation. Furthermore, there have not been pre-existing A/R project activities.

It is assumed that both trees and shrubs are in a steady state, since no significant change occurred in the area the last 10 years (see 1.16).

Step 8: Leakage analysis
Leakage includes the increase in GHG emissions outside the project boundary, which is associated with emissions from displacement of grazing activities that leads to loss of vegetation and collection of fuelwood to areas outside the project's boundary.

In accordance with the provisions of the methodology the project will not monitor leakage from activity displacement given that activity displacement leakage is not anticipated to occur. In addition, as per EB22, "pre-project GHG emissions by sources which are displaced outside the project boundary in order to enable a reforestation project activity under CDM shall not be included under CDM if the displacement does not increase these emissions with respect to pre-project conditions".[141]

Furthermore, no leakages of fuelwood collection will occur, given the distance of most of the project areas to the villages. The baseline is grassland with some isolated shrubs and trees. Therefore, there are almost no sources of fuelwood. In Cáceres the project area is not considered a source area for fuelwood, due to the plentiful sources of fuelwood nearer the village. In Cravo Norte the plantation is established on grassland where almost no trees can be found.

Step 9: Determination of GHG emissions caused by an increase in fossil fuel and fertilizer use due to the displacement
CO2 emissions from fossil fuel combustion and the use of fertilizer occur from the use of machinery in nursery, site preparation, thinning, harvesting, etc., excluding transportation fuel. SOPs have been established to calculate the amount of fossil fuel and fertilizer consumption due to the project. These GHG emissions are quite limited and include fertilizer, fossil fuel activities.

[141] http://cdm.unfccc.int/EB/Meetings/022/eb22_repan15.pdf

10. Monitoring Plan:

10.1. Purpose of the monitoring plan

This Monitoring Plan provides guidance on monitoring and standard operational procedures for the A/R project activity. All standard operational procedures mentioned in the PD refer to the process of data collection. The proposed project activity aims to generate net anthropogenic GHG removals by establishing native forest plantations under sustainable management. The A/R project activity makes special use of a variety of some less known native species planted in mixed stands. The plantations are established on land that is currently grassland or where gold mining occurred in the past.

This Monitoring Plan fulfils the requirement that the project activity should have credible and accurate monitoring procedures in place to enable the evaluation of project performance and verification of the net anthropogenic GHG emission removals. It sets out monitoring procedures that follow the provisions outlined in the PD and the approved monitoring methodology AR-AM0005 Version 03.

10.2. The A/R VCS project activity

10.2.1. General instructions on data collection

Collecting reliable field measurements is an important part of quality assurance (QA). Standard procedures should be followed to collect reliable data to ensure credibility in the estimation of the baseline, project emissions, leakage, and GHG removals.

During the monitoring process, the senior personnel overseeing the project activity shall verify the data collected by the field personnel. The project entity shall implement procedures that will ensure independent verification. Should there be differences in the electronic and paper based formats, these will be clarified in the terms defined and procedures followed. Particular attention shall be paid to monitoring and measurement errors. This issue will be addressed through mandatory data checks and training of field personnel.

10.2.2. Data storage

The project entity shall make necessary arrangements for data entry on the registry forms. The forms shall be both in paper and electronic formats to ensure that the information is stored in multiple ways. Generally data are collected in paper formats following the SOPs during field measurement. Data are then transferred to a web-based database. All paper and electronic formats are stored in Asorpar's office in Medellin. Further the entity shall ensure the transfer of data to the spreadsheet database as outlined in the monitoring methodology at required intervals. The data shall be archived using acceptable standards and stored in compliance with the instructions of the project information management system. The electronic data shall be stored securely at multiple locations using backup procedures. All GHG related information is collected and aggregated. An administrative manager is responsible for data transfer and storage.

10.2.3. Information (data) management system

The project information management links the operations of the field data collection and spreadsheet database. Further it outlines responsibilities of staff involved in collecting field data and organization of the spreadsheet database. The supervisory staff overseeing the field data and spreadsheet database must check and certify the data. If any changes occurred in the data collected and processed during the month, the supervisory staff has to provide necessary clarification.

10.2.4. Monitoring periods and frequency

The project monitoring is expected to cover the crediting period of 30 years, starting from 2002. The project participants will use the VCS buffer approach to address any loss of permanence. The monitoring process will cover periods of five years. The first monitoring interval will coincide with the verification interval, which is expected to be also every five years. Data needed for the monitoring of emission sources will be collected and analyzed annually.

10.2.5. Monitoring and operational procedures

The project participants use Standard Operation Procedures (SOPs) for data collection. All measured and experimental data shall be documented and archived. Operational procedures under this monitoring plan are defined as those that enable measuring and estimating net carbon stock changes associated with the plantations under the project activity, as well as general monitoring of forestry operations. The project participants shall keep records of all activities, like changes in the actual planted areas, site preparation and forest management. Further the use of fossil fuels and fertilizer shall be recorded and archived.

10.2.6. Monitoring of GHG emissions by source as a result of the project activity

Emissions from non-transport related fossil fuels will be monitored at the project site. Records to monitor the fuel use of diesel and gasoline will be held and updated at the plantation offices. Also, the amount of fertilizer use will be recorded and updated annually.

10.3. Monitoring of project implementation: forest establishment and management

The project participants shall monitor the implementation of the A/R VCS project activity through monitoring the:

- Boundary
- Forest establishment
- Forest management

The project monitoring team consists of the Technical Manager of Asorpar, Luis Gonzalo Moscoso, forestry engineers employed by Asorpar, the Field Supervisors and the Coordinators. Mr. Moscoso oversees all implementation and monitoring both administratively and in the field. Forestry engineers assist Mr. Moscoso in the general implementation of the monitoring plan. The Field Supervisors, with the support of Mr. Moscoso and the forestry engineers are responsible for the data collection based on the Standard Operating Procedures established by Mr. Moscoso and his team. Mr. Moscoso and the forestry engineers also perform quality checks throughout the monitoring process.

The project monitoring team will monitor and record each stratum and/or sub-stratum on which A/R project activity is undertaken over the crediting period. For that purpose sample plots will be installed. A special aspect of monitoring the A/R project activity is the variety of tree species being planted in eligible areas and requires particular attention. Changes in the sample plots of any strata and/or sub-strata will be recorded, including the areas of disturbance due to natural (e.g., fire and pests) and/or anthropogenic factors.

The project participants shall ensure that the established plantations are protected over the crediting period. Fire line and firebreaks shall be established. In the case of fire and pests outbreak the stratum affected shall be recorded and mapped. Replanting of the areas should be done and data recorded for each stratum and/or sub-stratum. The factors affecting the carbon stock changes shall be monitored.

Please refer to section 1.9 for details on technical procedures for project implementation. Technical procedures are explained in more detail in the book “Reforestation, a natural process” that has been written in 2005 by Asorpar’s technical manager Luis Gonzalo Moscoso Higuita in relation to the project in Cáceres.

10.3.1. Monitoring project boundary

The monitoring of the project boundary (strata and sub-strata) will either be done using direct ground truthing in the field with a Geographical Positioning System (GPS) device or remote sensing, or a combination of both. The project boundary will be monitored before each verification event. When field surveys (observational) are used to monitor the project boundary (strata and sub-strata), the existence and permanence of related permanent marks is controlled. During the crediting period the natural boundaries (e.g., rivers, valleys, roads, vegetation features) are used as reference, and where no natural boundary exists living fences have been established. Any discrepancies between the area reported and the area estimated under the proposed A/R VCS project activity in any part of a strata and/or sub-strata shall be recorded and reported. Same holds for the species planted, including the areas of disturbance due to natural (e.g., fire and pests) and/or anthropogenic factors.

The monitoring of the project boundary and the boundaries delineating the parcels of the proposed A/R project activity will be conducted according to the AR-AM0005 Version 03:

- Field surveys and remote sensing are used to determine the actual boundary of the A/R VCS project activity. Parcels (stratums and sub-stratums) will be distinguished according to actual reforestation with the specific species mix and by the planting year. In the case where the actual boundary deviates from the preceding description, additional information will be provided and projections will be adjusted *ex post*.
- The geographical coordinates (latitude and longitude) of each corner of the parcel polygon are determined using GPS, collected and exported to the GIS software (ArcInfo 9.3). There they are further processed to generate monitoring maps of the actual project boundary including species and year planted.
- The area planted within the project boundary will be monitored periodically throughout the crediting period. If changes to the planted area occur during the crediting period, the specific areas will be identified, mapped and reported to the

DOE for subsequent verifications. This includes those areas where the planting has failed to recover and in case of areas affected by fire and/or disease outbreak.

Note: The data of the grey cells of the table below are not monitored due to insignificance or the fact that these practices do not occur in the project scenario.

Table 25: Data and variables to be used to monitor the project boundary

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
10.3.1.01	Stratum	Alpha numeric	M	Before project, or during the project	100%	GPS is used to identify coordinates of the boundary
10.3.1.02	Sub-Stratum	Alpha numeric	M	Before project, or during the project	100%	GPS is used to identify coordinates of the boundary
10.3.1.03	Area of stratum and sub-stratum	ha	M	Before project, or during the project	100%	Calculated from the points collected by GPS
10.3.1.04	Area of historic A/R	ha	C	Annual	100%	N/A

10.3.2. Monitoring forest establishment

Standard operating procedures of commonly accepted forest management will be implemented to ensure that planting practice and quality conforms to that described in the PD.

The following monitoring activities will be conducted as part of the forest establishment:

- Register the type of activities applied for site and soil preparation, and the area involved.
- Register the planting activities: date, area, tree species, planting distance and area of stratum and/or sub-stratum.
- Document and explain any deviation from the planned forest establishment.
- Survival checking:
  - The survival rate of planted trees will be counted from year 1 to year 3 of the plantation. Re-planting shall be conducted within the same planting season, if the survival rate is lower than 90 percent of the final planting density.
  - The checking of the survival rate will be conducted when routine maintenance is carried out. Monitoring is done in temporary sample plots of 10x10 meters. As rule of a thumb a minimum of 10 plots per 100 ha (of the same stratum and/or sub-stratum) should be selected randomly.
- Register and document the installation of firebreaks.
- Document and explain the use and amount of fertilizer used for the forest establishment.

Note: The data of the grey cells of the table below are not monitored, due to insignificance or the fact that these practices do not occur in the project scenario.

Table 26: Data of forest establishment activities

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
10.3.2.01	Stratum	Alpha numeric	d, m	Before project validation		Used to geo-reference forest establishment activities
10.3.2.02	Sub-Stratum	Alpha numeric	d, m	Before project validation		Used to geo-reference forest establishment activities
10.3.2.03	Site and soil preparation			Documented according to occurrence	100%	Site and soil preparation does neither involve slash and burn nor the removal of biomass for the planting area.
10.3.2.04	Biomass stock per unit area before slash and burn	t d.m. / ha	c	Documented according to occurrence	100%	N/A; Slash and burn does not occur
10.3.2.05	Area planted per stratum	Ha	C	Before project validation	100%	Spatial extent of the planted determined by the use of GPS
10.3.2.06	Stratum and sub-stratum composition		M	Before project validation	100%	Each stratum has special geophysical conditions. It is further differentiated by year of establishment, species planted and planting density
10.3.2.07	Number of trees survived	Numeric	m, c	After planting season	In temporary sample plots	Sampling survey: total number of seedlings
10.3.2.08	Survival rate	%	C	After planting season	In temporary sample plots	From the sampling survey: ratio of counted versus expected seedlings
10.3.2.09	Area of fire line and firebreaks	Ha	C	During the establishment and maintenance	100%	Measured for different stratums
10.3.2.10	Amount and type of fertilizer N applied per unit area during establishment	kg N / ha / yr	m	Annually	100%	For different tree species and/or management intensity
10.3.2.11	Area of land where N was applied during establishment	ha / yr	m	Annually	100%	For different tree species and/or management intensity

10.3.3. Monitoring of forest management

Standard operating procedures will be implemented to ensure that planting practice and quality conforms to that described in the PD.

Commonly accepted forest management techniques will be used by the project. The following practices will be monitored:

- Weeding: date, area, location (stratum and/or sub-stratum)
- Fertilizer application: date, location (stratum and/or sub-stratum), type and amount of fertilizer used, and reason for fertilization
- Pruning, thinning, harvesting: date, location (stratum and/or sub-stratum), stand model, tree species, estimation of biomass removed (m^3)
- Quantity of fossil fuels used in the forest management and operations during each year of the project
- Register disturbances: date, location (stratum and/or sub-stratum), GPS coordinates, area and type of disturbance
- Confirm and checking the information on forest protection practices such as firebreaks
- Checking and confirming that harvested lands are re-planted or re-sowed as planned and register the area: date, location (stratum and/or sub-stratum), area, stand model, tree species and spacing

Note: The data of the grey cells of the table below are not monitored, due to insignificance or the fact that these practices do not occur in the project scenario.

Table 27: Projected forest management schedule

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
10.3.3.01	Stratum	Alpha numeric	d, m	Before project, or during the project		Used to geo-reference forest management activities
10.3.3.02	Sub-Stratum	Alpha numeric	d, m	Before project, or during the project		Used to geo-reference forest management activities
10.3.3.03	Area of weeding	ha	M	Documented according to occurrence. Recorded for each verification	100%	It will be recorded, which parcels (strata and/or sub-strata) received treatment
10.3.3.04	Amount and type of fertilizer N applied per unit area	kg N / ha / yr	M	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity
10.3.3.05	Area of land where N was applied	ha / yr	M	Documented according to occurrence. Recorded for each verification	100%	For different tree species and/or management intensity
10.3.3.06	Area of pruning	ha	M	Documented according to occurrence. Recorded for each verification	100%	Biomass will remain in the plantation
10.3.3.07	Area of thinning	ha	M	Documented according to occurrence. Recorded for each verification	100%	The areas are stored in the GIS database and in management (silviculture) maps to update the thinning schedule
10.3.3.08	Volume thinned	m^3	m, c	Documented according to	100%	The volume removed is recorded and tracked

				occurrence. Recorded for each verification		
10.3.3.09	Area of harvest	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	The spatial location of mature blocks is reported in GIS. The harvested areas are stored in the GIS database and in management (silviculture) maps to update the harvesting schedule
10.3.3.10	Volume harvested	m^3	m, c	Documented according to occurrence. Recorded for each verification	100%	The volume harvested is recorded and tracked
10.3.3.11	Quantity of fossil fuels used in the forest management and operations	litre	M	Documented according to occurrence. Recorded for each verification	100%	
10.3.3.12	Area affected by disturbance (e.g. pest, diseases, fire)	ha	e, m	Documented according to occurrence. Recorded for each verification	100%	Date from field visits and observation. The area will be measured and mapped. The damage will be assessed and the area will be monitored to see how the vegetation develops/ recovers
10.3.3.13	Volume lost due to disturbance event	m^3	E	Documented according to occurrence. Recorded for each verification	100%	Will be estimated on the basis of last inventory data
10.3.3.14	Area re-growth after disturbance	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	Will be calculated from ground surveys
10.3.3.15	Area and location of fire breaks	ha	m,c	Recorded for each verification	100%	Will be calculated from ground surveys
10.3.3.16	Area replanted or re-sowed	ha	m, c	Documented according to occurrence. Recorded for each verification	100%	The area replanted will be remeasured and mapped
10.3.3.17	Composition of re-planted or re-sowed area		M	Before project verification	100%	Differentiated by year of establishment, species planted and planting density

10.4. Stratification and sampling design

The *ex ante* stratification is based on geophysical characteristics of the area that probably will influence the planting scheme. Then, when found appropriate, the area will be divided into strata based on planting year, species selection, stand model and spacing. An *ex post* stratification will be conducted after the each monitoring event, if proved to be necessary, to address possible changes of project boundary and plantation management in comparison to the project design. The *ex post* stratification will also address the change in carbon stocks if they are more or less variable than it is expected. Strata or sub-strata may be grouped into one stratum or sub-stratum if they demonstrate similar tree composition, carbon stock, carbon stock change and spatial variation. Otherwise, new strata may be defined. Stratification will be based on the following criteria:

- Identification of factors influencing the carbon stocks: major factors that will influence tree growth (geophysical characteristics, soil type, planting year, tree species, planting scheme, forest management activities, stand development, erosion processes, catastrophic disturbances such as fire, pest, or disease etc.)
- Site classification based on factors identified in the section above
- Additional information on site characteristics or other variables not considered before

The following methods described or referred to in the approved methodology AR-AM0005 Version 03 will be used to determine the sampling design:

Sampling Frame – The sample frame is the actual set of units from which a sample is drawn. In the case of the applied random sample, all units from the sampling frame have an equal chance to be drawn and to occur in the sample. The sampling frame generally coincides with the population of interest – the area reforested through the A/R project activity.

Permanent sample plots (PSPs) are used for sampling over time to measure and monitor changes of the relevant carbon stocks. Permanent plots will be installed prior to the first verification but may not be installed at time 0. GPS readings will be taken at the centre of the plot and the radius of the plot will be set. The sample plots are used to take measurements such as tree height, DBH and species type. The plots are treated in the same way as the rest of the stratum and/or sub-stratum, for example, in terms of site preparation, weeding, pruning, thinning and harvesting. Inside the sample plots unique number tags are assigned on all trees, when trees reach a diameter of $\geq$ 2.5 cm at DBH. The unique tree ID allows keeping track on the information concerning individual trees. For all trees the DBH measurement will be taken at a height of 1.3 m. This is good practice in inventory and assures that the same point is measured continuously. The field forms for every PSP shall be recorded and kept in the PSP file.

The *ex post* stratification will be carried out in GIS and allows calculating the area of each stratum. Once the *ex post* stratification has been carried out the number of PSPs required will be calculated. Equations M.1 and M.2 from AR-AM0005 will be used to calculate the number of PSP's required per stratum to reach a confidence level of 95 %.

Data will be collected using the same methods for all strata. This field sampled data is further processed to generate summarized statistics and finally estimate mean carbon stocks and variance for each stratum and/or sub-stratum. Because the actual variability of the project stratum will be unknown and some plots may be lost, the number of plots will be conservatively increased by 10% of the number determined using the below methods. However, it is possible to reasonably modify the sample size after the first monitoring event based on the actual variation of the carbon stocks determined from taking the *n* samples.

With the above information, the sample size (number of sample plots to be established and measured) can be estimated as follows:

where:

n	Sample size (number of sample plots required for monitoring)
t_α	*t* value for a significance level of α (0.05) or confidence level of 95%
N_i	Number of sample units for stratum *i*, calculated by dividing the area of stratum *i* by the area of each plot
N	Total number of sample units of all stratum levels, $N = \sum N_i$
s_i	Standard deviation of stratum *i*
E	Allowable error (±10% of the mean)
C_i	Cost to select a plot of the stratum *i*
I	Stratum i (total number of strata I)
W_i	N_i/N

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

where:

n_i	Number of sample units (permanent sample plots) per stratum, that are allocated proportion to $W_h * s_i/\sqrt{C_i}$
C_i	Cost to select a plot of the stratum *i*
n	Sample size (number of sample plots required for monitoring)
s_i	Standard deviation of stratum *i*
I	Stratum i (total number of strata I)
W_i	N_i/N

When no information on costs is available or the costs may be assumed as constant for all strata, then:

where:

n	Sample size (number of sample plots required for monitoring)
t_α	*t* value for a significance level of α (0.05) or confidence level of 95%
N_i	Number of sample units for stratum *i*, calculated by dividing the area of stratum *i* by the area of each plot
N	Total number of sample units of all stratum levels, $N = \sum N_i$
s_i	Standard deviation of stratum *i*
E	Allowable error (±10% of the mean)
I	Stratum i (total number of strata I)

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

where:

n_i Number of sample units (permanent sample plots) per stratum, that are allocated proportion to $W_h * s_i/\sqrt{C_i}$

N_i Number of sample units for stratum *i*, calculated by dividing the area of stratum *i* by the area of each plot

s_i Standard deviation of stratum *i*

N Total number of sample units of all stratum levels, $N = \sum N_i$

E Allowable error (±10% of the mean)

t_α *t* value for a significance level of α (0.05) or confidence level of 95%

I Stratum i (total number of strata I)

Plot size – The project participants anticipate using circular shaped PSP of 249 m^2 (radius of 8.9 m), since these are easy to establish and re-measure within the terrain of the project boundary. Sample plots of the same size within the recommended range will be adopted. The methodology recommends an upper and lower bound for the size of plots to achieve desired accuracy. It is suggested to use 100 m^2 for dense stands and 1,000 m^2 for open stands. Since the plot size depends on the density of stands (stocking) and spatial heterogeneity of the stratum, the A/R project activity will use a sample plot area of 249 m^2 to minimise sampling intensity, time, and resources spent in the measurements.

Locating permanent sample plots – Standard operating procedure: "SOP Establishment of Plots" will be used to establish all plots. The plots will be systematically located with a random start in each stratum and/or sub-stratum to avoid subjective choice of plot locations (plot centres, plot reference points, movement of plot centres to more "convenient" positions). The plot locations will be identified with the help of a GPS device in the field. For each plot the geographic position (GPS coordinate), administrative location and compartment series number will be recorded and archived. The PSPs will be established before the first monitoring takes place and measured for each monitoring event. In the case of special circumstances (e.g., forest fires, uneven growth) additional PSPs may be laid out.

10.5. Monitoring of the baseline net GHG removals by sinks

According to the methodology AR-AM0005 Version 03, the carbon stock changes of the baseline net GHG removal by sinks are set to zero and do not need to be monitored over the project lifetime. The proposed A/R VCS project activity aims to establish forests plantations on grasslands. The baseline net GHG removal by sinks for the baseline scenario uses the approved methodology in quantifying the carbon stock changes in the baseline scenario. Based on the recommendations of the methodology the baseline net GHG removal by sinks prior to the start of the proposed A/R project activity are set to zero for lands without growing trees. Same is assumed for land with growing trees, since the trees remain on site in the project scenario and the land incorporated does not satisfy the condition to be defined as forest.

10.6. Monitoring 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 non-CO_2 GHG emissions measured in CO_2 equivalents by sources that are increased as a result of the implementation of an A/R project activity, while avoiding double counting, within the project boundary, attributable to the A/R project activity. Therefore,

where:

C_{ACTUAL}	Actual net greenhouse gas removals by sinks; tonnes 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*; tonnes CO_2-e yr^{-1} in year *t*
$GHG_{E,t}$	Annual GHG emissions by sources within the project boundary as a result of the implementation of the A/R project activity; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years
I	Stratum *i* (I = total number of strata)
J	Species *j* (J = total number of species)
K	Substratum *k* (K = total number of substrata)

10.6.1. Conversion of volume estimates to total tree biomass

As recommended by the GPG for LULUCF, if national or site specific ratios are available or have been developed they should be used to estimate volume and biomass. Due to the absence of species specific parameters (project and regional) for the Biomass Expansion Factor (BEF) and Root-to-shoot ratio (R) during PD preparation the project participants use default values from the GPG LULUCF 2003. The **BEFs** given in Table 3A.1.10 of the GPG LULUCF represent averages with a range for average growing stock and age. The project participants use the BEF for the climate zone "Tropical Broadleaf" in the carbon model: 3.4 (2.0-9.0). The BEF is reduced to the lowest level to follow the conservative approach. The **Rs** given in Table 3A.1.8 of the GPG LULUCF represent averages values with a range for growing stock and age. The project participants use the R for "secondary tropical/sub-tropical forest" in the carbon model: 0.42 (0.14-0.83). Following a conservative approach, the lowest value of the range is applied.

Biomass Expansions Factor (BEF)	Root-to-shoot ratio (R)
Dimensionless	Dimensionless
2.0	0.14

Species specific values for the basic wood density will be applied to convert the volume to biomass as displayed in the table below. Following a conservative approach, the lowest value of the range is applied.

Scientific name	Family	Common name	Basic wood density
			t d.m/m³
Acacia mangium	Mimosaceae	Acacia	L=0.45 / M=0.53 / H=0.69
Cariniana pyriformis	Lecythidaceae	Abarco	L=0.48 / H=0.839
Cedrela odorata	Meliaceae	Cedro	L=0.41 / H=0.525
Cespedesia macrophylla	Ochnaceae	Paco	M=0.63
Cordia gerascanthus	Boraginaceae	Solera	M=0.74 / M=0.897
Croton smithianus	Euphorbiaceae	Guacamayo	M=0.51
Didimopanax morototoni	Araliaceae	Tortolito	M=0.41 / M=0.58
Dipteryx oleifera	Fabaceae	Almendro/Choibá	M=0.85
Enterolobium cyclocarpum	Leguminosea	Piñon	L=0.35 / M=0.46 / H=0.6

Gmelina arborea	Verbenaceae	Melina	L=0.4 / M=0.48 / H=0.56
Hevea sp	Euphorbiaceae	Caucho	L=0.55 / M=0.61 / H=0.7
Hymenaea courbaril	Leguminosea	Algarrobo	M=0.73
Ochroma pyramidale	Bombacaceae	Balso	L=0.096 / M=0.19 / H=0.24
Pochota quinata	Bombacaceae	Ceiba	L=0.35 / M=0.48 / H=0.55
Schyzolobium parahyba	Leguminosea	Tambor	L=0.24 / H=0.479
Swietenia macrophylla	Meliaceae	Caoba	L=0.485 / M=0.61 / H=0.84
Tabebuia rosea	Bignoniaceae	Roble	L=0.48 / H=0.609
Tapirira guianensis	Anacardiaceae	Fresno	M=0.5

Species where no specific basic wood densities could be identified from the literature, a conservative value of 0.3 has been applied.

10.6.2. Measuring and estimating carbon stock changes over time

As per the provisions of the baseline methodology selected, carbon stocks in deadwood, litter, and soil pools are not monitored. Therefore, changes in carbon stocks equal the carbon stock changes in above-ground and below-ground biomass within the project boundary. The changes in the above-ground biomass and below-ground biomass will be estimated using BEFs or allometric equations, depending on their availability. If no allometric equation is available for calculating volumes based on DBH and height measurement, commercial volume will be estimated applying a form factor of 0.5.

where:

$\Delta C_{ijk,t}$ Sum of average annual change in carbon stock in living biomass of trees for stratum *i*, species *j*, sub-stratum *k* in the project scenario; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{AB,ijk,t}$ Sum of average annual change in carbon stock in (above ground) living biomass of trees for stratum *i*, species *j*, sub-stratum *k* in the project scenario; tonnes CO_2-e yr^{-1} in year *t*

$\Delta C_{BB,ijk,t}$ Sum of average annual change in carbon stock in (below ground) living biomass of trees for stratum *i*, species *j*, sub-stratum *k* in the project scenario; tonnes CO_2-e yr^{-1} in year *t*

44/12 3.667; conversion factor from carbon to CO2-e

T Ranges from 1 to end of crediting period; years

I Stratum *i* (I = total number of strata)

J Species *j* (J = total number of species)

K Substratum *k* (K = total number of substrata)

For all stratums, a SOP is utilized to calculate the changes in live carbon stock changes between monitoring events.

Note: The data of the grey cells of the table below are not monitored, due to insignificance or the fact that these practices do not occur in the project scenario.

Table 28: Carbon stock changes

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
10.6.2.01	Stratum	Alpha numeric	d, m	Before project, or during the project		Used to geo-reference carbon stock changes
10.6.2.02	Sub-Stratum	Alpha numeric	d, m	Before project, or during the		Used to geo-reference carbon stock changes

				project		
10.6.2.03	Sample plot	Alphanumeric	m	Before first verification	100%	Plot ID will be assigned to each permanent sample plot
10.6.2.04	Location of the plot	GPS coordinates	m	Before each verification	100%	Field data or GPS coordinates to locate a plot in project boundary
10.6.2.05	Year of A/R	Year	m	Before each verification	100%	Year of planting is recorded in the monitoring plan
10.6.2.06	Tree species		d	Before each verification	100% within the PSP	Arranged in PDD
10.6.2.07	Number of trees	Number	m	Before each verification	100% within the PSP	Counted in plot measurement
10.6.2.08	Diameter at breast height (DBH)	Cm	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval
10.6.2.09	Tree height	M	m	Before each verification	100% within the PSP of min DBH class	Measured at each monitoring interval
10.6.2.10	Merchantable volume	m^3	c, e	Before each verification	100% within the PSP of min DBH class	Merchantable volume will be extrapolated to strata and/or sub-strata
10.6.2.11	Wood density	td.m./m^3	d			N/A; Literature values
10.6.2.12	Biomass expansion factor (BEF)/species	Dimensionless	d			N/A; IPCC literature values
10.6.2.13	Root-to-shoot ratio	Dimensionless	d			N/A; IPCC literature values
10.6.2.14	Carbon fraction	tC / t.d.m.	d			N/A, IPCC default factor (0.5)
10.6.2.15	CO_2-e conversion factor	tCO2 / tC	d			N/A, IPCC default factor (3.667)
10.6.2.16	C stock in above ground biomass per stratum	tC	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.17	C stock in below ground biomass per stratum	tC	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.18	C stock change above ground biomass per stratum	tC / yr	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.19	CO_2 stock in above ground biomass per stratum	tCO_2	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.20	CO_2 stock in below ground biomass per stratum	tCO_2	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.21	CO_2 stock change above ground biomass per stratum	tCO_2 / yr	c	Before each verification	100% of samples of the stratum	Calculated
10.6.2.22	Grassland removed due to A/R per stratum	Ha	e	Prior to project	Estimation of 100% of grassland area identified before the project implementation	N/A, insignificant. Area of grassland converted to forests
10.6.2.23	CO2 emissions due to grassland removal	tCO_2 / ha	e, c	Prior to project	Estimation of 100% of grassland area identified before the project implementation	N/A, insignificant. Area of grassland converted to forests
10.6.2.24	Area affected by disturbance	Ha	e	Before each verification	100% of the area affected by	Data from field visits and

					disturbance	observation
10.6.2.25	CO2 emissions due to disturbance	tCO_2 / ha	e, c	Before each verification	100% of the area affected by disturbance	Data from field visits and observation

10.6.3. Monitoring GHG emissions by sources increased as result of project activity

The A/R project aims to monitor the increases of greenhouse gas (GHG) emissions from fossil fuel combustion, loss of biomass from the conversion of grassland, non-CO_2 emissions from biomass burning (if practiced to clear the land to afforest or reforest), and nitrous oxide emissions from fertilizer application, if significant. The GHG emissions will be estimated based on project monitoring data and IPCC emission factors.

Monitoring of the GHG emissions by sources will take place according to the methodology AR-AM0005 Version 03:

where:

$GHG_{E,t}$	Annual GHG emissions as result of the implementation of the A/R project activity within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{FuelBurn,t}$	CO_2 emissions from combustion of fossil fuels within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{BiomassLoss,t}$	GHG emissions from the loss of biomass in site preparation and conversion to A/R within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$E_{Non-CO2,BiomassBurn,t}$	Non-CO_2 emission as a result of biomass burning within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years

$E_{FuelBurn}$ from combustion of fossil fuels within the project boundary will be monitored. Sources include the machinery used during site preparation and forest management activities within the project area during the life of the project. The emissions from the use of these vehicles are monitored.

$E_{BiomassLoss}$ is considered to be insignificant.

$E_{Non-CO2,BiomassBurn}$ is monitored and the methodology provides steps to calculate these emissions. The project participants do not intend to practice biomass burning during site preparation. Therefore, the emissions associated with this source are not calculated. The monitoring parameters for this are, however, described below (grey cells).

Note: The data of the grey cells of the table below are not monitored, due to insignificance or the fact that these practices do not occur in the project scenario.

Table 29: GHG emissions by sources increased as result of 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
10.6.3.01	Diesel / gasoline consumption in A/R activities	Litre	m	Annually	100% of the diesel / gasoline consumption	Fuel consumption per unit area for site preparation / harvesting
10.6.3.02	Emission factor for diesel	kg / litre	d	At start of the project		N/A; National inventory, IPCC

						default value
10.6.3.03	Emission factor for gasoline	kg / litre	d	At start of the project		N/A; National inventory, IPCC default value
10.6.3.04	Area burnt	Ha	m	Annual	100% of the applicable area	N/A; Measured for strata and sub-strata
10.6.3.05	Mean biomass per unit area	t d.m./ha	m	Annual	100% of the applicable area	Sample survey for different strata and sub-strata
10.6.3.06	CO_2 emission from biomass	tCO_2e / yr	c	Before each verification	100% of the applicable biomass amount	
10.6.3.07	Proportion of biomass burnt	Ratio	m	Annual	100% of the applicable area	N/A; Sampling survey after slash and burn
10.6.3.08	Biomass combustion efficiency	Ratio	d	Before the project		N/A; IPCC default value (0.5)
10.6.3.09	C/N ratio	Ratio	d	Before the project		N/A; IPCC default value (0.01)
10.6.3.10	N_2O emission from biomass burn	tCO_2e / yr	c	Before each verification	100% of the applicable area	N/A
10.6.3.11	CH_4 emission from biomass burn	tCO_2e / yr	c	Before each verification	100% of the applicable area	N/A
10.6.3.12	Total GHG emission from biomass burn	tCO_2e / yr	c	Before each verification	100% of the applicable area	N/A
10.6.3.13	Area of land fertilized	ha/yr	m	Annual	100% of the applicable area	Species & management
10.6.3.14	Amount of synthetic fertilizer N per ha	kg N/ha/yr	m	Annual	100% of the applicable area	N/A, 95-99% is organic fertilizer
10.6.3.15	Amount of synthetic fertilizer N	tN/yr	c	Annual	100% of the applicable area	
10.6.3.16	Volatile fraction of NH_3 & NO_x for fertilizers	Ratio	d	At the start of the project		N/A; IPCC default value (0.1)
10.6.3.17	Amount of organic fertilizer N	tN/yr	c	Annual	100% of the applicable area	
10.6.3.18	Volatile fraction of NH_3 & NO_x of organic fertilizers	Ratio	d	At the start of the project		N/A; IPCC default value (0.2)
10.6.3.19	Emission factor for emission from N input	N_2O N-input	d	Before monitoring		N/A; IPCC default value (1.25%)
10.6.3.20	Direct N_2O emission of N input	tCO_2e/yr	c	Annual	100% of the applicable amount	

Standard operational procedures for monitoring emissions resulting from the project are the following:

Step 1: The type and amount of fossil fuels used in project activities, such as site preparation, planting, thinning and harvesting (but excluding transportation) will be monitored and recorded. Sources are, for example, log books, sales records, etc.

Step 2: The project activities that use fossil fuels will be identified and the parameters of activities such as number of hours of machines operation, fuel consumption per hour of the machines, type of vehicles used, amount of timber thinned or harvested etc. will be monitored and recorded. Sources are, for example, log books, sales records, etc.

Step 3: The emission factors (EF) of the fuels used in the project should be chosen. If national/regional EFs are not readily available, IPCC default EFs will be used.
Step 4: The operation-wise GHG emissions will be calculated. The IPCC 1996 Guidelines will be used to estimate the CO_2 emissions from combustion of fossil fuels using the equation below:

where:

$E_{FuelBurn,t}$	CO_2 emissions from combustion of fossil fuels within the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$CSP_{diesel,t}$	Volume of diesel consumption; litre (l) yr^{-1} in year *t*
$CSP_{gasoline,t}$	Volume of gasoline consumption; litre (l) yr^{-1} in year *t*
EF_{diesel}	Emission factor for diesel; kg CO_2 l^{-1}
$EF_{gasoline}$	Emission factor for gasoline; kg CO_2 l^{-1}
0.001	Conversion from kg to tones of CO_2
T	Ranges from 1 to end of crediting period; years

10.7. Monitoring leakage

The leakage represents the increase in GHG emissions by source that occurs outside the boundary of an A/R VCS project activity. Leakage is measurable and attributable to the A/R project activity. The applied methodology AR-AM0005 Version 03 covers two types of leakage according the equation below.

where:

LK_t	Increase of GHG emissions outside the project boundary; tonnes CO_2-e yr^{-1} in year *t*
$LK_{Displacement\_grazing,t}$	Increase of GHG emissions outside the project boundary resulting from displacement of grazing activities; tonnes CO_2-e yr^{-1} in year *t*
$LK_{Fuelwood,t}$	Increase of GHG emissions outside the project boundary resulting from displacement of fuel wood collection; tonnes CO_2-e yr^{-1} in year *t*
T	Ranges from 1 to end of crediting period; years

In accordance with the specifications of the methodology, the project will not monitor leakage from activity displacement given that it is not anticipated to occur. In addition, as per EB22, "pre-project GHG emissions by sources, which are displaced outside the project boundary in order to enable a reforestation project activity under CDM shall not be included under CDM if the displacement does not increase these emissions with respect to pre-project conditions"[142].

However, the displacement of grazing activities to other grasslands (without overgrazing) does not result in leakage. It is considered that in general grazing activities in this area are executed in an extensive manner and commercial animal farming is not present. Hence, leakage from displacement of grazing activities is set to zero:

However, there is no collection of firewood in the project area in the baseline. Therefore this variable is also set to zero:

[142] Annex 15 of EB 22: http://cdm.unfccc.int/EB/Meetings/022/eb22_repan15.pdf

Based on both contemplations the A/R project activity considers leakage to be zero:

10.8. Quality Assurance and Quality Control (QA/QC)

The implementing organisation Asorpar Ltd. is managing the reforestation project and will be responsible for the centralised documentation of all project planning and implementation. QA/QC procedures will be implemented and the use of these procedures monitored to ensure that net anthropogenic GHG removals by sinks are measured and monitored precisely, credibly, verifiably, and transparently. Asorpar Ltd. will coordinate QA/QC activities and is responsible for implementing and documenting these QA/QC procedures. Asorpar Ltd. ensures that the QA/QC plan is developed and implemented. For this purpose Asorpar Ltd. will designate a QA/QC coordinator.

The project will follow the IPCC GPG of using two types of procedures in order to ensure that the inventory estimates and their contributing data are of high quality:[143] [144] [145] Quality assurance (QA) and Quality control (QC). The plan that describes specific QC / QA procedures will be presented in the following:[146] [147]

a) Standard Operating Procedures (SOP) for data collection that will be established for all procedures such as: GIS analysis; field measurements; data entry; data documentation, and data storage.
b) Training courses will be held for all relevant personnel on all data collection and analysis procedures.
c) Steps will be taken to control for errors in the sampling and data analysis to develop a credible plan for measuring and monitoring carbon stock change in the project context. The same procedures shall be used during the project life to ensure continuity.

10.8.1. Field data collection

The personnel involved in the measurement of carbon pools will be fully trained in field data collection and analysis by the technical manager. SOPs will be developed for each step of the field measurements and followed so that measurements are comparable over time. If different interpretations of the SOPs exist among the field teams, they will be jointly revised to ensure clearer guidance. This procedure will be repeated during the field data collection.

To verify that plots have been installed and the measurements taken correctly:

- A minimum of 10% of randomly selected plots will be re-measured by a supervisor with a team not involved in the initial measurement sampling.

[143] IPCC GPG for LULUCF; Chapter 5.5 Quality assurance and quality control
[144] IPCC GPG and Uncertainty management in National GHG Inventories; Ch. 8 QA and QC
[145] IPCC GPG for LULUCF; Chapter 3.2 Forest land
[146] IPCC GPG for LULUCF; Chapter 5.5 Quality assurance and quality control
[147] IPCC GPG and Uncertainty management in National GHG Inventories; Ch. 8 QA and QC

- The re-measurement data will be compared with the original measurement data. Any errors found will be corrected and recorded. The level of errors recorded will be calculated and reported using this equation:

10.8.2. Data entry

The proper entry of data is required to produce reliable carbon estimates. Therefore a web-based data entry form for all those data measured in the field required by the methodology will be used. All data sheets will include a "Data recorded by" field. Communication between all personnel involved in measuring and analyzing data will be used to resolve any apparent anomalies before final analysis of the monitoring data can be completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot will not be used in the analysis. Expert judgment and comparison with independent data will be used to ensure data results are in line with expectations. Additionally, field data will be reviewed by the technical manager or a senior member of the monitoring team further ensuring that the data and analysis are realistic.

10.8.3. Data maintenance and archiving

Due to the long length of the project and the speed at which technology changes data archiving will be an essential component. Data will be archived in several forms and copies of all data will be provided to each project participant.

- Original copies of the field measurement (data sheets and electronic files) and laboratory data will be stored in a secure location.
- Copies will be stored in a dedicated and safe place (preferably offsite) of all data analysis and models, the final estimate of the amount of carbon sequestered, any GIS products, and the measuring and monitoring reports.
- Electronic copies of all data and reports will be updated periodically and converted to any new format required by future software or hardware. A project participant involved in the field measurements will be assigned to implement this updating.

10.8.4. Description of the operational and management structure(s) that the project operator will implement in order to monitor the proposed A/R VCS project activity

The proposed A/R VCS project activity is implemented by Asorpar Ltd. utilizing the locally available and experienced staff. The A/R VCS project is implemented under the authorization and supervision of the technical manager of Asorpar Ltd. (Luis Gonzalo Moscoso). The technical manager organizes technical training and consultation, and is responsible for the organization and coordination of measuring and monitoring the actual GHG removals by sinks. Any activity related to monitoring and measuring data will be reported to and archived under Asorpar Ltd. in both electronic and paper formats.

Under the proposed A/R project activity the project entity will provide technical instruction on reforestation and forest management, conduct the specific supervision of the implementation of the proposed A/R project activity, collect specific activity data at routine basis, be responsible for measuring and monitoring of the actual GHG removals by sinks, establish an expert team when necessary (e.g., to address any technical issues), conduct checks, and verify the accuracy of measured and monitored data.

10.9. Uncertainty assessment

Introduction[148,149,150] – The major sources of uncertainties related to changes in carbon stock in the living biomass pool include: natural factors such as fire and pest outbreaks; stand variables such as variation in the yield tables, allometric equations, biomass expansion factors (BEFs), wood density, and carbon fraction; and the errors contributed by the measurement.

In general there is a strong relationship between sampling design and uncertainty estimates. Good practice requires the monitoring to be accurate. Monitoring schemes should neither "over-estimate" nor "under-estimate", as far as can be judged. Uncertainties will be reduced as far as practicable. Uncertainty information is not intended to dispute the validity of the monitoring estimates, but is assessed to help priorities efforts to improve the accuracy in the future and guide decisions on methodological choice. The project will follow the IPCC GPG on the assessment of uncertainty. Uncertainty in inventories arises through at least three different processes:

- Uncertainties from definitions
- Uncertainties from natural variability of the processes
- Uncertainties resulting from the assessment of the process or quantity: (i.) Measuring, (ii.) Sampling, (iii.) Reference data, (iv.) Expert judgment

Method to determine uncertainty[151,152] – Estimated carbon stock changes and emissions/removals arising from LULUCF activities have uncertainties associated with area or other activity data, biomass growth rates, BEFs and other coefficients. In general three main statistical concepts are used for the representation of associated uncertainty: probability density functions (PDF), confidence limits (CL) and minimum range of the measure. Uncertainties in the emission factors and activity data will be described using a PDF, and using uncertainties associated with the minimum range of the measure. They are reported as a confidence interval (CI) giving the range within which the underlying value of an uncertain quantity is thought to lie for a specified probability. The IPCC suggests the use of a 95% CI, such that with a 95% probability of containing the unknown true value. This can be further expressed as a percentage uncertainty, defined as half the CI width divided by the estimated value of the quantity. The percentage uncertainty is applicable when either the underlying PDF is known or when a sampling scheme or expert judgment is used. Since data from random sampling are used it is good practice to base the assessment of uncertainties on sampling principles, rather than using default values or expert judgment.

The following formula of calculating the uncertainty percentage applies if the measurement is done with a device whose scale is using a minimum unit of $2\delta x$:

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[148] IPCC GPG for LULUCF; Chapter 5.2 Cross-cutting issues
[149] IPCC GPG and Uncertainty Mgmt in National GHG inventories; Ch. 6 Quantifying uncertainties in Practice
[150] IPCC GPG and Uncertainty Mgmt in National GHG inventories; Annex 1 conceptual basis uncertainty analysis
[151] IPCC GPG for LULUCF; Chapter 5.2 Cross-cutting issues
[152] IPCC GPG and Uncertainty Mgmt in National GHG inventories; Ch. 6 Quantifying uncertainties in Practice

$$U(\%) = \frac{\delta x}{x}$$

where:

U(%) Percentage uncertainty

δx Is half of the minimum measurement unit of the scale used

x Measured value of the respective variable (e.g. DBH and Height)

Methods to combine uncertainties[153,154,155] – Estimated carbon stock changes and emissions/removals arising from LULUCF activities have uncertainties that have to be combined at the category level and estimated in level and trend in the inventory (monitoring) as a whole. Uncertainties of various input data estimates are available either as default values, expert judgment or based on sound statistical sampling. In GPG 2000 two methods are suggested to combine uncertainties:

- Tier 1: Simple error propagation equations (*good practice and preferred solution*)
- Tier 2: Monte Carlo (*here not further considered*)

The uncertainty analysis according to Tier 1 (SEP) is good practice since it is easy to apply. Tier 1 analyses uncertainties by using the error propagation equation in two forms. The two rules exist for combining uncertainted uncertainties under addition and multiplication for different situations.[156]

<u>Rule 1 – Simple propagation of errors</u>[157]

Rule 1 is used to combine emission factor and activity data ranges by source/sink category & GHG. The total % uncertainty can be calculated with the equation of Rule 1. The rule is used to estimate the uncertainty of a product (combined by multiplication) of several quantities (e.g., when an emission estimate is expressed as a product of emission factor and activity data). The equation applies where no significant correlation is among data, uncertainties are relatively small, standard deviation (SD) divided by the mean (μ) is less than about 30%, and uncertainties have Gaussian (normal distribution) – not a strict rule. The equation gives approximation where uncertainties are larger than this. When the variables are correlated but the uncertainties are small, the formula has to be modified[158].

where:

U_s Percentage uncertainty of emission by sources or removal by sinks; it is the product of the quantities

U_i Percentage uncertainties associated with each of the parameters (quantities) and activity data; *i*=1,2,..,*n*

i=1,2,3,…*n* Number of quantities

<u>Rule 2 – Simple propagation of errors</u>[159]

Rule 2 is used to arrive at the overall uncertainty in project emissions and the respective trend between the base year and the current year. The following equation is

[153] IPCC GPG for LULUCF; Chapter 5.2 Cross-cutting issues

[154] IPCC GPG and Uncertainty Mgmt in National GHG inventories; Ch. 6 Quantifying uncertainties in Practice

[155] IPCC GPG and Uncertainty Mgmt in National GHG inventories; A. 1 conceptual basis uncertainty analysis

[156] IPCC GPG and Uncertainty Mgmt in National GHG inventories; Ch. 6 Quantifying uncertainties in Practice

[157] IPCC GPG for LULUCF; Chapter 5.2 Cross-cutting issues

[158] IPCC GPG and Uncertainty Mgmt in National GHG inventories; A. 1 conceptual basis uncertainty analysis

[159] IPCC GPG for LULUCF; Chapter 5.2 Cross-cutting issues

to be used when the overall uncertainty for the project uncertainty quantities has to be calculated (combined by addition). When summing of emission/removal, the latter considered with a negative sign. Therefore, the absolute value of the sum of all category estimates should be used in the denominator. The equation assumes that there is no significant correlation among emission/removal estimates, uncertainty is relatively small, and the standard deviation (SD) divided by the mean (μ) being less than about 30%. But the equation gives an approximation where uncertainties are larger than this. If the source categories (or sinks) are correlated, the error propagation equation has to be modified[160].

where:

U_c Combined percentage uncertainty
U_{si} Percentage uncertainty of each emission by sources or removal by sinks; %
C_{si} Mean value of each emission by sources or removal by sinks i
$i=1,2,3,\ldots n$ Number of quantities

The table below represents relevant variables of the project and the way of calculating and justifying their level of uncertainty:

Data (Indicate ID number)	**Uncertainty level of Data (High/Medium/Low)**	**Justification of level of uncertainty**
Magnitude of measurements associated to GPS	Low (N/A)	Error 1/49000.[161]
Number of trees survived	Low (N/A)	Quality Assurance and Quality Control (QA/QC) procedures assure a minimum of error. SOP is established.
Amount and type of fertilizer (synthetic and organic)	Low (N/A)	Quality Assurance and Quality Control (QA/QC) procedures assure a minimum of error. SOP is established.
Volume harvested	It depends on the minimum scale of the device used for the measurement of diameter/perimeter and height.	Calculated with Tier 1 and the uncertainties associated with diameter/perimeter and height.
Quantity of fossil fuels used in the forest management and operations	Low (N/A)	Quality Assurance and Quality Control (QA/QC) procedures assure a minimum of error. SOP is established.
Volume lost due to disturbance event	It depends on the minimum scale of the device used for the measurement of diameter/perimeter and height.	Calculated with Tier 1 and the uncertainties associated with diameter/perimeter and height.
Number of trees	Low (N/A)	Quality Assurance and Quality Control (QA/QC) procedures assure a minimum of error. SOP is established.
Diameter at breast height (DBH) or Circumference at	It depends on the minimum scale of the device used for the	Estimated using the formula δx/x, where δx is half of the

[160] IPCC GPG and Uncertainty Mgmt in National GHG inventories; A. 1 conceptual basis uncertainty analysis
[161] Verification of the precision of GPS navigation devices (*Verificación de la precisión de GPS navegadores*) http://www.fagro.edu.uy/~topografia/docs/Verificacion%20de%20la%20precision%20de%20%20GPS%20Navegadores.pdf

breast height (CBH)	measurement of the diameter/perimeter.	scale used in the device for measuring diameter/perimeter and x is the diameter/perimeter measured.
Tree height	It depends on the minimum scale of the device used for the measurement of the tree height.	Estimated using the formula δx/x, where δx is half of the scale used in the device for measuring tree height and x is the height measured.
Merchantable volume	It depends on the minimum scale of the device used for the measurement of the diameter/perimeter and height.	Calculated with Tier 1 and the uncertainties associated with diameter/perimeter and height.
Wood density	N/A	Lowest literature value used to follow the most conservative approach.
Biomass expansion factor (BEF)/species	N/A	IPCC default value
Root-to-shoot ratio	N/A	IPCC default value
Carbon fraction	N/A	IPCC default value
CO_2-e conversion factor	N/A	IPCC default value
Diesel / gasoline consumption in A/R activities	Low (N/A)	Quality Assurance and Quality Control (QA/QC) procedures assure a minimum of error. SOP is established.

Statistical error (uncertainty) [162] – When working with a statistical sample, the average is determined from randomly selected data points. This average is representative for the real value in the sense that it can be ensured with a 95% confidence that the average value of the entire data pool falls within the margin of the error given by the formula of the Standard error of the mean:

$$S_E = \frac{s}{\sqrt{n}}$$

where:
S_E Standard error of the mean
s Standard deviation
n Size of the sample

If the data are assumed to be normally distributed, the sample mean and standard error of the sample can be used to calculate the approximate confidence intervals for the population mean:

$$\text{Upper 95\% Limit} = \mu + S_E * 1.96$$
$$\text{Lower 95\% Limit} = \mu - S_E * 1.96$$

where:
μ Mean
S_E Standard error of the mean
t_α t-value is 1.96

[162] David Freedman, Robert Pisani; Statistics, Fourth Edition; W. W. Norton & Company; 4th edition (February 13, 2007), pp 359

Then if we have an uncertainty associated with the sample mean μ propagated along the calculations (denoted by δμ and calculated with Tier 1), the real confidence interval for the mean will be:

$$\text{Upper 95\% Limit} = \mu + (S_E * 1.96) + (\delta\mu)$$
$$\text{Lower 95\% Limit} = \mu - (S_E * 1.96) - (\delta\mu)$$

where:

μ Mean
S_E Standard error of the mean
t_α t-value is 1.96
$\delta\mu$ Percentage uncertainty of the propagated error

List of Supplementary Documents:

Annex I: Flora and fauna species threatened in the region of Cáceres

Scientific Name	Local Name	Category
Plants		
Anacardium excelsum	Caracolí	*LC/NT*
Ochoterenaea colombiana	-	*LC*
Aniba perutilis	Comino	*CR*
Amphitecna isthmica	-	*VU*
Dipterix oleifera	Choibá	*VU*
Jacaranda caucana	-	*LC*
Parmentiera stenocarpa	-	*VU*
Tabebuia chrysantha	-	*LC*
Tebebuia striata	-	*NT/VU*
Cavanillesia platanifolia	-	*NT/VU*
Huberodendron patinoi	Carrá, Nogal	*VU/EN*
Spirotheca rhodostyla	-	*NT*
Cordia alliodora	-	*LC*
Cordia gerascanthus	-	*NT/VU*
Caryocar amigdaliferum	Caguí, Almendrón	*EN*
Pourouma hirsutipetiolata	-	*LC*
Licania arborea	-	*EN*
Tapura colombiana	-	*VU*
Eschweilera sessilis	-	*NT*
Gustavia romeroi	-	*EN*
Gustavia speciosa	-	*NT*
Lecythis ampla	-	*NT*
Lecythis tuyrana	-	*VU*
Magnolia espinalii	-	*CR*
Magnolia hernandezii	Molinillo, Copachí	*EN*
Magnolia polyhypsophylla	Almanegra	*CR*
Magnolia urraoensis	Almanegra, Gallinazo	*EN*
Magnolia yarumalensis	Alamnegra, Gallinazo Morado	*EN*
Cariniana pyriformis	Abarco	*CR*
Pachira quinata	Cedro Macho, Ceiba Tolúa	*EN*
Mammals		
Alouatta seniculus	Mono aullador	*CR*
Aotus lemurinus	Mono de noche	*VU*
Cebus albifrons	Capuchino	*CR*
Cebus apella	Capuchino	*CR*
Birds		
Cryptorellus colombianus	Tinamú Colombiano	*EN*
Crax alberti	Paujil de pico azul	*CR*
Ara militaris	Guacamaya verde	*VU*
Pionopsitta pyrilia	Cotorra cariamarilla	*VU*
Capito hypoleucus	Torito capiblanco	*EN*
Melanerpes chrysauchen	Carpintero enmascarado	*VU*
Clytoctantes alixii	Hormiguero pico de hacha	*EN*

(Gobernación de Antioquia *et al.* 2005; Cárdenas & Salinas 2006, Rengifo *et al.* 2002). VU: vulnerable; EN (en peligro): endangered; CR (en peligro critico): critically endangered; NT (casi amenazado): near threatened; LC (amenaza baja): low threat

Annex II: Threatened fauna species in the region of the Orinoco

Scientific Name	Local Name	Category
Fish		
Osteoglossum ferreirai	Arauana Azul, Arawana	EN
Colossoma macropomum	Cachama Negra, Cherna, Gamitana	NT
Brachyplatystoma juruense	Apuy, Manta Negra, Camisa Rayada	VU
Brachyplatystoma filamentosum	Valentón, Plumita, Lechero, Pirahiba	EN
Brachyplatystoma flavicans	Dorado, Plateado	EN
Brachyplatystoma vaillantii	Blancopobre, Pirabutón, Capaz	EN
Goslinea platynema	Baboso, Saliboro, Garbanzo	EN
Paulicea luetkeni	Saliboro, Bagre Sapo, Peje Negro	EN
Pseudoplatystoma tigrinum	Pintadillo Tigre, Bagre, Caparari	EN
Primates		
Aotus brumbacki	Mono buho	VU
Aotus hershkovitzi	Mono de noche	DD
Aotus vociferans	Mono aullador	LR
Ateles belzebuth	Mono araña	VU
Callicebus torquatus	Tití colorado	LR
Cebus apella	Capuchino castaño	LR
Saimiri sciureus	Mono ardilla	LR
Cacajao calvus	Uakari rojo	
Cacajao melanocephalus	Uakari blanco	VU
Mammals		
Leopardus pardalis	Leopardo	
Cerdocyon thous	Zorra	
Hydrochaeris hydrochaeris ithsmius	Chigüiro	
Myrmecophaga tridactyla	Oso hormiguero, oso palmero	VU
Reptiles		
Crocodylus intermedius	Caimán del Orinoco, llanero	
Birds		
Neochen jubata	Pato Carretero	NT
Falco deiroleucus	Halcón colorado	DD
Pauxi pauxi	Paujil Copete de Piedra	VU
Neocrex columbianus	Polluela Pizarra	DD
Polystictus pectoralis	Tachurí Barbado	NT

Source: Mojica (2002), Renjifo (2002), Corporinoquía (2004) EN (endémico): endemic, VU: vulnerable, NT (casi amenazado): near threatened, LR (bajo riesgo): low risk , DD (datos insuficientes): insufficient data