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

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

CONTENTS

Annexes

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

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

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

Carbon Sequestration in Small and Medium Farms in the Brunca Region, Costa Rica (COOPEAGRI Project)

Version no. 2

Date: 16/03/2012

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

COOPEAGRI is a cooperative of 10,162 farmers dedicated to agriculture activities such as coffee, sugarcane, and cattle raising. As part of the proposed A/R CDM project activity, farmers associated with COOPEAGRI will introduce forestry activities in their privately owned farms. The A/R CDM project will have a total area of 892.42 ha distributed over three activities - agroforestry systems, assisted natural regeneration and forest plantations (see Table 1).

Table 1. Total project area distributed by A/R activity

ACTIVITY	TOTAL AREA (ha)
Forest plantations	108.21
Assisted Natural regeneration	396.70
Agroforestry systems	387.51
Total	892.42

The reforestation activities will be made with native species, such as: Amarillon (*Terminalia amazonica*), Pilon (*Hieronyma alchorneoides*), and Cedro amargo (Cedrela odorata), etc, and non-native species, such as: Melina (*Gmelina arborea*) and Teak (*Tectona grandis*), and Eucalipto (*Eucalyptus deglupta*). The project is expected to generate a total net anthropogenic GHG removal of approximately **176,050 t of CO2-e in a period of 20 years, or 8,803 t of CO2-e per year.**

Lands to be reforested are located in the Perez Zeledon County, in three regions. The central region or the Valley is presently covered by pastures, coffee, sugarcane, and small forest patches. The terrain is consists of rolling hills, with a slope ranging from 0 to 30%, and an elevation between 300 and 1200 m. The forestry activities that will be promoted in these areas are forest plantations and agroforestry activities such as small forest blocks, trees mixed with crops, and tree planting in rows.
The North and South Hillsides regions are covered by pastures and few crops such as coffee. The elevation in the North Hillsides varies from 700 to 2200 m, with slopes greater than 60 %. The forestry activities that will be promoted in these areas are agroforestry and assisted natural regeneration.

The promotion of diverse land uses in the project area implies that farmers will maintain good levels of incomes and food security, but also that it will favor the production of environmental services. The expected benefits of the proposed A/R project activity are:

- **Biodiversity conservation:** The project will promote restoration of deforested lands, contributing to create a diverse landscape, to connect forest patches in the project area, and to create habitats for biodiversity protection, especially small mammals and birds.
- **Local employment:** The project will provide employment opportunities for local men and women through site restoration, planting, weeding, tending, thinning, protection, harvesting, and nursery management.
- **Prevention of land degradation:** The project will prevent landslides, improve hydrological regimen (infiltration, water quality and flows), and minimize soil erosion.
- **Improved GHG removals through the increase of biomass carbon pools:** The project activity enhances GHG removals by increasing above and below ground biomass and preventing significant soil disturbances.

The proposed A/R CDM project activity will be promoted by FONAFIFO (Fondo Nacional de Financiamiento Forestal). FONAFIFO was created by the Costa Rican government to implement a Program of Payments for Environmental Services (or PSA program) to promote reforestation and forest conservation on private lands in the country. Through the proposed A/R CDM project activity, FONAFIFO is planning to expand the scope of the PSA program in a specific area of the country: Perez Zeledon County. FONAFIFO is doing this by **getting directly involved in the implementation of A/R CDM projects**, and creating a new PSA modality: reforestation using assisted natural regeneration that applies only for lands deforested before 31 December 1989. FONAFIFO will manage the PSA program while Coopeagri will provide technical assistance to and work with the farmers, given its relationships in the project region.

The cost of project implementation during the first 20 years is estimated in US$ 1.536 Millions. Nearly 79.4 % of the total costs are payments for environmental services to farmers participating in the project.
Carbon credits offsets will finance around 51.6 % of the costs, and the rest will be financed by the other environmental services – biodiversity protection, water protection, scenic beauty– that will be paid by FONAFIFO using their own resources. Without the help of the carbon revenue, FONAFIFO could not afford to do this expansion of the PSA program. In this system, a fair scheme is also applied, environmental services of local impact are paid locally, and global environmental services are paid globally.

A.3. Project participants:

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Government of Costa Rica (host)	National Forestry Financing Fund (FONAFIFO)	No
Government of Canada	International Bank for Reconstruction and Development as Trustee for the BioCarbon Fund	Yes
(*) In accordance with the CDM A/R modalities and procedures, at the time of making the CDM-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		

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

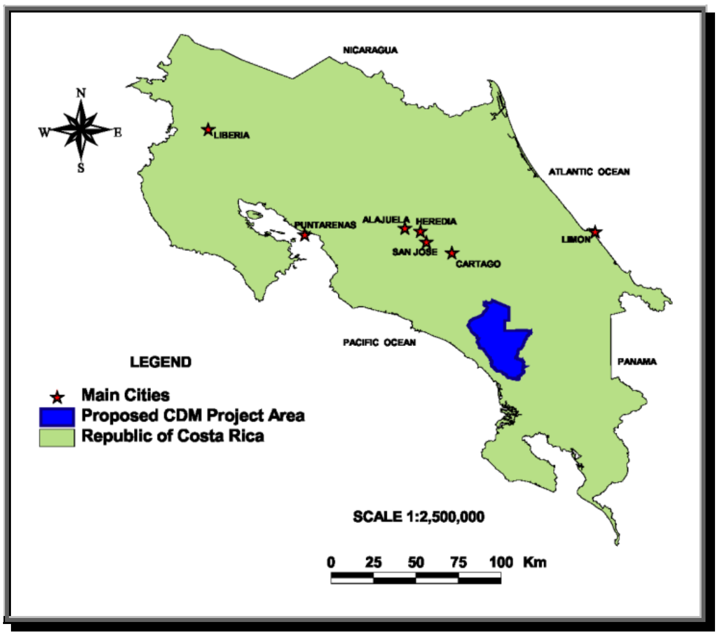
Note: When the CDM-AR-PDD is prepared to support a proposed new baseline and monitoring methodology (form CDM-AR-NM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.

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

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

The proposed CDM Project activity is within the administrative limits of the Perez Zeledon County, which belongs to the San Jose Province, Costa Rica. The project area is clearly defined and stored as a shape file in the project Geographic Information System (GIS) (see Map 1).

Map 1. Location of the CDM project area in Costa Rica



A.4.1.1. Host Party(ies):

>> Republic of Costa Rica

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

>> Province: San Jose.

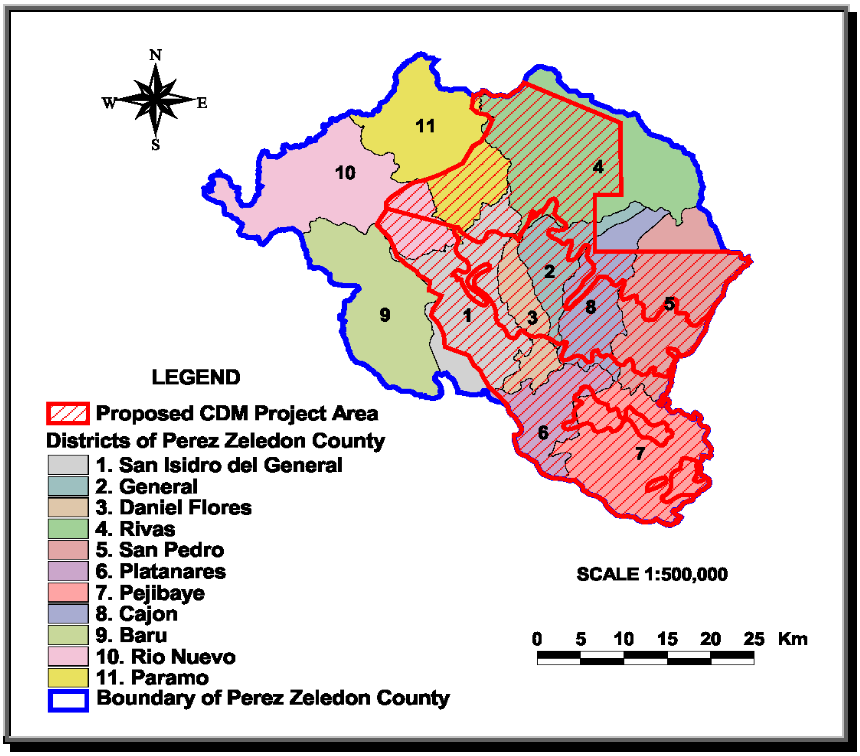
A.4.1.3. City/Town/Community etc:

>> The CDM project includes 10 districts of Perez Zeledon`s County as shown on Map 2.

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

>> The geographic location of the project is Latitude North: 9.37 to 9.67 Longitude West: -83.47 to -83.97 (Datum WGS84). It covers 892.42 ha, spread over 10 districts and one municipality.

Map 2. Districts of Perez Zeledon`s County and proposed CDM project area.



Project A/R activities will be developed in parcels within privately owned farms. Each parcel is geo-referenced using GPS technology and incorporated into the project GIS, which is a requirement in the implementation of FONAFIFO's PSA program. The list of the geo-referenced A/R parcels is presented in Annex 5. The project participants have control over the afforestation or reforestation for these areas of land.

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

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

Perez Zeledon County is located in the western section of San Isidro's General Valley in the South-East part of Costa Rica. It is divided into 11 districts and 230 towns from which 194 are located in

the project area; all these towns are under one municipality. The population density[1] of the county is 63 persons/km^2. The CDM project area is located in three sub-regions (North Hillsides, Valley and South Hillsides) (see Map 3) of Perez Zeledon county. The characteristics of the sub-regions are summarized in the Table 2.

Table 2. Socio-economic characteristics of the CDM project sub-regions.

CHARACTERISTICS	NORTH HILLSIDES	VALLEY	SOUTH HILLSIDES
No. of towns*	47	76	71
Population*	9881	19782	18808
No. of households*	2379	4552	4378
Major crops**	Pastures and small forest patches	Coffee, sugarcane, pastures and small forest patches	Pastures and small forest patches
No. of cattle / ha***	0.64	0.64	0.64
Landscape regions**	Hillsides	Rolling hills	Hillsides
Forest cover**	39.4%	7.6%	4.0%
Major environmental issues**	Deforestation, soil erosion, sedimentation of rivers, poor river hydrology, lack of habitats for birds and small mammals.	Floods, water avenues, sedimentation of rivers, poor river hydrology, lack of habitats for birds and small mammals.	Deforestation, soil erosion, sedimentation of rivers, poor river hydrology, lack of habitats for birds and small mammals.
Total area (ha)	**42,020**	**31,353**	**44,008**

Source: * ITCR. 2004. Atlas Digital de Costa Rica 2004, **Carbon Finance Document "Carbon Sequestration in Small and Medium Farms in the Brunca Region, Costa Rica" 2005, *** CORFOGA 2000. Cattle census (original title Informe del Censo Ganadero del 2000) Figure 2, average for Brunca region. See http://www.corfoga.org/censo.php.

Geology:

The geology of the region where the project is located varies from intrusive and volcanic rocks of the Tertiary period to sedimentary rocks from the Eocene to Quaternary periods, as well as from the Cretaceous to the Pliocene periods (see Map 3) [2].

The geology of the North Hillsides is composed of intrusive and volcanic rocks near the surface, as well as volcanoclastic sedimentary rocks. The composition of intrusive rocks varies from gravel to sub-volcanic granite and rhyolite and composition of volcanic rocks includes tuffs and andesite tuff breccias; while the composition of volcanoclastic sedimentary rocks varies from breccia to volcanoclastic sandstone including marine carbonate rocks.

The Valley's geology is composed of volcanoclastic sedimentary rocks, the same type of sedimentary rocks found in the North Hillsides sub-region.

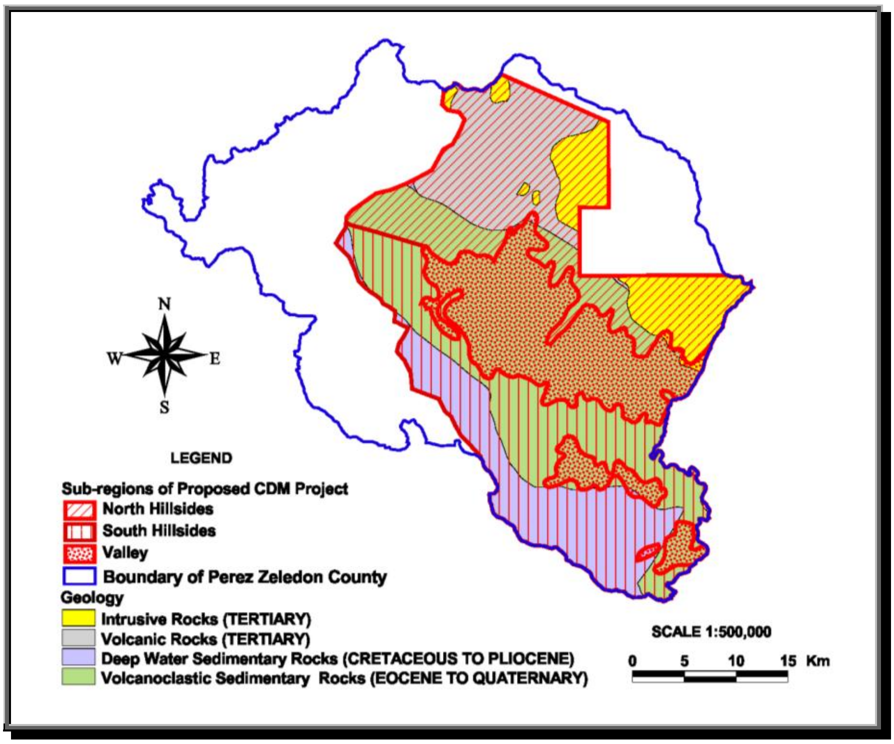
[1] Schram, Albert. 1997. Socioeconomic study: Characterization of the Perez Zeledon Canton. Central American Center of population. (CCP). University of Costa Rica (Schram, Albert. 1997. Estudio socio-económico: una caracterización del Canton de Perez Zeledon. Centro Centroamericano de Población (CCP). Universidad de Costa Rica).

[2] Bergoeing, J.P. 1982. Geomorphology of some areas of Costa Rica, based on photointerpretation of Landsat MSS spectral Band 7. Ministry of Works and Transport. National Geographic Institute. 6p.

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

The geology of South Hillsides' also includes volcanoclastic sedimentary rocks and deep-water sedimentary rocks. The deep-water composition of sedimentary rocks includes limestone, sandstone, lutite and turbidite.

Map 3. Geology of the region by sub-region.



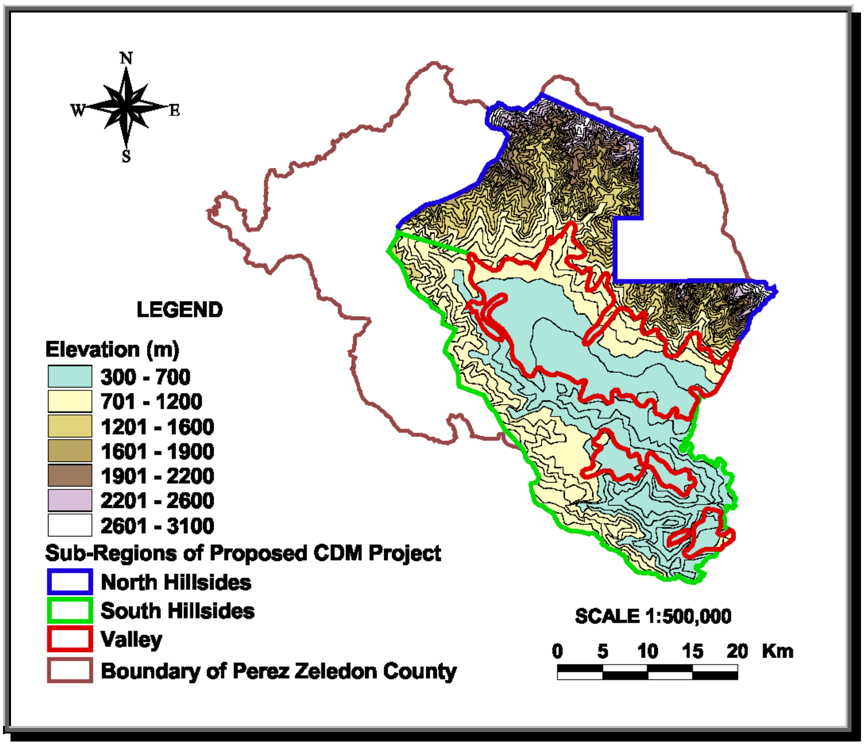
Source: FONAFIFO 2006.

Topography:

The topography of the region is shown on Map 4.
The North Hillside sub-region extends to the Chirripo National Park and has slopes ranging from 60% to 80% or even more in some areas. From these hillsides, three main rivers run to the valley: the Pacuar, the General, and the Peñas Blancas. These three rivers later form the Rio Grande de Terraba. Elevation of these hillsides varies from 800 to 2200 m.

The Valley has rolling hills, with slopes ranging from 0 to 30% with an elevation of 400 to 800 m.
The South Hillsides sub-region extends to the "Paso de la Danta" Biological Corridor, which is part of the Mesoamerican Biological Corridor. Elevations in this sub-region vary from 700 to 1200 m and very steep areas (slopes greater than 60%) are less frequent than in the North Hillsides.

Map 4. Topography of the region by sub-region.



Source: FONAFIFO 2006.

Figure 1. General view of the North Hillsides sub-region.

Figure 2. General view of Valley sub-region.

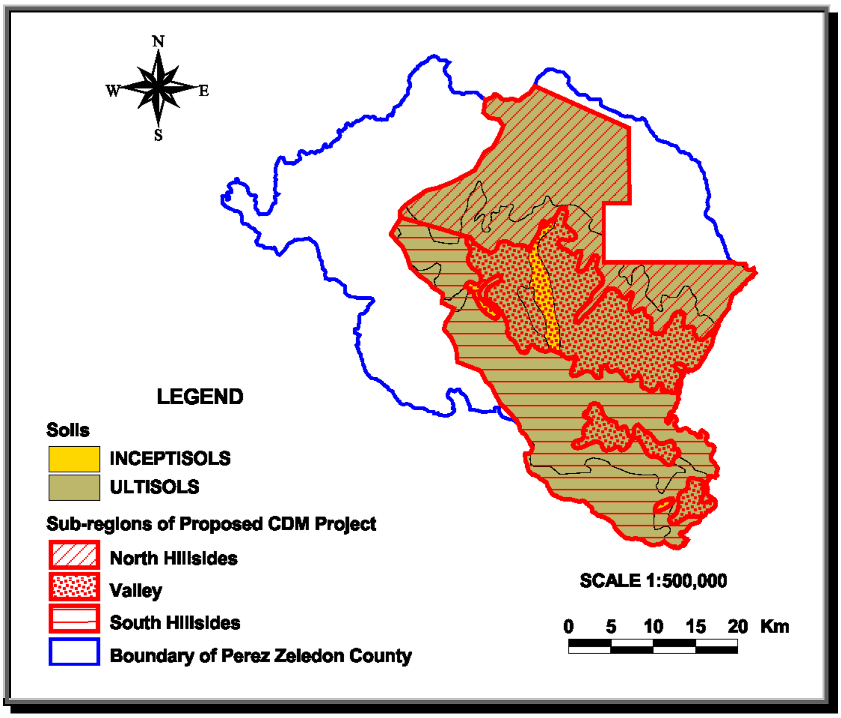
Figure 3. General view of the South Hillsides sub-region.

Soils:

The soils of the region are shown on Map 5. Most of the soils in the North and South Hillsides sub-regions are Humult Ultisols on steep terrains (slopes > than 60%) or strongly wavy terrains (slopes ranging from 30 to 60 %). They contain an argillic[3] horizon with less than 35 % base saturation. The Humult sub-order indicates that these soils have a high content of organic matter. Ultisols are generally deep soils, well-drained, and red or yellow in color, which indicates relatively low fertility.

The soils in the Valley sub-region are also mostly Humult Ultisols, although this sub-region has also some Tropept Inceptisols. Even though Ultisols are the predominant soils in this sub-region, they differ from the Ultisols on the other two sub-regions because most of the terrain in the Valley are moderate (slopes ranging from 15 to 30 %) or gently (slopes ranging from 2 to 15 %) slopes. Inceptisols are young soils with a cambic[4] B-horizon under an ustic regimen with terrains softly wavy or flat (0% to 2%). The Costa Rican Ministry of Agriculture and Cattle[5] reports an annual soil loss of 7 to 8 t / year due to erosion in the region.

Map 5. Soil types for the region by sub-region.



Source: FONAFIFO 2006.

Hydrology:

[3] Argillic horizon: a zone of accumulation of silicate clays. The horizon contains at least 20 % more clay than the horizon above it.
[4] Cambic horizon: a horizon too weakly developed to meet the criterion of any other diagnostic horizon.
[5] Personal communication: Diogenes Cubero. 2005. MAG.

There are five principal rivers in Perez Zeledon County, including the Pacuar, the San Pedro, and Pejivalle, and Peñas Blancas Rivers. All of them originate in the North Hillsides or the South Hillsides. Their water run to the Valley sub-region where are collected by the Rio General. This river later changes its name to Rio Grande the Terrraba, and it is the river where the "Instituto Costarricense de Electridad (ICE)" is developing the Diquis Hydrolectric Power Plant.
The river system has a total length of 1692 kilometers, and the watershed area is 1173 square kilometers. The water is intensely used by local communities in the county, and there are 135 local aqueducts in the watershed, including 14 water wells in the Valley sub-region.

Climate:

Precipitation:

In the North Hillsides sub-region, the average precipitation ranges from 3,000 to 4,500 mm per year with a dry regimen of 1 to 2 months. In the Valley, the average precipitation ranges from 2,000 to 3,000 mm per year with a dry regimen of 3 to 4 months. And in the South Hillsides sub-region, the average precipitation ranges from 2,000 to 2,500 mm per year with a dry regimen of 3 to 4 months. [6]

Temperature:

In the North Hillsides sub-region, the annual temperature ranges from 15 to 20 °C (Low Montane and Montane elevation zones). In the Valley sub-region, the annual temperature ranges from 24 to 28 °C (Tropical elevation zone). And in the South Hillsides sub-region, the annual temperature ranges from 20 to 24 °C (Premontane elevation zone). [7]

Land use:

In a study financed by the Central American Commission of Environmental and Development (CCAD) and FAO[8], it was found that total of 60,200[9] hectares were converted to non-forested[10] land prior to 31 December 1989. These converted lands are dedicated to agriculture and livestock raising and generally have been for at least the last 30 years covered by the study, if not more.

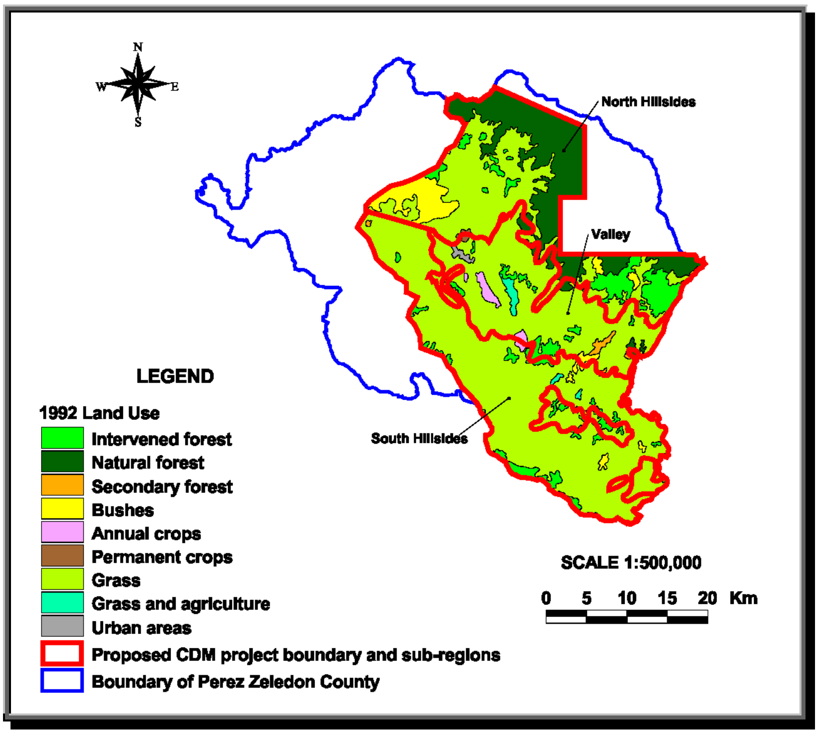
The land use distribution for the total region is presented in Table 3. The main land cover in the area is pasture, followed by agriculture (see Map 6.)

Table 3. Land cover in the region

REGION/LAND COVER	HECTARES	PERCENTAGE (%)
Forest	20773	17.8
Agriculture and pasture	90228	76.9
No Data	6320	5.4

[6] National Meterological Institute. Climate in Costa Rica, South Pacific (Instituto Meteorológico Nacional. Clima en Costa Rica. Pacifico Sur). See http://www.imn.ac.cr/educacion/climacr/pacifico_sur.html
[7] National Meterological Institute. Climate in Costa Rica, South Pacific (Instituto Meteorológico Nacional. Clima en Costa Rica. Pacifico Sur). See http://www.imn.ac.cr/educacion/climacr/pacifico_sur.html.
[8] Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica in the face of Climate Change. Central American Series of Forest and Climate Change. Central American Comission of Environment and Development. (CCDA)/FAO. 60 pp.(Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica frente al cambio Climatico. Serie Centroamericana de Bosques y Cambio Climatico. Comision Centroamericana de Ambiente y Desarrollo (CCDA)/FAO. 60 pp.)
[9] Calculated using CDM Project´s Geographic Information System.
[10] No-forest lands according to country's reported forest definition.

Map 6. Land Use of the region by sub-region.



The dis-aggregated land use at the level of sub-regions is presented in Table 4. The North Hillsides is the sub-region with greater percentage of forest cover compared to the South Hillsides and the Valley sub-regions; however its forest cover is still less than the area for agriculture and pastures. The South Hillsides and Valley sub-regions have most of the area dedicated to agriculture and pasture.

Table 4. Land cover of the region by sub-region in 1992

SUB-REGION	LAND COVER	HECTARES	PERCENTAGE (%)
North Hillsides	Forest	16,614	39.4
	Agriculture and pasture	19,588	46.6
	No Data	5,818	13.9
	Sub-total	**42,020**	**100.0**
South Hillsides	Forest	1,763	4.0
	Agriculture and pasture	41,758	94.9
	No Data	487	1.1
	Sub-total	**44,008**	**100.0**
Valley	Forest	2,396	7.6
	Agriculture and pasture	28,941	92.3
	No Data	16	0.1
	Sub-total	**31,353**	**100.0**

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

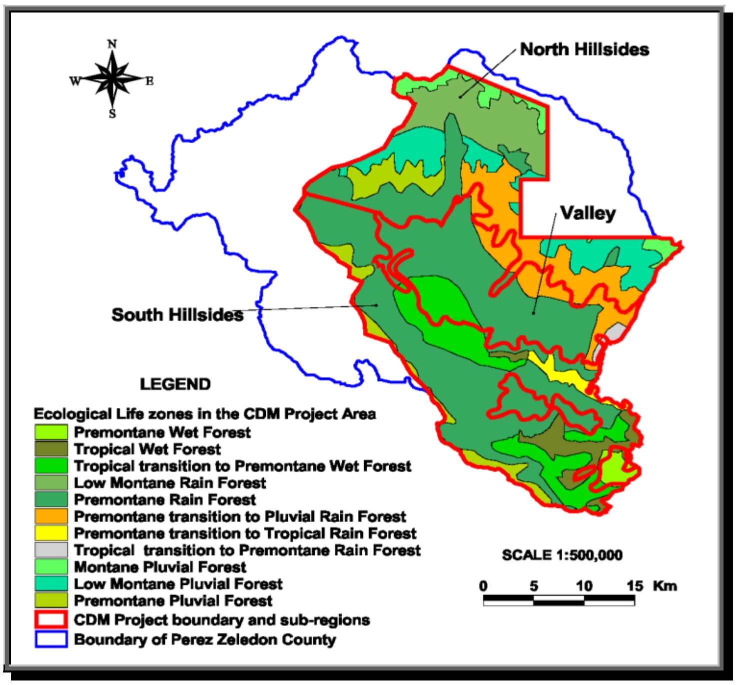
>> Data obtained from the web site of the National Biodiversity Institute[11] (INBIO) indicated that the flora of the region has been intensely studied, however there are few data regarding mammals, birds, insects, and reptil species. A study by the Scientific Tropical Center (CCT)[12] at the Neo-tropic Bird Sanctuary "Los Cusingos", done on 8 April 2004, reported a total of 229 bird species and 2,723 individuals, which were identified in only one day. The most abundant bird species that day were Barn Swallow *(Hirundo rustica),* Swainson's Thrush *(Catharus ustulatus)* and Cherries´s Tanager *(Ramphocelus costaricensis)* with more than 100 individuals counted. Among the less abundant species (with only one individual) were Blue-black Grosbeak *(Cyanocompsa cyanoides),* Canada Warbler *(Wilsonia Canadensis),* Louisiana Waterthrush *(Seiurus motacilla),* Great-crested Flycatcher *(Myiarchus crinitus),*Ruddy Wood creeper *(Dendrocincla homochroa)*, Common Potoo *(Nyctibius griseus),* Ruddy Quail-Dove *(Geotrygon montana*), and Swainson's Hawk (*Buteo swainsoni).*

The results of this bird count provide evidence of the rich biodiversity of these sub-regions due to the fact that many of these bird species often require specific food sources (vegetables or animals) that must be present in the area for their support.

Map7. Ecological Life Zones in the CDM project area.

[11] http://atta.inbio.ac.cr/scripts/pbcgi60.exe/TUTORIAL/uo_pbdemo/f_getlogon01?as_userid=&as_userpass=

[12] Lopez-Vargas, W.2004. Bird Count in Alexander Skutch Corridor. The Neotropical Bird Sanctuary of Los Cusingos. CST. 12 pp. (original title: Lopez-Vargas, W.2004. Conteo de Aves: Corredor Alexander Skutch. Santuario Neotropical de Aves Los Cusingos. CCT. 12 pp.)



Flora

The North and South Hillsides forest types are Low Montane and Montane Rain Forests such as cloud forest, tropical oak forests, or mixed forest that comprise tropical oaks, alder, *podocarpus, lauracea*, *ulmus*, etc. The Valley is covered mainly with tropical rain forest species such as *Vochysia*, *Dendropanax*, *Terminalia*, *Tabebuia*, *Dimopanax*, *Hyeronima.*

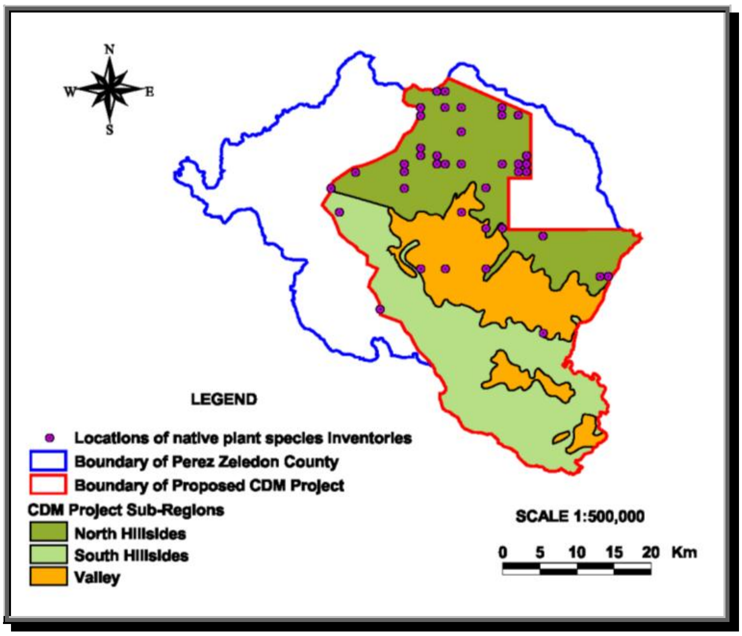
The destruction of forest cover has resulted in the degradation of the ecosystem. Due to severe overgrazing, pastures are degraded, and vegetative cover is transformed into resistant and weedy species. These negative changes have resulted in undesirable consequences for wildlife habitat.

INBIO's web site reports plant species data and sample locations (latitude and longitude coordinates) which were used in the project GIS to identify 65 indigenous plant species, 4 endangered plant species and 26 new plant species in the CDM project area.

Indigenous plant species:

The sites where these 65 native species were found are shown on Map 8. Among the native species located in the North Hillsides sub-region are *Monstera epipremnoides*, *Chamaedorea crucensis*, *Clusia osaensis*, *Clusia talamancana*, *Sechium talamancensis*, and *Dendrophthora turrialbae*. Among the native species detected in the Valley sub-region are *Weberocereus imitans*, *Croton skutchii*, *Conostegia bigibbosa*, and *Alloplectus tetragonus*. And among the native species identified in the South Hillsides sub-region are *Lacmellea zamorae*, *Justicia skutchii*, *Schefflera brenesii*, *Byrsonima herrerae*, and *Marcgravia pittieri*.

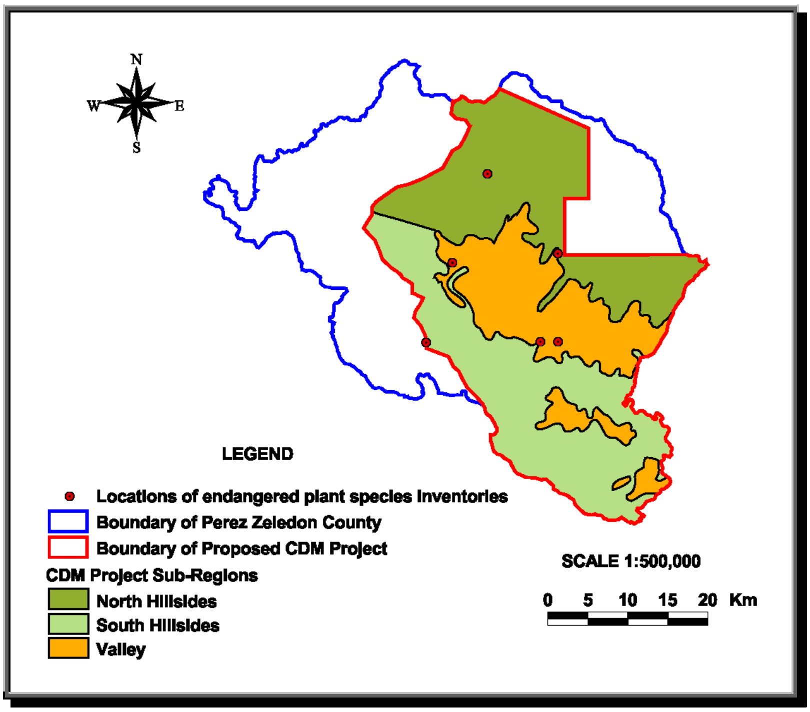
Map 8. Locations of native plant species within the CDM project area.



Endangered plant species:

The sites where these 4 endangered species were found are shown on Map 9. *Guarea grandifolia* is an endangered tree species in all three project sub-regions; while *Hymenaea courbaril*, *Humiriastrum diguense,* and *Enterolobium schomburgk* are endangered tree species in the Valley area.

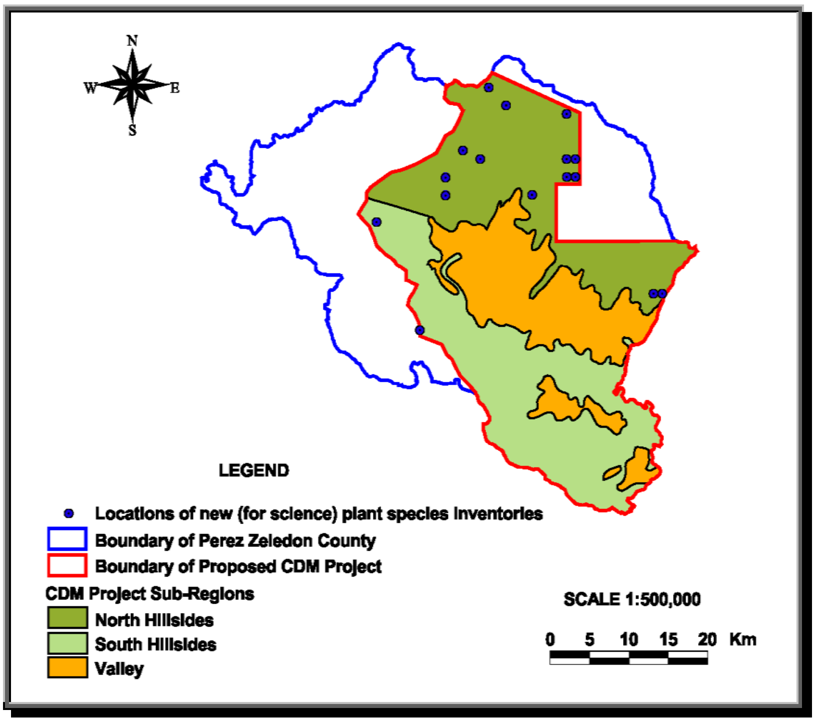
Map 9. Locations of endangered plant species within the CDM project area.



New plant species:

The sites where these new plant species were found are shown on Map 10. Out of the 87 new plant species located on Perez Zeledon`s County, 26 were discovered within the CDM project area, specifically in the North Hillsides (20 new species). Among these new species discovered in the North Hillsides sub-region are *Guatteria talamancana*, *Ilex skutchii*, *Calathea retroflexa*, *Passiflora gilbertiana*, *Ocotea praetermissa*, *Polystichum concinnum*, and *Philodendron thalassicum*. The new species discovered in the South Hillsides sub-region are *Lacmellea zamorae*, *Philodendron dodsonii*, *Chamaedorea rossteniorum*, *Costus ricus*, *Byrsonima herrerae*, and *Sarcopera rosulata*.

Map 10. Locations of new plant species within the CDM project area.



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

>> The selection of species for Forest Plantations (FP) or Agroforestry Systems (AFS) is based on the field experience. The selected species grow well in plantations, have good seed supply, and will provide additional incomes to the farmers. In addition, the products of these species have good access to markets; they are fast growing and well known by the farmers.

Forest species for Assisted Natural Regeneration (ANR) will be all native species. The natural regeneration process allows the recovery of the original forest type, therefore, it will be promoted in the project hillsides areas (North and South), where there are still remaining forest patches that will function as seed sources.

In the case of Agroforestry Systems, the project proposes to plant native species and and potentially non-native species in association with crops and pastures. In the case of Forest Plantations, the project will promote the use of three native species and three non-native species. Given the total size of the region where plantations will be established, (see Table 2), the percentage of area planted with non-native species will be very low.

Table 5. Main tree species used in Forest Plantations and Agroforestry reforestation activities

TREE SPECIES	TYPE
Amarillon (*Terminalia amazonica*)	native
Cedro amargo (Cedrela odorata)	native
Pilon (*Hieronyma alchorneoides)*	native
Eucalipto *(Eucalypus degluta)*	non-native
Melina (*Gmelina arborea)*	non-native
Teak (*Tectona grandis*).	non-native

Native species:

The native species shown on Table 5 have been used in reforestation projects of Costa Rica since 1990. These species are very popular among farmers, and with the help of FONAFIFO, COOPEAGRI and other organizations, "seed stands" have been established in the region of Perez Zeledon to provide good seed quality for reforestation and agroforestry projects.

Terminalia amazonica[13] ("Amarillón")*:* Trees of this species can reach 30 m height and 90 cm diameter in their natural environment. This species grows well on steep (see Figure 6) or flat terrains with moderately deep to deep soils and good drainage. However, this species growth occurs on loamy soils with pH ranging from acid to neutral. It does not tolerate claly soils and it does not compete well with "Brachiaria". Amarillon is also sensitive to dry weather of more than 4 months long. It requires annual temperatures from 21 to 24 ºC and annual precipitations between 2,000 and 4,500 mm. Its wood has a variety of uses such as ships, plywood, furniture, construction, tool handles, floors, etc. Amarillon´s bark is rich in tannins and can be used for tanning leather. The species rotation ranges from 20 to 40 years.

Figure 6. Amarillon's forest plantation on a hillside (6 years old).

[13] Solis, M. and Moya, R. 2000. *Terminalia amazonia* en Costa Rica. FONAFIFO. pp 97

Hieronyma alchorneoides[14] ("Pilón"): Trees of this species can reach up to 45 m height, and 1.2 m in diameter in their natural environment. Pilón grows well on rolling hills and tolerates acid and stony soils with low fertility. It can be found up to an altitude of 800 m above sea level and a precipitation range between 3000 and 4000 mm. Pilón's wood has a variety of uses such as exterior and interior construction, floors, bridges, boats, poles, marine constructions, etc. The species rotation ranges from 20 to 40 years (see Figure 4).

Figure 4. Pilon's forest plantation after first thinning (4 years old).

Cedrela odorata[15](Cedro amargo): is one of the threatened species in Costa Rica. This is a deciduous tree that can reach 30 to 35 m height and 60 cm DBH. During the first few years this tree grows an average annual rate of 1.3 to 1.8 m in height and 1.3 to 1.6 cm in DBH (Niembro, R. Anibal). After the first few years (3 to 4 years) it is a fast growing tree that can increase 2.5 cm/year in diameter and 2 m/year in height under good site conditions (Cintron, Barbara B. 1990) (see Figure 5)[16]. This species adapts well to a variety of soils, mainly those well drained with sandy and loamy textures (CATIE, 1997). It does well in calcareous soils as well as in soils rich in organic matter (Niembro, R. Anibal) and well drained acid soils derived from volcanic rocks (Ultisols). Cedro amargo does not tolerate heavy and flooded soils. It is more abundant in low lands and at the foothills (Cintron, Barbara B. 1990). Cedro amargo trees should not be planted in pure plantations because of their susceptibility to the shoot borer *Hypsipyla grandella*, instead it should be planted mixed with other fast growing species or in agroforestry systems. The wood from this tree is among the most desired in Latin American because of its value in the manufacture of veneer and furniture. This species specific gravity ranges from 0.42 to 0.63, it is resistant to fungi and insect attacks such as termites

[14] Solis, M. and Moya, R. 2000. *Hieronyma alchorneoides* en Costa Rica. FONAFIFO. pp 97

[15]

- Niembro, Rocas Anibal. *Cedrela odorata* L. In: Tropical Tree Seed Manual, Part II: Species Descriptions. By J. A. Vosso. Editor. 2003. USDA-Forest Service. 386-388 pp. (http://www.rngr.net/publications/ttsm/species/PDF.2003-12-08.1748).
- Cintron, Barbara B. 1990. *Cedrela odorata* L. Cedro hembra, Spanish cedar. In: Burns, Russell M.; Honkala, Barbara H., eds. Silvics of North America: 2. Hardwoods. Agric. Handb. 654. Washington, DC: U.S. Department of Agriculture, Forest Service: 250-257.
- Tropical Agricultural Research and Higher Education Center (CATIE). 1997. *Cedrela odorata*. Costa Rica, Forestry Seeds Project (PROSEFOR). Technical Note on management of forestry sedes. No. 24. 2 p. (CENTRO AGRONOMICO TROPICAL DE INVESTIGACION Y ENSEÑANZA (CATIE). 1997. *Cedrela odorata*. Costa Rica, Proyecto Semillas Forestales (PROSEFOR), Nota técnica sobre manejo de semillas forestales No. 24. 2 p.)
- Herrera Alegría, Z. Lanuza B. 1,996. Species for reforestation in Nicaragua. Nicaragua, Ministry of Environment and Natural Resources (MARENA), Forestry Service. 185 p. In: http://www.petexbatun.net/maderas/cedro (Herrera Alegría, Z. Lanuza B. 1,996. Especies para reforestación en Nicaragua. Nicaragua, Ministerio del Ambiente y Recursos Naturales (MARENA), Servicio Forestal. 185 p. In: http://www.petexbatun.net/maderas/cedro)

[16] http://www.petexbatun.net/maderas/cedro

(CATIE, 1997) and it keeps a nice fragrance for many years. The wood of this tree is also used for musical instruments, and interior decoration. It can be used in finished and interior divisions, decorative flat sheet, first class cabinets, cabinetmaking, doors and windows, doors carved, plywood, boats (internal parts), moldings and boards (Herrera, 1996). Its bark is used as remedy for diarrhea, fever, vomiting, hemorrhages, bronchitis, and indigestion (Niembro, R. Anibal). This species rotation ranges from 20 to 30 years.

a)

b)

Figure 5. a) *Cedrela odorata* –Cedro amargo tree. b) One year old *Cedrela odorata* planted in association with coffee plantation in Turrialba, Costa Rica (Navarro, C. and Hernandez, G. 2001)

Non-native species:

The non-native species shown on Table 5 have already been planted in many other regions of Costa Rica. The first Melina and Teak plantations were established in 1960 and 1930 respectively. The country has also developed high level of knowledge and expertise in the use of these species, and there are no reports of negative impacts when the plantations are established on terrain with low slope and proper management (especially in the case of Teak). Also there aren't any reports of invasiveness for these two species in the country.

Gmelina arborea[17] ("Melina"): This tree species is widely adapted to different sites and climates in Costa Rica, ranging from wet to dry regimes. It is a fast growing species but requires low terrains (see Figure 6) with fertile soils and plenty of water (see Figure 6). It likes soils with high content of calcium and magnesium. Melina wood has a variety of uses in construction, furniture, pulp, etc. The species rotation ranges from 10 to 14 years.

Figure 6. Melina's forest plantation with pruning.

Tectona grandis[18] ("Teca" or "teak"): Trees of this species can reach more than 35 m height (in best sites) and more than 30 cm in diameter at ages greater than 15 years old. This species adapts well to a variety of soils, but it prefers alluvial flat areas with fertile, well drained deep soils, pH neutral to acid and sandy to loamy soil texture. In addition, this species requires soils with high content of calcium (Ca), phosphorous (P), magnesium (Mg), as well as plenty of light and space. It is very sensitive to weeds and fire. Teak is not recommended on sites with slopes greater than 30%, or on sites affected by strong winds. Other limiting factors for this species are shallow flat soils with a stony layer near the ground surface, bad drainage or flooded areas, hard loamy or compacted soils, shallow and sandy soils, high content of interchangeable iron (Fe) and aluminium (Al). Teak's wood has also a variety of uses such as bridges, furniture, carpentry, floors, doors, poles, musical instruments, toys, etc. The rotation for this species ranges from 25 to 40 years (see Figure 7).

[17] Rojas, F. et al, 2004. Guide for producers of *Gmelina arborea* in Costa Rica. FONAFIFO. pp151 (Rojas, F. et al, 2004. Manual para productores de *Gmelina arborea* en Costa Rica. FONAFIFO. pp151)

[18] Fonseca, W. 2004. Guide for producers of *Tectona grandis* in Costa Rica. FONAFIFO. pp109 (Fonseca, W. 2004. Manual para productores de *Tectona grandis* en Costa Rica. FONAFIFO. pp109)

Figure 7. Teak's forest plantation with thinning, but no pruning.

Eucalyptus deglupta[19] (Deglupta): is a fast growing tree that may reach 35 to 60 m height and 50 to 200 cm DBH. This species grows well in deep and slightly acid soils, as long as they are not compacted and they do not have drainage problems. Phosphorus and calcium levels higher to 8 ppm and 5 meq/100 g of soil, favor this species growth. The wood of *E. deglupta* is used in construction in general, boat floors and the finishing of small vessels. It is also used in heavy construction, cabinetmaking and joinery. It is also used as transmission poles; rustic construction, fences, firewood, pulpwood, agglomerate boards and charcoal (see Figure 8).

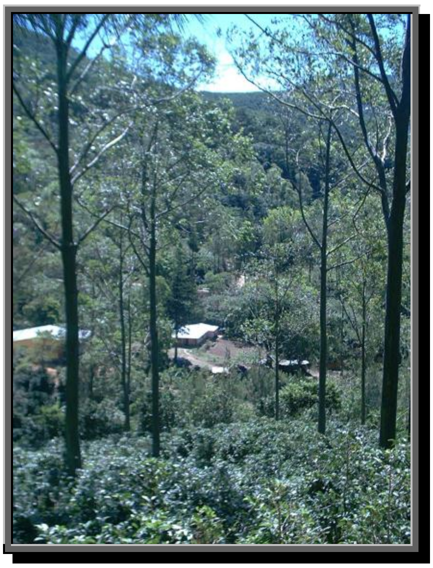


Figure 8. *Eucalyptus deglupta* combined with coffee in San Rafael, Dota, CR.

[19] CATIE 1994. Deglupta: *Eucalyptus deglupta*.Blume. Multiple-uses Tree Species in America Central /CATIE –Programa Integrated Managemente of Natural Resources. Turrialba, Costa Rica. (Technical Series. Technical Report No. 240) 43 pp. (CATIE 1994. Deglupta: *Eucalyptus deglupta*.Blume. Especie de arbol de uso multiple en America Central /CATIE –Programa Manejo Integrado de Recursos Naturales. Turrialba, Costa Rica. (Serie tecnica. Informe tecnico No. 240) 43 pp.)

FONAFIFO has already considered the need for having seed sources for the development of the plantations with both native and non-native species. Consequently, it has supported a program of tree improvement oriented to the production of good seed quality for agroforestry and tree plantations. The best plantation stands in the area have been selected, and by thinning them, improved stands called "seed stands" have been developed. These stands belong to COOPEAGRI, its associates, or other farmers in the region. COOPEAGRI collects the seeds using tree claiming ropes, hand cutters, bags, etc.

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

>>

The project will promote the development of a diverse landscape in all three sub-regions (North Hillsides, Valley, and South Hillsides) through an improved farm organization where areas of land use optimal for cattle or crops will remain under those land uses, while areas of land use optimal for forestry will be used to establish the CDM project activities. Forest Plantations, Natural Regeneration and Agroforestry Systems will be promoted by the project to maximize social and environmental benefits, including the generation of carbon offsets.

The seedlings for all project activities, with the exception of reforestation by Assisted Natural Regeneration, will be produced at COOPEAGRI`s nursery, located at "La Presa" farm in the Daniel Flores District, with certified seed (from CATIE`s Seed Bank when available) or from previously selected trees to guarantee seedling quality. In general, Teak needs about 3 months in the nursery, Amarillon and Pilon need about 6 months, Cebo and Cedro need 3 to 5 months. Melina and Eucalyptus needs about 2 and half months of nursery maintenance and management. The planting stock will be produced in jiffy pellets or black polyethylene bags. Foliage fertilization (one time at 0.0043 gr/tree of complete fertilizer formula, equivalent to 18% of nitrogen / tree) will be applied in the nursery.

In the case of Forest Plantations and Agroforestry Systems, the site preparation will be done using manual methods to ensure minimum soil disturbance. It will be limited to making a hole with a tree planting shovel and keeping free of weeds in a circle around the seedlings (35 cm radius). The use of herbicides may be required in sites with aggressive grasses, but only during the first years. The project proposes the use of approved herbicides as shown in Table 6. Training will be provided to farmers on the methods of herbicide application, including the use of protective equipment when applying herbicides, handling of pesticides and safe disposal used pesticide containers.

Table 6. List of approved herbicides[20]

PRODUCT NAME (Herbicides)	ACTIVE INGREDIENT	WHO CLASS
Polaris	Isopropylamine glyphosate	-
Roundup 480 AS	Isopropylamine glyphosate	-
Roundup 75 WSG	Monoammonuim glyphosate	-

Note: Classification of active ingredient based on WHO´s hazard classification system.

A second fertilization (50 gr/tree of 10-30-10 complete fertilizer formula, equivalent to 5 gr of nitrogen / tree) will be applied during tree planting. Weed control will be done manually three times a year for the first two years for all the species.

Reforestation by Assisted Natural Regeneration will be recommended on deforested hillside areas with the highest slopes, in both North and South sub-regions. The remaining forest patches and the seed-soil-bank will function as seed sources. Forest species from natural regeneration will be all native species. The natural regeneration process allows the recovery of the original forest type. This project activity includes the identification of the areas, the establishment of wire-fences around them

[20] Ishii-Eiteman, M and Ardhianie, N. 2002. Community Monitoring of Integrated Pest Management versus Conventional Pesticide Use in a World Banck Project in Indonesia. Internacional Juornal Occupational Environmetal Health, 8: 200-231.

to excluded cattle (if required), the prevention of forest fires by establishing fire breaks, the signage of the area, species enrichment if necessary, and hunting/pouching control.

Agroforestry Systems will be promoted on all three sub-regions. On the hillsides, this activity will be limited to the lower slopes. The systems included in the proposed CDM project are plantation in small blocks, plantation of trees in rows & fences, and trees mixed with crops. The species selection will be based on site conditions and farmer's preferences. The spacing will vary depending on the technique of the agroforestry system selected by the farmer. The average number of trees planted is estimated in 400 trees/ha, which represents a tree crown cover above 30% at maturity in situ.

Reforestation through Forest Plantations will be recommended on medium to high quality sites presently covered with pasture in the Valley area. The species spacing will be 3 x 3 m for a total of 1,111 trees/ha.
Pruning in Forest Plantations will vary depending on the recommended silvicultural practices of the species (see Table 7). Thinning of native species and Teak will be done at ages 6, 10 and 15, while harvesting will be done at age 20. In the case of Melina, thinning will be done at ages 5 and 8, while harvesting will be done at age 12.

Table 7. Guidelines by species for the establishment and management of the forest plantations

Stand model	**Species used**	**PLANTATION DENSITY**	**THINNING and ROTATION**
SM 1 – Melina Plantations	*Gmelina arborea*	Tree spacing 3 x 3 m (1111 trees/ha).	**Thinning** The first one shall be done when the trees are 5 years old. The second one when the trees are 8 years old. Starting from a plantation density of 1,111 trees/ha, the thinning regimes will have an intensity of 30%. **Rotation** In the proposed CDM project the rotation will be 12 years
SM 2- Teak and/or Eucalyptus plantations	*Tectona grandis* *Eucalyptus deglupta*	Tree spacing 3 x 3 m (1111 trees/ha).	**Thinning** The first one shall be done when the trees are 6 years old. The second one when the trees are 10 years old. And the third one when the trees are 15 years old. Starting from a plantation density of 1,111 trees/ha all the thinnings will have an intensity of 30%. **Rotation** In the proposed CDM project, the rotation will be 20 years.
SM 3 - ANR	*The final species composition will depend on the seed trees available in the area however similar native species are expected as the ones that will be planted (Terminalia amazonia, Cedrela Odorata).*		**Thinning** No thinning are planned **Rotation** In the proposed CDM project the rotation will be 20 years
SM 4 - Agroforestry Trees+Crops	*Hieronyma alchorneoides* *Terminalia amazonia* *Cedrela odorata* *Gmelina arborea* *Tectona grandis*	400 trees/ha	**Thinning** No thinning are planned **Rotation** In the proposed CDM project the rotation will be 20 years
SM 5 - Silvopastoral Trees + Pastures	*Hieronyma alchorneoides* *Terminalia amazonia* *Cedrela odorata* *Gmelina arborea* *Tectona grandis*	400 trees/ha	**Thinning** No thinning are planned **Rotation** In the proposed CDM project the rotation will be 20 years

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

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

>> Not Applicable

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

>> The proposed reforestation activities will be developed in marginal pasture lands that have less that than 0.64 animals per hectare. As a result of the proposed A/R CDM Project activity, no displacement of economic activities to areas outside the project boundary will occur. Leakage avoidance activities include COOPEAGRI assistance in the establishment of agroforestry activities.

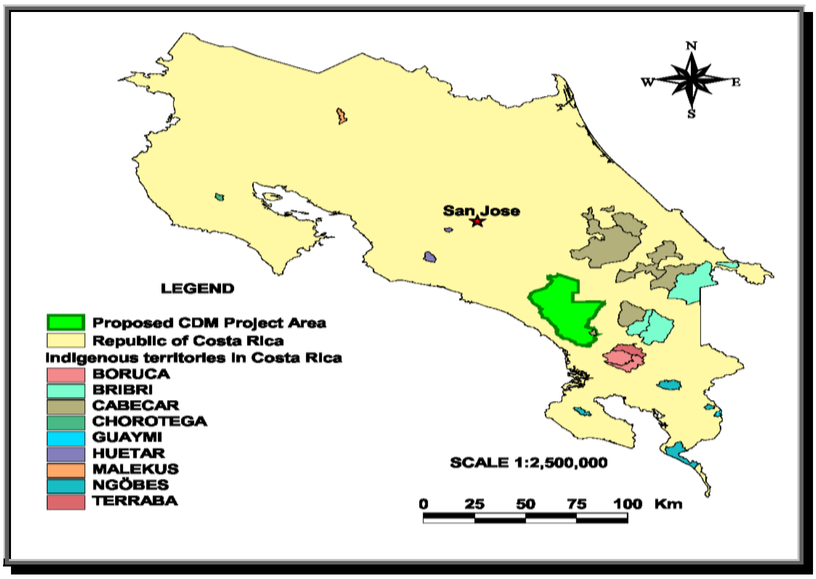
A.6. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

>>

The project includes a total of 892.42 ha land privately owned by small and medium farmers affiliated to COOPEAGRI, a cooperative that groups 10,162 farmers currently dedicated to agricultural activities, such as coffee, sugarcane, and cattle. Each of the cooperative associates that will participate in this project have a registered land title and a cadastral map. It is also important to mention that there are no large indigenous areas within the Perez Zeledon County (see Map 11). Project activities will not result in any resettlement and will not limit the access to previously used lands by indigenous people.

All the farmers included in the proposed A/R CDM project (see Annex 5) have signed a contract with FONAFIFO. This contract establishes that farmers give the rights of access of the sequestered carbon (tCERs) to FONAFIFO, and that in exchange, the farmers will receive from FONAFIFO annual payments for the forest environmental services produced by them, including the carbon sequestration.

Map 11. Indigenous territories in Costa Rica and CDM project area.



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

>> A list of farmers included in the project is presented in Annex 5. All discrete area in the project boundary has a unique geographical identification; and is privately owned by a participating farmer. The eligibility of each land parcel was verified using the "Procedures to demonstrate the eligibility of lands for afforestation and reforestation CDM project activities" approved by the CDM Executive Board (Annex 18, EB35)[21]. The application of the procedures is presented below.

Step 1. Evidence that the land within the planned project boundary is eligible for an A/R CDM project activity

Step 1-a Demonstrate that the land at the moment the project starts is not forest

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

The farmer's parcels to be reforested in the proposed A/R CDM project activity are currently covered by pastures or are under agriculture, some of them with isolated trees. Crown cover is below thresholds for defining forests adopted by Costa Rica's DNA[22]. Land surveys, field pictures, 2003 aerial photographs, and a 2005 forest cover map are used to demonstrate this condition. The collected data were incorporated into the Project GIS platform, which will be available to the DOE at the time of validation. Five project parcels did show forest cover in the 2005 forest cover map, however field visits proved that it was a classification error (see pictures in project file).

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

There are not young natural stands or plantations present in the project discrete areas. Land surveys, field pictures, and 2003 aerial photographs were incorporated into the Project GIS to demonstrate their condition. This data will be available to the DOE at the time of validation.

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21 Hereinafter referred as "AR eligibility tool" (http://cdm.unfccc.int/EB/035/eb35_repan18.pdf).

22 In agreement with the draft decision -/CMP.1 Land-use, land-use change and forestry (LULUCF) from CP. 7 "Marrakesh Accords"(2001). Definitions, modalities, rules and guidelines relating to LULUCF under the Kyoto Protocol, for LULUCF activities under Articles1 3.3 and 3.4, Costa Rica adopted the following definitions:
(a) "**Forest**" is a minimum area of land of 1.0 hectare with a minimum tree crown cover (or equivalent stocking level) of 30 % with trees with the potential to reach a minimum height of 5 meters at maturity *in situ*. A forest may consist either of closed forest formations where trees of various stores and undergrowth cover a high proportion of the ground or open forest. Young natural stands and all plantations which have yet to reach a crown density of 30 percent or tree height of 5 meters are included under forest, as are areas normally forming part of the forest which are temporarily un-stocked as a result of human intervention or natural causes but which are expected to revert to forest. The proposed minimum width that will apply to define forest and units of land subject to afforestation, reforestation and deforestation activities is 30 meters.
(b) "**Reforestation**" is the direct human-induced conversion of non-forested land to forested land through planting, seeding and/or the human-induced promotion of natural seed sources, on land that was forested but that has been converted to non-forested land. For the First commitment period, reforestation activities will be limited to reforestation occurring on those lands that did not contain forest on 31 December 1989.

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

All discrete areas are not temporarily un-stocked, they are presently covered by pastures or coffee, some of them with isolated trees. Landowners will not permit the re-growth of forest due to current land uses and pressures in the project region, as it is shown in section C5.

Step 1-b Demonstrate that the activity is a reforestation project activity:

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

The project area has been used for cattle and agriculture for the last 60 years. As a result of these traditional land uses, the existing ecosystems have been severely altered and most of the natural vegetation has been eliminated and replaced with pastures. The 1990 forest cover map was used to demonstrate that discrete areas in the project were converted to non-forested[23] land prior to 31 December 1989.

ii. For afforestation project activities, demonstrate that for at least 50 years vegetation on the land has been below the thresholds adopted by the host country for definition of forest..

Does not apply

Step 2: Verifiable information to demonstrate steps 1 (a) and 1 (b)

Project files and GIS platform include digital high resolution aerial photographs from 2003 to demonstrate land use and forest cover at the time the project started. In addition each discrete area under project control was surveyed, and located using GPS taken coordinates. Forest cover maps from 1990, and 1997 were prepared or acquired to evaluate land use at 31 December 1989 deadline. The 1990 forest cover map is in digital format, and it was prepared by the University of Alberta, EOS Laboratory using 1990 Landsat remote sensing imagery. All forest cover maps (1990, 1997, 2000, and 2005) are available in digital form and they were prepared using Landsat images.

To test the eligibility of these parcels, the corresponding polygons were also overlaid on historical remote sensing data, such as, 1990, 1997, and 2000 forest cover maps. All project sites were confirmed that the land at the moment the project starts was not forest on 31 December 1989, and that the land has not been forest land at any time since 1 January 1990 according to the national forest definition communicated by the DNA. All field survey data, remote sense data, and analyses of imagery were incorporated into the project GIS platform, and will be made available to the DOE at time of validation.

[23] No-forest lands according to country's reported forest definition.

A.8. Approach for addressing non-permanence:

>> The major objective of the project is to increase the forest cover of project region through reforestation and agro-forestry activities. Project participants have chosen the issuance of temporary Certified Emission Reductions (tCERs) for the net anthropogenic GHG removals by sinks achieved by the proposed A/R CDM project activities.

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

>>

The first expected verification will be in the year 2012 with the following verifications being every 5 years as per the requirements of the CDM modalities and procedures.

Summary of results obtained in Sections C.7., D.1., and D.2.				
Year	**Estimation of baseline net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of actual net GHG removals by sinks (tonnes of CO_2 e)**	**Estimation of leakage (tonnes of CO_2 e)**	**Estimation of net anthropogenic GHG removals by sinks (tonnes of CO_2 e)**
Year 1	0	5,290	0	5,290
Year 2	0	7,510	0	7,510
Year 3	0	8,543	0	8,543
Year 4	0	10,029	0	10,029
Year 5	0	9,583	0	9,583
Year 6	0	9,783	0	9,783
Year7	0	9,486	0	9,486
Year 8	0	8,657	0	8,657
Year 9	0	9,710	0	9,710
Year 10	0	9,772	0	9,772
Year 11	0	8,893	0	8,893
Year 12	0	9,644	0	9,644
Year 13	0	7,486	0	7,486
Year 14	0	8,630	0	8,630
Year 15	0	8,904	0	8,904
Year 16	0	6,500	0	6,500
Year 17	0	9,078	0	9,078
Year 18	0	9,783	0	9,783
Year 19	0	9,831	0	9,831
Year 20	0	8,938	0	8,938
Total (tonnes of CO2 e)	0	176,050	**0**	176,050

Note. Ex-ante estimations made using the TARAM V.1.3 Excel Spreadsheet

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

>> The total cost for the proposed A/R CDM project is estimated at US$ 1.536 million, and it is expected to be financed by the BioCarbonFund for up to US$ 791,982 through carbon credits purchase, and FONAFIFO is expected to invest US$ 724,038 and COOPEAGRI US$ 20,000 as counterpart funds for project implementation.

No funding is expected from the Official Development Assistance and the Parties to the Annex I of the United Nations Framework Convention of Climate Change for undertaking the project.

SECTION B. Duration of the project activity / crediting period

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

>> 01/08/2006. This date represents when the first planting occurred on lands that are certified and included in contracts with farmers.[24]

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

>> The expected operational lifetime of the project is 60 years.

B.3 Choice of crediting period:

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

>> 20 years-00-months

The 20-year crediting period is renewable for a further two periods of 20 years for a total period of 60 years.

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

>> NA

SECTION C. Application of an approved baseline and monitoring methodology

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

>>"Reforestation or afforestation of land currently under agricultural use" (AR-AM0004/Version 04)

Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02)

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

The proposed A/R CDM project activity involves reforestation of degraded lands through three activities: agroforestry systems, assisted natural regeneration, and forest plantations

The project activities comply with the applicability conditions of the methodology, i.e.:

- Lands to be afforested or reforested are degraded and the lands are still degrading or remain in a low carbon steady state;

Evidence that the project meets this condition is provided in section C.5.1 step 3 b

- Carbon stocks in soil organic carbon, litter and dead wood can be expected to further decrease due to soil erosion and human intervention or increase less in the absence of the project activity, relative to the project scenario;

[24] The first certification of land under the project was signed on 28 August 2006, certifying that the lands were planted in August 2006. This certification was then the basis of PSA contract SJ-02-20-0050-2006, which was signed on 7 November 2006 and was the first contract signed as part of the project.

As shown in section C.5.1 step 3 b, the project is implemented on degraded lands which continue to degrade including occurrence of soil erosion and degradation. Hence carbon stocks in soil organic carbon, litter and dead wood can be expected to further decrease in the absence of the project activity.

- Site preparation does not cause significant longer-term net decreases of soil carbon stocks or increases of non-CO_2 emissions from soil;

As per Section A.5.4, site preparation will be limited to making a hole with a tree planting shovel and keeping a circle of 35 cm radius free of weeds around the seedlings. Hence site preparation does not cause significant longer-term net decreases of soil carbon stocks or increases of non-CO2 emissions from soil.

- Flooding irrigation is not permitted

Flooding irrigation or soil drainage will not be used in this project.

- Soil drainage and disturbance are insignificant, so that non CO_2-greenhouse gas emissions from these types of activities can be neglected;

As per Section A.5.4, site preparation will be limited to making a hole with a tree planting shovel and keeping a circle of 35 cm radius free of weeds around the seedlings and can therefore be considered insignificant.

- The A/R CDM project activity is implemented on land where there are no other on-going or planned A/R activities (no afforestation/reforestation in the baseline).

Land that will be reforested is owned by small and medium farmers who were not implementing A/R activities on their lands by themselves. Section C.5.1, step 3 (e) and section C.6 show that without the CDM project activity, it is very unlikely that these farmers would have implemented A/R activities.

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

>> Carbon stocks in the pools of soil organic matter, dead wood and litter will not decrease more as a result of the proposed A/R project activity than in the baseline, because the planted trees will be on marginal agricultural land that have lower soil organic matter content, and little dead wood and litter. In other words, the carbon stocks in these pools are expected to increase relative to the baseline, which is likely to incur on further losses of soil carbon caused by degradation, or at best is constant in carbon at low steady state. Therefore, to be conservative, we choose to account only for the above-ground biomass and below-ground biomass in the proposed A/R project activity. Carbon pools selected by the proposed project and in agreement with the methodology AR-AM0004 Version 04 are presented Table 8.

Table 8. Selection and justification of carbon pools

Carbon Pools	**Selected (answer with yes or no)**	**Justification / Explanation of choice**
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

The sources and gases included in the selected methodology area listed in Table 9 below.

Table 9. Gases considered from emissions by sources other than resulting from changes in carbon pools

Source	Gas	Included/ Excluded	Justification / Explanation
Burning biomass	CO_2	No	However, carbon stock decreases due to burning are accounted as a carbon stock change
	CH_4	Yes	Non-CO2 gas emitted from biomass burning
	N_2O	No	Non-CO2 gas emitted from biomass burning

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

For the baseline stratification, the methodology states that it is usually sufficient to stratify according to the area of major vegetation types. In the whole project the basic land use is similar and consists of a mix of pastures, agricultural crops and brush. However there are differences related to climatic conditions between the North Hillsides Lands (1200 to 3000 m.a.s.l; rainfall: 3000-4500 mm/year; temp: 15-20 ºC) and the lower areas of the Valley and South Hillsides ((300 to 1200 m.a.s.l; rainfall: 2000-2500 mm/year; temp: 20-28 ºC). Due to these climatic differences and the landscape topography, land use in the Northern Hillsides generally consists of pastures in steep terrain while land use in the Valley and South Hillsides consist of mixed agricultural lands and pasture lands in rolling hills. Based on this distinction, the project area will be divided in the following 2 baseline strata:

1. North Hillsides;
2. Valley and South Hillsides

Table 10. Ex-ante stratification for baseline net GHG removals by sinks

Index (i)	Description	Code[25]	Area (ha)	Number of discrete areas
1	North Hillsides	BLS1	340.56	17
2	Valley and South Hillsides	BLS2	551.86	187
	Total		892.42	204

The ex-ante stratification of the project for the calculation of the actual net GHG removals by sinks is based on the different stand models that are expected in the project. As described in section A.5.4, the project is implementing 3 types of A/R activity:

1. Assisted Natural Regeneration (ANR)
2. Forest Plantations (FP)
3. Agroforestry Systems (AFS)

For the forest plantations, 2 general stand models can be distinguished based on the species used. These stand models are plantations with Gmelina arborea and plantations with Tectona grandis

[25] ID or Code used in TARAM spreadsheet.

and/or Eucalyptus. In terms of the agroforestry systems, there are 2 major systems, one based on intercropping with cash crops, the other one based on silvopastoral systems. Based on these distinctions the following general stand models can be identified in the project:

1. Stand model 1: Gmelina arborea (SM1)
2. Stand model 2: Tectona grandis and/or Eucalyptus (SM2)
3. Stand model 3: Assisted Natural Regenaration (SM3)
4. Stand model 4: Agroforestry- Trees mixed with crops (SM4)
5. Stand Model 5: Silvopastoral -. Trees in Pastures (SM5)

As described above, there are differences related to climatic conditions and topography between the North Hillsides Lands and the lower areas of the Valley and South Hillsides. These circumstances affect the growth assumptions for the stand models. To take account of these differences, the ex-ante project stratification is based on both the location (North hillsides vs Valley and South Hillsides) and the stand model used. This results in the following ex-ante strata having been identified for the project scenario:

1. North Hillsides/ANR
2. North Hillsides/Melina
3. Valley Lands and South Hillsides/Melina plantations
4. Valley Lands and South Hillsides /Teak and/or Eucalyptus plantations
5. Valley lands and South Hillsides /Agroforestry Trees+Crops
6. Valley Lands and South Hillsides /Silvopastoral Trees+Pastures
7. Valley lands South Hillsides/ANR

These 7 strata for the ex-ante estimation of the actual net GHG removals by sinks of the **proposed CDM project activity**, are distributed as described in table 11.

Table 11. Ex-ante stratification for actual net GHG removals by sinks

Index (i)	**Name**	**Code**	**Area**	**Number of discrete areas**
1	North Hillsides/ANR	BLS1-SM3	322.24	13
2	North Hillsides/Melina	BLS1-SM1	18.32	4
3	Valley Lands and South Hillsides/Melina plantations	BLS2-SM1	72.08	19
4	Valley Lands and South Hillsides /Teak and/or Eucalyptus plantations	BLS2-SM2	17.81	4
5	Valley Lands and South Hillsides /Agroforestry Trees+Crops	BLS2-SM4	227.07	92
6	Valley Lands and South Hillsides /Silvopastoral Trees + Pastures	BLS2-SM5	160.44	69
7	Valley Lands and South Hillsides/ANR	BLS2-SM3	74.46	3
	Total		**892.42**	**204**

C.5. Identification of the baseline scenario:

>> The baseline scenario was determined through the following steps:

Step 1. Demonstration that the proposed AR CDM project activity meets the conditions under which the methodology is applicable and that baseline approach 22(a) can be used.

Step 2. Delineation of the project boundary.

Step 3. Analysis of historical land use, local and sector land-use policies or regulations and land use alternatives.

Step 4. Stratification of the AR CDM project area

Step 5. Determination of the baseline land-use / land-cover for each stratum.

The procedures followed implementing these steps are presented below in section C.5.1.

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

>> The procedure to identify the most plausible baseline scenario was the following:

Step 1: Demonstrate that the proposed A/R CDM project activity meets the conditions under which the proposed methodology is applicable, and that baseline approach 22(a) can be used.

As per C.3. above, the proposed A/R CDM project activity meets the conditions under which the AR-AM-004 Version 04 methodology is applicable and baseline approach 22(a) can be used.

Step 2: Define the project boundary as described in Section II.2 above.

As per section A.4, the proposed A/R project activity contains more than one discrete area of land. Each discrete area is located in a privately owned farm. Annex 5 includes the list of the farmers and the geographical coordinates of each project discrete area. Each discrete area of land was surveyed and located using GPS coordinates or geo-referenced on 2003 or 2005 aerial photographs; its boundary is clearly defined excluding any area in between discrete parcels, and a unique geographical identification was assigned to them.

The area of each parcel was calculated using the GIS platform. The GIS database also includes: farmer's name, PSA-contract number, type and area of A/R activity (in ha), baseline stratum, and project activity stratum. Land cover data for each discrete area in the project area and before the start of the project activity, were collected and added to the GIS platform.

Step 3. Analyze historical land use, local and sectoral land-use policies or regulations and land use alternative

(a) *Analysis of historical and existing land-use/land-cover changes in the context of the socio-economic conditions*

Costa Rica experienced one of the highest rates of deforestation worldwide during the 1970s and 1980s.
During the 60's and the beginning of the 70's, the deforestation rate was 55,000 ha/year; and towards the end of the 70's, the rate increased to 60,000 ha/year. These levels of deforestation led the country to lose almost 70% of its forest cover. Forests on private land were mainly converted to pasture and agriculture. Deforestation was principally driven by the rapid expansion of the road system and by policies that encouraged deforestation, including cheap credit for cattle and land titling laws that rewarded deforestation[26].

To determine the historic and existing land use/land-cover changes in the project area, cartographic maps from 1960 to 1980 and aerial photos from 1992, 1997 and 2005 were used. The cartographic maps and aerial photos were geo-referenced and stored in the project GIS. Seventy-five sample areas without forest cover were selected in the 2003 aerial photos for the North Hillsides, Valley, and South Hillsides respectively. These same areas were located in the 1997 and 1992 photos and on cartographic maps. The results presented in Table 12 show that 100% of the sample areas have maintained their current land use during the last 11 years, and that 90.7 % of the areas have maintained pastures or crops for more than 20 years.

Table 12. Historical land use trend in the CDM project area.

YEAR	LAND USE	NORTH HILLSIDES	VALLEY	SOUTH HILLSIDES	TOTAL
2003	Not forest	25	25	25	75
	Forest	0	0	0	0
1997	Not forest	25	25	25	75
	Forest	0	0	0	0
1992	Not forest	25	25	25	75
	Forest	0	0	0	0
1980	Not forest	20	23	25	68
	Forest	5	2	0	7

Figure 9 below shows the current land management in the North Hillsides. It represents the typical situation in the area where part of the area is dedicated to pastures. The area of the pastures changes cyclically according to the meat price. It might temporarily become brush-lands but land will not be left unused for long. The area for agricultural crops will also change depending on market prices although the changes depend on the crop type (for example once an area is planted with coffee, the land use is not likely to change very quickly even if the coffee prices drop).

[26] Refer to R-Pin as submitted by the Costa Rican Government to the Forest Carbon Partnership Facility, available at http://www.forestcarbonpartnership.org/fcp/sites/forestcarbonpartnership.org/files/Documents/PDF/FCPF_R-PIN_Template_Costa_Rica_Agosto08_ultima_version.pdf

Figure 9. Current land management in the North Hillsides sub-region.

(b) Evidence that historical and current land-use/land-cover change has led to progressive degradation of the land over time including a decrease or steady state at a reduced level of the carbon stocks in the carbon pools

As per the requirements of the methodology, historical degradation can be indicated by vegetation degradation and/or soil degradation. As discussed in step above, vegetation degradation is occurring because land was forest at times in the past and non-forest in more recent times. Because of the land use pattern and the pressure on the land, self-encroachment of trees will not occur. This is also confirmed by table 12 which shows that land that has been converted to pastures or agricultural lands remains as such and does not revert back to forest. This trend is confirmed by studies such as Leiva

(2003)[27]; Baltissen (1988)[28]; Von Platen (1985)[29] , and, specifically for the project region, Sifuentes (2009)[30].
Hence, once lands are used as agricultural land or pastures, lands are likely to remain in a low carbon state or are subject to further degradation. Indicators of further degradation in the project area are related to soil degradation and soil erosion which can be witnessed in the field through a visual assessment (pictures of the situation in the field are attached to the PDD). The visual assessment shows occurrence of exposed sub-soils and existence of gullies.

(c) Identification of national, local and sectoral land-use policies or regulations adopted before 11 November 2001 that may influence land-use/land-cover change

Costa Rica has several policies that influence land use. These include:
a. The Political Constitution (1949),
b. The Soil Use, Management and Conservation Law (No. 7779, 1998),
c. The Forestry Law (No. 7575, 1996),
d. The Biodiversity Law (No 7788, 1997),
e. The National Plan of Forestry Development (2001-2010),

The Soil Use, Management and Conservation Law aims to protect, conserve and improve soils. The law promotes better planning through environmental inventories, active participation of the communities in decision making processes related to land use and improved practices.

The objective of the Biodiversity Law is to conserve the biodiversity and the sustainable use of the resources, as well as the distribution of the derived benefits and costs. The law specifically regulates the use, the handling, the associate knowledge and the right distribution of the benefits and costs derived from the advantage of the elements of the biodiversity.

The National Plan of Forestry Development was created as follow up for the National Plan of Forest Development. Its main concern was the phenomenon of the illegal harvesting and its transcendence in the country.

Forestry Law No. 7575 which was adopted in 1996 banned forest clearing. The same law also provides the legal and regulatory basis to contract landowners for the environmental services provided by their lands, and establishes a financing mechanism for this purpose. This law empowers

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[27] Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica in the Face of Climate Change. Centroamerican Series of Forest and Climate Change. Central American Comission of Environment and Development (CCAD/FAO) (Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica frente al cambio Climatico. Serie Centroamericana de Bosques y Cambio Climatico. Comision Centroamericana de Ambiente y Desarrollo (CCDA)/FAO.)

[28].Baltissen, G. 1988. Effects of forest clearing and land use on soil properties of two land use sequences in Cocorí, Atlantic Zone of Costa Rica. Editorial Turrialba, CATIE / Agricultural University Wageningen, Atlantic Zone Programme / MAG, CR.

[29] Von Patten, H. 1985. Appropriate land use systems of smallholder farms on steep slopes in Costa Rica: a study on situation and development possibilities. Hohenheimen Universitat, DE.
[30] Sifuentes, M. 2009. Assessing the Design of Mixed Small-farms and the Condition of Improved Grasslands in the South of Costa Rica. Master Thesis. Turrialba, Costa Rica.
Sifuentes, M. 2009. Evaluación del diseño de pequeñas fincas agropecuarias y de la condición de las pasturas mejoradas en la zona sur de Costa Rica. Tesis de Maestría. Turrialba, Costa Rica, 2009

the National Forestry Financing Fund (FONAFIFO) to issue contracts for the environmental services provided by privately owned forest ecosystems (known as the PSA program).

As per the methodology, these policies should not significantly impact the project area. A review of the above policies shows that they only provide incentives that promote good practices. None of these policies forces land owners to change their current land use that leads to degradation. As it is shown in the following steps and in section C.6, there are barriers for land owners to change their current land use. These barriers are not affected by these policies and land degradation practices continue if barriers have not been removed. Forestry Law No. 7575 can potentially have an effect on land use; however, as it is shown in step e below, the incentives provided by the forestry law No. 7575 are not sufficient to result in land use changes in area of the proposed A/R CDM project activity.

This is evidenced by the lack of impact that the PSA program had on the project area prior to the project start. As shown in Table 13 and Figure 10, PSA forest plantations were implemented in only 136.9 hectares out of 117,321 hectares in the project region of Perez Zeledon County totaling 0.1% of the project region from 1997 to 2005. These data and map show that the policies had a negligible effect on the project area. Hence it is clear that the policies have not significantly impacted the land use in the boundary of the proposed A/R CDM project activity.

Table 13. Area of pre-project Forest Plantations implemented under the PSA program since 1997 in Costa Rica and within the project area.

Decree No.	Area of PSA Forest Plantations implemented in Costa Rica since 1997 (ha)	Area of PSA Forest Plantations implemented in project region since 1997 (ha)
26141-H-MINAE (1997)	4,629	No data available.
26977-MINAE (1998)	4,173	0
27831-MINAE (1999)	3,156	44.5
28610-MINAE (2000)	2,050	7.5
29394-MINAE (2001)	2,085	24.0
30090-MINAE (2002)	1,627	0
31081-MINAE (2003)	3,040	22.8
31767-MINAE (2004)	1,935	30.5
32226-MINAE (2005)	1,345	7.6
Total	**24,040**	**136.9**
Average	**2,671**	**17.5**

Source: Integrated Project Management System, FONAFIFO. 2006

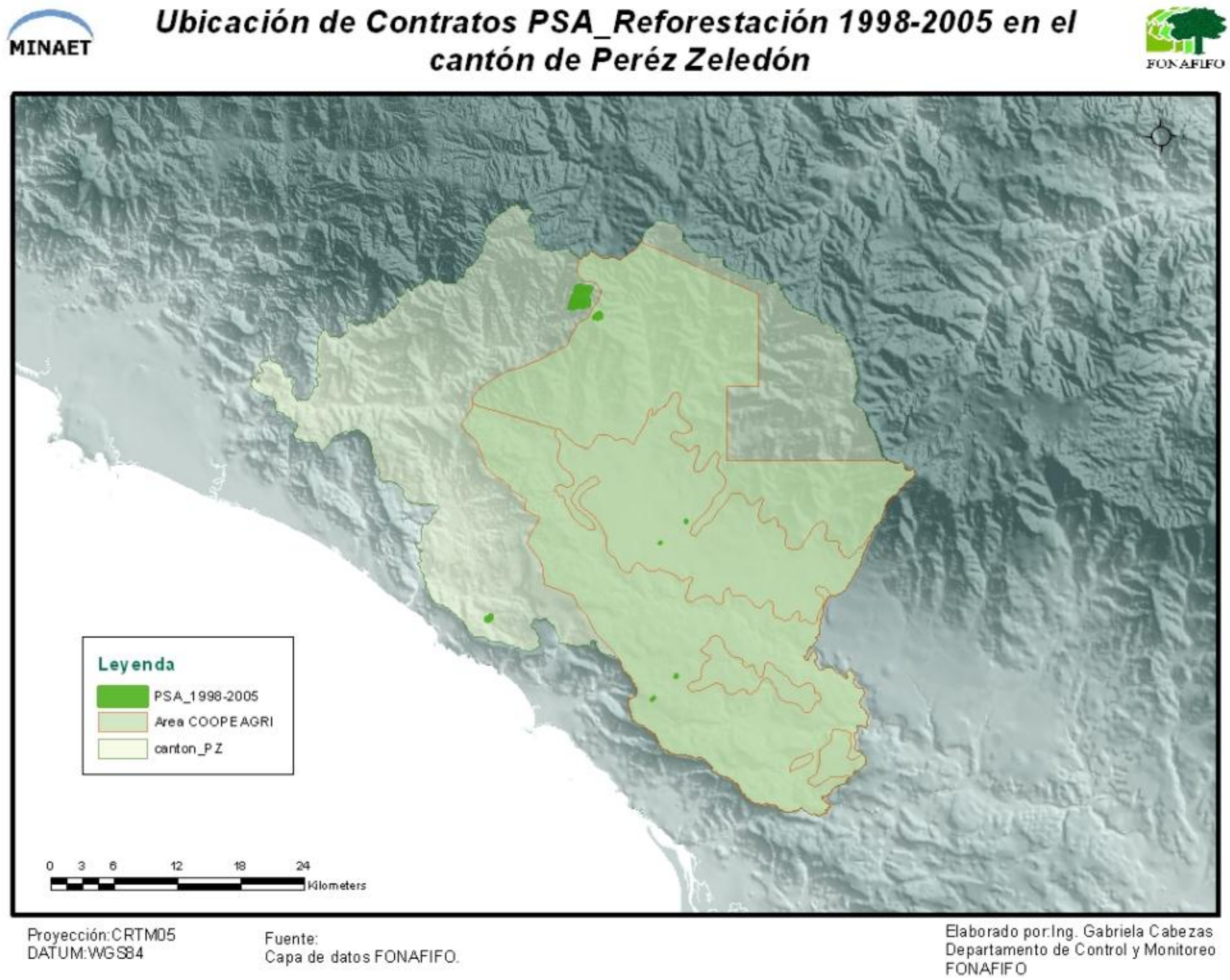

Figure 10. Location of PSA Reforestation Contracts 1998-2005 in the Peréz Zeledón Canton
Source: FONAFIFO

(d) Identification of alternative land uses on the degraded lands

Field observations and personal communications with farmers and leaders of local organizations such as COOPEAGRI, and the local Agencies of Agricultural Services from the Ministry of Agriculture and Cattle Farming, as well as financial analysis for the region, were used to identify land use alternatives for each sub-region.[31]

In the North Sub-region the plausible land use alternatives identified are: coffee, forest conservation, cattle farming (meat), cattle farming (dairy), limited agricultural crops, agroforestry systems, forest plantations and mining. And in the Valley and South Hillsides Sub-regions are: coffee, cattle farming (meat), forest conservation, agriculture of subsistence (grains), cattle farming (dairy), commercial horticulture, agriculture of subsistence (fruits and vegetables), cash crop agriculture (grains), agroforestry systems, forest plantations and mining.

[31] Mejías Esquivel, Ronald. 2005. Cost-Benefit Analysis to Determine Additionality for the COOPEAGRI Carbon Sequestration Project. (Mejías Esquivel, Ronald. 2005. *Análisis Beneficio-Costo para Determinar la Adicionalidad del Proyecto de Carbono COOPEAGRI).* Sections 2 and 4.

These land uses are associated with 3 possible land use scenarios:

Scenario 1: Land uses in the project sites may change from pastures to crops and vice versa, depending on the market price fluctuations of cattle and crops. Pasture lands are maintained and traditional grassland management (slash and burn) prevent the development of second growth forests.

Scenario 2: Farmers improve their agriculture production systems adopting improved technology for cash crop and meat production, therefore they require less land for these activities allowing natural regeneration to develop in the remaining lands.

Scenario 3: Farmers using their own resources adopt the proposed project activities; therefore, reforestation of the pasture lands within the project boundary will be done without being registered as an A/R CDM project activity.

All these scenarios do not contradict the land use policies and regulations identified above.

Table 14. Different land uses associated with each of these scenarios

	North Sub-region	**Valley and South Hillsides Sub-regions**
Scenario 1	coffee, cattle farming (meat), cattle farming (dairy), limited agricultural crops (fruits and vegetables)	coffee, cattle farming (meat), agriculture of subsistence (grains), cattle farming (dairy), agriculture of subsistence (fruits and vegetables), ,
Scenario 2	Limited cash crop agriculture (grains),	cash crop agriculture (grains), commercial horticulture,
Scenario 3	agroforestry systems, forest plantations	Agroforestry systems, forest plantations

(e) Demonstration that land-use/land-cover within the boundary of the proposed A/R CDM project activity would not change and/or lead to further degradation and carbon stock decrease in absence of the proposed project activity

Scenario 1 is the current land use in the project sites. As stated above, current lands use policies will not prevent this scenario.

Scenario 2 involves “green house production” of cash crops products such as tomatoes, green pepper, flowers, etc. This scenario demands high upfront investment in infrastructure and the improved technology is expensive to operate and maintain, and requires careful control of irrigation, fertilization, and pests and diseases. In the case of floriculture production in controlled environments, it has become essential for farmers to quickly adopt new technology, and the newest flower and plant varieties. The average sized greenhouse is a hectare in size and may cost between $200 to $400 per square meter to build, and even with modern production systems, new operations can be outdated within five years. For the farmers that are part of the project, the relative attractiveness of this scenario is low because of the high investment costs this are not a feasible option for them. Current land use policies do not actively promote or prevent this scenario.

Scenario 3 is the proposed project activity without the CDM. As discussed in section C.6, the small and medium farmers in the project area face significant barriers for the implementation of reforestation activities. From the policies identified in sub-step c above, only the Forestry Law No. 7575 could impact this scenario as it empowers the National Forestry Financing Fund (FONAFIFO) to issue contracts for the environmental services (PSA) provided by privately owned forest ecosystems.

When the PSA program was established, it covered two land use modalities: Forest Protection, and Natural Forest Management, and one A/R activity: reforestation through Forest Plantations[32]. Participation in the PSA program is voluntary and demand-based. It has been very popular with landowners, with requests to participate far outstripping available financing. Forest conservation has consistently been the most popular contract, accounting for 91% of the area covered since 1998, and for 95% of enrolled area at the end of 2005. Reforestation and forest plantation only accounted for 4% of the total area at end of 2005 with agroforestry contracts not yet accounting for a significant area at that time[33] .

The low uptake of reforestation activities under the PSA programme is particularly clear in Peréz Zeledón where the proposed CDM project activity is located. This can be seen in step 3 (c), Table 13 and Figure 10 above, which show the failure of the PSA program in the project area prior to the project start. These data show the lack of success in reaching small and medium farmers in reforestation activities. As part of the CDM project, FONAFIFO has started a cooperation with COOPEAGRI which represents the farmers in the area specifically in order to reach small and medium farmers.[34] . COOPEAGRI will provide technical and legal assistance to facilitate the participation of small farmers. Under the normal PSA program FONAFIFO does not provide technical or legal assistance to farmers. Only with the start of the CDM project activity in 2006, and because of the cooperation with COOPEAGRI, did FONAFIFO identify Brunca as a priority area[35]. Without this partnership between FONAFIFO and COOPEAGRI, it is very unlikely that these small and medium farmers would have implemented A/R activities and therefore the forestry law or the policies of FONAFIFO would not have impacted the project area.

Based on this analysis, scenario 1 is therefore considered as the most likely baseline scenario for each stratum and therefore the current land use would not change. As shown in step 3 (b) above, this scenario would lead to further degradation and carbon stock decrease and a change can only occur as a result of the implementation of the proposed A/R CDM activity.

Step 4. Baseline Stratification of the A/R project area

Please refer to section section C.4. The project area can be divided in the following 2 baseline strata:

1. North Hillsides;
2. Valley and South Hillsides.

Step 5. Determination of the baseline land-use / land-cover for each stratum.

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[32] DECREE No.26141-H-MINAE, approved on 11 July 1997

[33] Pagiola, S. 2006. Payments for Environmental Services in Costa Rica. MPRA Paper No. 2010, posted 07 November 2007. Available at http://mpra.ub.uni-muenchen.de/2010/1/MPRA_paper_2010.pdf

[34] Letter of understanding from COOPEAGRI to FONAFIFO, dated 20 July 2004.

[35] Gazette No. 151 - Tuesday, 8 August 2006.

Please see section C.5.2 below

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

>>
As described in section C.5.1, the North Hillsides are generally pastures in steep terrain with some agricultural activities while the Valley and South Hillsides consist of mixed agricultural lands and pasture lands in rolling hills (also refer to description of scenario 1 in table 14).
In both strata land might be left temporarily as fallow but traditional land use practices, such as: cattle grazing and slash- and- burn, prevent the regeneration of natural forests within the farmer parcels. This was confirmed by field observations and surveying. The field observations were further confirmed by the analysis of the forest cover maps from 1990, 1997, 2000, 2005, and digital aerial photos from 2003, which show that all discrete areas in the project have not reverted back to being forest land since 1 January 1990.

Historical land use analysis also shows that current land-use/land-cover change has led to progressive degradation of the land over time, since for more than 20 years areas similar to ones included in the proposed A/R CDM project activity have not changed their current land use, that is: pastures or agriculture. For the two baseline land use strata, there is therefore no chance of self-encroachment of trees under the current conditions and under the project conditions. This results in a decrease or a steady state at a reduced level of the carbon stocks in the carbon pools.

The analysis above indicates that the land area within the boundary of the proposed A/R CDM project activity is likely to maintain its current status: degraded and/or subject to further degradation, and so methodology AR-AM0004 is applicable.

C.6. Assessment and demonstration of additionality:

>> The additionality test was done through the application of the "**A/ R Methodological tool: Tool for the Demonstration and Assessment of Additionality in A/R CDM Project Activities" (Version 02),** approved by the CDM Executive Board. The test follows the steps below:

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

The project operations started on 1 August 2006 when the first planting occurred on lands that are certified and included in contracts with farmers.[36]

The following table details the actions taken to show prior consideration of the CDM.

Table 15: Actions taken that show prior consideration of the CDM and that the incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity

[36] The first certification of land under the project was signed on 28 August 2006, certifying that the lands were planted in August 2006. This certification was then the basis of PSA contract SJ-02-20-0050-2006, which was signed on 7 November 2006 and was the first contract signed as part of the project.

Date	Milestone
27 July 2004	After the establishment of the guidelines to prepare AR-CDM project activities, FONAFIFO prepared and submitted a Project Identification Note (PIN) to the World Bank Bio-Carbon Fund in 2004 to be considered as a potential project within the fund's carbon finance portfolio[37].
25 October 2004	PIN was selected for receiving preparation funds[38]
15 November 2005	The Government of Costa Rica and the World Bank began to discuss the design of a World Bank-supported project *Mainstreaming Market-Based Instruments for Environmental Management* in 2005 and appraised the project in 2006. A key consideration in designing this project was the potential to use the sale of carbon credits to finance forest regeneration in degraded areas, which the PSA Program had been unable to address because of their high cost.[39] [40]
April 2006	ERPA was signed with the Bio-Carbon Fund in 2006, with an ERPA amendment in 2009.
1 August 2006	First planting occurred on lands that are certified and included in contracts with farmers.

Therefore, there is ***evidence that the incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity***, including the first planting, the certification of lands, and the signing of contracts with farmers**.**

Following the start date of the project, continuing actions were taken to secure CDM status for the proposed project activity in parallel with its implementation. These actions are detailed in table 16 below.

Table 16: Actions taken to secure CDM status for the proposed project activity

Date	Milestone
14 June 2006	New methodology submitted for the proposed project activity (ARNM0026) Submission not approved -

[37] Support letter of the DNA that was included with the PIN submission was issued on 27 July 2004.

[38] World Bank Carbon Finance Document dated 25 October 2004 documents the discussion between FONAFIFO and the World Bank on the planned purchase of emission reductions.

[39] World Bank, "Report No. AB1913: Project Information Document (PID) – Concept Stage for *Scaling up and Mainstreaming Payment for Environmental Services in Costa Rica Project*," 15 November 2005, p. 3. Available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2005/11/23/000021271_20051123112435/Rendered/PDF/Costa0Rica0Env10Concept0Stage1final.pdf

[40] World Bank,"Report No: 36084-CR: Project Appraisal Document for *Mainstreaming Market-Based Instruments for Environmental Management Project*," 10 May 2006. Available at http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/05/22/000160016_20060522121022/Rendered/PDF/36084.pdf

09 March 2007	Revised new methodology submitted for the proposed project activity (ARNM0026-rev) Submission not approved
1 February 2008 – 30 June 2008	Consultant (Edgar Ortiz) hired for PDD development using methodology AR-AM0004
1 July 2009 – 30 June 2010	Consultant contract extended for PDD development
23 July 2010	Start of validation

Step 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity

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

As already discussed in section C.5.1, in the absence of the proposed AR CDM reforestation project activity the following land-use scenarios would have occurred on the land within the project boundary of the proposed A/R project activity:

Scenario 1: Pre-project land use continues, i.e., land uses in the project sites may change from pastures to crops and vice versa, depending on the market price fluctuations of cattle and crops. Pasture lands are maintained and traditional grassland management (slash and burn) prevent the development of second growth forests.

Scenario 2: Farmers improve their agriculture production systems, adopting improved technology for cash crop and meat production; therefore they require less land for these activities allowing natural regeneration to develop in the remaining lands.

Scenario 3: Farmers using their own resources adopt the proposed project activities; therefore, reforestation of the pasture lands within the project boundary will be done without being registered as an A/R CDM project activity.

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

The mandatory and applicable laws and regulations that affect the identified land use scenarios are mainly:

a. The Political Constitution (1949),
b. The Soil Use, Management and Conservation Law (No. 7779, 1998),
c. The Forestry Law (No. 7575, 1996),
d. The Biodiversity Law (No 7788, 1997),
e. The National Plan of Forestry Development (2001-2010).

The identified lands use scenarios do not contradict national or international law or regulation. They also are in compliance with the policy framework of the country, which has been established in the National Development Plan 2006-2010. ***Consequently the proposed A/R project activities are not the only alternatives that are in compliance with all national or international laws and regulations.***

Sub-step 1c. Selection of the baseline scenario

The procedure to select and determine the most plausible baseline scenario is described in Section C.5.1."

STEP 3. Barrier analysis

Sub-step 3a. Identify barriers that would prevent the implementation of type of the proposed project activity:

i) Barriers related to local tradition

Barriers related to local traditions are based on the lack of knowledge that farmers have about the market conditions for forest products. Cattle farming is the main production activity in the North Hillsides stratum while in the Valley and South hillsides, the more important land use activities are coffee plantations and pastures for cattle. The area has been dedicated to cattle and coffee for more than 30 years[41]. The farmers are familiar with the markets for these products and have existing traditional equipment and technology for these products, which are well developed in the project area. Furthermore as table 17 shows, the market prices for cattle and coffee observed at the national and international markets have tended to increase before the start of the project activity, reinforcing the existing land uses, which result in a decrease or steady state at a reduced level of the carbon stocks. In addition, a lack of capacity to engage in other land uses remains without additional assistance.

As part of the proposed CDM A/R project activity, COOEAGRI will actively promote A/R activities. COOPEAGRI staff has prepared both printed and audio-visual materials and has presented the project to the farmers in their communities. COOPEAGRI staff will provide training to the farmers and the community members.

Table 17. Market prices in Costa Rica for cattle, and coffee

[41] Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica in the face of Climate Change. Central American Series of Forest and Climate Change. Central American Comission of Environment and Development. (CCDA)/FAO. 60 pp.(Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica frente al cambio Climatico. Serie Centroamericana de Bosques y Cambio Climatico. Comision Centroamericana de Ambiente y Desarrollo (CCDA)/FAO. 60 pp.)

Year	Cattle[i] (Colon/kg)	Coffee[ii iii] ($/quintal)
2001	688	58.86
2002	729	57.02
2003	734	65.24
2004	809	79.53
2005	1106	111.38
2006	1243	112.30
2007	1300	121.83

[i] Average price of cattle in Costa Rica. Based on taking the average of all months for males from : http://web.cnp.go.cr/index.php/informacion-de-mercados/pecuario/bovinos/precios-en-planta

[ii] International Coffee Organization. Coffee Mark Report 2007. New York Prices. On line: http://www.ico.org/documents/cmr1207e.pdf

[iii] Note that although price trend was upward in this period, due to the volatility in coffee prices, it has been known to collapse as well. Regardless of profitability, coffee growing is a cultural phenomenon and is practiced regardless.

ii) Barriers relating to land (e.g., markets, transport):

Because of the local traditions of cattle farming, coffee plantations, and pasture for cattle, the farm owners cannot market wood products from reforestation and agroforestry systems by themselves because they do not have the equipment, technology and transportation means to bring their products to the market centers. So, they depend on intermediaries that take most of their profit. These factors erode the competitiveness and profitability of alternative land uses. Therefore, when farmers balance the limitations of adopting several land uses, and in absence of additional incomes, they value reforestation activities as an activity with higher market limitations.

As part of the proposed CDM A/R project activity, COOEAGRI will organize the farmers and provide technical assistance to the participating farmers and help them to overcome this barrier.

iii) Investment barriers:

As a 2005 project feasibility study showed,[42] although investing in plantations and agro forestry systems is basically profitable, it is not very attractive for small and medium farmers because:

- there is a high initial cost involved, which many farmers find difficult to finance;
- aside from the income from occasional thinning, trees provides no income until harvest, creating a severe cash flow problem for farmers compared to the low but steady returns from extensive pasture; and
- as pastures are already in place, there are no investment requirements.

[42] Mejías Esquivel, Ronald. 2005. Cost-Benefit Analysis to Determine Additionality for the COOPEAGRI Carbon Sequestration Project. (Mejías Esquivel, Ronald. 2005. *Análisis Beneficio-Costo para Determinar la Adicionalidad del Proyecto de Carbono COOPEAGRI*)

- expected harvest income is very uncertain, as it depends on yield over a very long time period (and so may be affected by droughts, pests, fires, etc.) and on prices at the time of harvest.

Small and medium farmers lack access to credit for this type of long term production activity and unpredictable and sometimes negative cashflow in the interim years. In sum, timber plantations and agro forestry are unlikely to be adopted without project support because initial costs are high, there are long periods without income, and future incomes are uncertain, making alternative land uses only very marginally attractive to farmers, particularly small and medium farmers, and posing significant obstacles to their adoption. Furthermore, as discussed in section C.5.1, the PSA program did not prioritize the Brunca region until CDM was considered in 2006, demonstrating the lack of access to alternatives that small and medium farmers in the area faced prior to the project start.

The natural regeneration activities in the proposed project activity do not involve actively planting vegetation. However, for regeneration to take hold, plots may need to be fenced off to prevent the entry of livestock, which can in some cases entail significant initial expenditures, as well as on-going maintenance costs. Unlike plantations or agroforestry, natural regeneration is not expected to generate any significant income to landholders. Because of this, even very low-return land uses tend to be preferred instead of allowing regeneration to occur.

To help to (partly) alleviate this barrier, payments offered to farmers participating in the proposed CDM A/R project activity are distributed over five years, but with 70 percent of the total frontloaded in the first two years. This significantly decreases the burden of initial costs and increases the overall financial attractiveness. However, it must be noted that for many farmers, these payment do not do enough, particularly in terms of reducing financial barriers: initial costs to participating farmers are reduced but not eliminated, and cash flow issues remain a concern.

iv) Technological barriers:
Prior to the project activity there were very few farmers in the project area that had established timber plantations. This can be seen in step 3 (c), Table 13 and Figure 10 above, which show the lack of success in reaching farmers in the project area in reforestation activities. Therefore, there is a lack of technical knowledge about forest plantations and agroforestry systems specifically when it comes to selecting appropriate species for their farms and then managing them. Furthermore, it was found that in general in Costa Rica it is difficult for small farmers to participate in the PSA scheme because of the legal paper work required, lack of information, and low motivation[43]. FONAFIFO does not provide technical assistance on these technical aspects as part of the PSA program. However as part of the proposed CDM A/R project activity, COOEAGRI will provide technical and legal assistance to the participating farmers.

Sub-step 3 b. 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):

Land use scenario 1 (continuation of current mix of land uses) is not prevented by any of the barriers identified in sub-step 3 a above.

[43] Miranda, M., Porras, I.T., and Moreno, M.L., 2003. The social impacts of payments for environmental services in Costa Rica: A quantitative field survey and analysis of the Virilla watershed. Markets for Environmental Services Paper No.1, IIED, London. Available at http://pubs.iied.org/pdfs/9245IIED.pdf

Barriers related to local tradition do not apply. In the case of cattle and agriculture, farmers are very familiar with the markets for their products, as these are the traditional land uses. Furthermore, there is no technical, land or transport barrier to accessing these markets since cattle can walk to the markets, and the harvesting and transport of agricultural products do not require specialized equipment.

Investment barriers also do not apply to land use scenario 1 since it is a continuation of existing activities which don't require investments. Although some of the existing lands uses, such as pastures, provide low returns, they do provide a continuous revenue stream; and as they are already in place, there are no investment requirements.

Finally, there are no technological barriers for alternative 1. These are existing practices and farmers are very familiar with them, and capacity already exists.

Conclusion
Based on the analysis above it is concluded that the identified barriers **do not prevent Scenario *1, which is considered the most likely baseline scenario.***

Step 4: Common practice test

Costa Rica started a national reforestation program in 1997 as part of the program for "Payment for Environmental Services" or PSA program. Since 2003, FONAFIFO, which is also implementing the proposed CDM project activity, took responsibility of the implementation of the program.

As discussed earlier, 95% of the area enrolled in the program consisted of forest conservation areas while planted forest only accounted for 4% of the total are at the end of 2005[44]. Furthermore, studies also found that the bulk of the PSA program benefits tend to go disproportionately to better-educated, wealthier farmers who possess larger farms and forest areas, and who are better diversified into nonfarm income-generating sources (Ortiz et al., 2003[45]; Miranda et al., 2003[46]; Zbinden and Lee, 2005[47]). In fact, the PSA program penetrated only 0.1% of the region prior to the start date of the proposed CDM project activity. Furthermore, the average size of farms enrolled in the PSA program is significantly larger than the average size of farms participating in the proposed project, for all types of activities (see Table 18).

[44] Pagiola, S. 2006. Payments for Environmental Services in Costa Rica. MPRA Paper No. 2010, posted 07 November 2007. Available at http://mpra.ub.uni-muenchen.de/2010/1/MPRA_paper_2010.pdf

[45] Ortiz Malavasi, R., Sage Mora, L.F., and Borge Carvajal, C., 2002. Impact of the Payment for Environmental Services Program in Costa Rica as a Tool for Poverty Alleviation in the Rural Areas. RUTA, San José (Ortiz Malavasi, R., Sage Mora, L.F., and Borge Carvajal, C., 2002. Impacto del Programa de Pago por Servicios Ambientales en Costa Rica como medio de reducción de pobreza en los medios rurales. RUTA, San José)

[46] Miranda, M., Porras, I.T., and Moreno, M.L., 2003. The social impacts of payments for environmental services in Costa Rica: A quantitative field survey and analysis of the Virilla watershed. Markets for Environmental Services Paper No.1, IIED, London. Available at http://pubs.iied.org/pdfs/9245IIED.pdf

[47] Zbinden, S., and Lee, D., 2005. Paying for environmental services: An analysis of participation in Costa Rica's PES Program. World Development, 33:255–272 (see http://www.sciencedirect.com/science/article/pii/S0305750X04001937

Table 18. Number and size of farms participating in PSA program versus Project

	National PSA Program*		Proposed CDM Project**	
Activity	**Number of participating farms**	**Average size of participating farms (ha)**	**Number of participating farms**	**Average size of participating farms (ha)**
Forest management	8	145.17	N/A	N/A
Forest protection	5744	123.16	N/A	N/A
Reforestation	1556	97.16	27	7.32
Regeneration	85	137.07	16	34.56
Agroforestry system	1652	22.21	161	6.5

* Data for 2003 to 2011, from SIAP database, as of 14 November 2011

** Data from project start in 2006 to 2011.

From the above it is clear that reforestation activities by small and medium farmers are not common practice. The reason that the proposed A/R CDM project activity is able to reach these farmers is because the rules and operational conditions for the implementation of the project are different from the PSA program. First, to increase the participation of small farmers in the proposed A/R CDM project, FONAFIFO is cooperating with a local organization (COOPEAGRI) to provide technical and legal assistance to facilitate the participation of small farmers in the A/R CDM project. Under the normal PES program FONAFIFO does not provide technical or legal assistance to farmers and this direct assistance was necessary to overcome the technical and market barriers, and to reduce participation costs to the farmers.

Second, in the case of the reforestation through the assisted natural regeneration modality, under the proposed A/R CDM project only can participate lands that were deforested prior to 31 December 1989, and the payment for the environmental services was increased to US$ 64 /year (previously US$ 44/year).

The above analysis shows, that there are essential distinctions between the proposed CDM project activity and any reforestation activities implemented under the baseline scenario, therefore, the proposed A/R CDM project activity is not common practice and, hence, it is additional.

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

>>

The estimation of baseline GHG removals by sinks is based on the estimation of the sum of the changes in carbon stocks of the existing living biomass of the discrete areas with trees or woody perennials;

As per AR-AM-004 Version 04, the changes in stocks of the living vegetation (above-ground and below-ground biomass) does not include the biomass of herbaceous vegetation. Therefore:

$$C_{BSL} = \Delta C_{B,LB} \qquad (1)$$

Where:

C_{BSL} = baseline net greenhouse gas removals by sinks; tonnes CO_2-e

$\Delta C_{B,LB}$ = baseline sum of the changes in living biomass carbon stocks (above- and below-ground); tonnes CO_2-e.

As shown in section C.2 and C.5 above, the baseline scenario for the lands to be afforested or reforested is degraded lands, subjected to grazing activity or agricultural crop activity where some woody vegetation might exist.

Following the guidance from EB 46 Annex 16, (Guidance on conditions under which the change in carbon stocks in existing live woody vegetation are insignificant), it was determined that the change in carbon stocks in the woody vegetation that might occur in the baseline scenario are insignificant and therefore can be accounted for as zero. This is based on condition (iii) in the guidance which states that the change in the carbon stocks might be considered zero if: "Growth conditions are already, or are expected to become within 10 years (e.g., due to on-going land degradation), such that biomass in existing woody vegetation is expected to become static or to decline".

Several studies such as Leiva (2003)[48]; Baltissen (1988)[49]; Von Platen (1985)[50] , and, specifically for the project region, Sifuentes (2009)[51].have shown that the baseline land use system in the region ensures that lands will keep degrading or remain in a low carbon steady state and that the overall vegetation will not increase. As discussed in section C.5.1, indicators of further degradation in the project area are related to soil degradation and soil erosion which can be witnessed in the field through a visual assessment (pictures of the situation in the field are attached to the PDD).

Therefore the baseline net greenhouse gas removals by sinks are expected to be negative due to ongoing degradation. Under these circumstances, based on Annex 16 of EB46, it is conservatively assumed that the baseline net greenhouse gas removals by sinks are zero for all strata in the project:

$$C_{BSL} = 0 \text{ for all } t^* \leq t_{cp} \qquad \textbf{(2)}$$

where:

C_{BSL} Baseline net greenhouse gas removals by sinks; t CO_2-e

t^* Number of years elapsed since the start of the A/R project activity; yr

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48 Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica in the Face of Climate Change. Centroamerican Series of Forest and Climate Change. Central American Comission of Environment and Development (CCAD/FAO) (Leiva, M.; Alfaro, M; Hidalgo, M. and Mendez, A. 2003. Costa Rica frente al cambio Climatico. Serie Centroamericana de Bosques y Cambio Climatico. Comision Centroamericana de Ambiente y Desarrollo (CCDA)/FAO.)

49.Baltissen, G. 1988. Effects of forest clearing and land use on soil properties of two land use sequences in Cocorí, Atlantic Zone of Costa Rica. Editorial Turrialba, CATIE / Agricultural University Wageningen, Atlantic Zone Programme / MAG, CR.

50 Von Patten, H. 1985. Appropriate land use systems of smallholder farms on steep slopes in Costa Rica: a study on situation and development possibilities. Hohenheimen Universitat, DE.

51 Sifuentes, M. 2009. Assessing the Design of Mixed Small-farms and the Condition of Improved Grasslands in the South of Costa Rica. Master Thesis. Turrialba, Costa Rica. (Sifuentes, M. 2009. Evaluación del diseño de pequeñas fincas agropecuarias y de la condición de las pasturas mejoradas en la zona sur de Costa Rica. Tesis de Maestría. Turrialba, Costa Rica,)

t_{cp} Year at which the first crediting period ends; yr

Table 19. Estimation of the *ex ante* baseline net GHG removals by sinks

Year	**Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2 e**
Year 1	0
Year 2	0
Year 3	0
Year 4	0
Year 5	0
Year 6	0
Year 7	0
Year 8	0
Year 9	0
Year 10	0
Year 11	0
Year 12	0
Year 13	0
Year 14	0
Year 15	0
Year 16	0
Year 17	0
Year 18	0
Year 19	0
Year 20	0
Total estimated baseline net GHG removals by sinks (tonnes of CO2 e)	0
Total number of crediting years	20
Annual average over the crediting period of estimated baseline net GHG removals by sinks (tonnes of CO2 e)	0

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

>> Parts of the baseline study were started in 2005 and it was completed on 15 July 2011.
The team responsible for determining the baseline is shown on Table 20.

Table 20. Team preparing the baseline study

Name	Specialty	Contact
Edgar Ortiz Malavasi	Forestry Resources Management	**eortiz@itcr.ac.cr**
Gilmar Navarrete	Forestry	**g.navarrte@fonafifo.go.cr**
Ronald Mejias Esquivel	Environmental economist	**rmejiase@yahoo.com**

National Forestry Financing Fund (FONAFIFO) is the project entity responsible for developing and monitoring the proposed A/R CDM project, is a Project Participant, and was responsible for the baseline study. The contact persons at FONAFIFO for the proposed A/R CDM project are:

Mr. Jorge Mario Rodriguez Zuñiga, Executive Director (jrodriguez@fonafifo.go.cr)
Mr. Oscar Sanchez Chaves. Payments for Enviromental Services program Coordinator (osanchez @fonafifo.go.cr)

Entity address: FONAFIFO, Avenida 7, Calles 5 y 3 / Apartado Postal 594-210, San Jose-Costa Rica.
Web site: www.fonafifo.go.cr
Entity telephone numbers: (506) 257-8475 Fax: (506) 257-9695

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

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

>> The actual net greenhouse gas removals by sinks represent the sum of the verifiable changes in carbon stocks in the carbon pools within the project boundary, minus the increase in non-CO_2 GHG emissions measured in CO_2 equivalents by sources that are increased as a result of the implementation of the CDM-AR project activity. Therefore,

$$C_{ACTUAL} = \Delta C_{P,LB} - GHG_E \quad \textbf{(3)}$$

Where:

C_{ACTUAL} = actual net greenhouse gas removals by sinks; tonnes CO_2-e

$\Delta C_{P,LB}$ = sum of the actual changes in living biomass carbon stocks (above- and below-ground); tonnes CO_2-e

GHG_E = Sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of an A/R CDM project activity; t CO2-e

A) Estimation of actual Δ*CP,LB* (changes in living biomass carbon stocks in the project scenario)

The changes in living biomass carbon stocks in the project scenario were estimated using the carbon gain-loss method. The equations used to estimate them are the following:

$$\Delta C_{P,LB} = \Delta C_{P,LB_T} - E_{biomasslos} \quad \textbf{(4)}$$

Where:

$\Delta C_{P,LB}$	=	sum of actual changes in living biomass carbon stocks , tonnes CO_2-e
$\Delta C_{P,LB\,T}$	=	sum of the changes in living tree biomass carbon stocks , tonnes CO_2-e
$E_{biomassloss}$	=	decrease in the carbon stock in the living biomass carbon pools of non-tree vegetation in the year of site preparation, up to time *t**; tonnes CO_2-e

A.1 Treatment of pre-existing vegetation

The methodology requires that removal of pre-existing vegetation is accounted for if this is likely to be significant. During its 50th meeting, the CDM Executive Board provided guidelines on conditions under which GHG emissions from removal of existing vegetation due to site preparation are insignificant (Annex 21). These guidelines provides three conditions and states that GHG emissions from felling, clearance, decay or burning of existing woody biomass during site preparation are insignificant if at least one of the conditions are met.

One of these conditions is that " (c) The baseline scenario is degrading land involving decline in woody vegetation cover". For this project, the baseline scenario is degrading land with declining woody vegetation cover as was shown through the applicability conditions of the methodology and in section C.5.

Hence

$$E_{biomasslos} = 0 \qquad \textbf{(5)}$$

A.2 Estimation of changes in the living biomass carbon stocks (*ΔC_{P,LBT}*)

Changes in carbon stocks of living tree biomass are estimated using:

$$\Delta C_{P,LB_T} = \sum_{t=1}^{t^*} \sum_{i=1}^{m_{BL}} \sum_{k=1}^{K_P} \Delta C_{P,LB,ikt} \qquad \textbf{(6)}$$

Where:

$\Delta C_{P,LB_T}$	=	sum of the changes in living biomass carbon stocks in the project scenario (above- and below-ground); tonnes CO_2-e
$\Delta C_{P,\,LB,ikt}$	=	annual carbon stock change in living biomass for stand model *k*, in stratum *i*, at time *t;* tonnes CO_2-e yr^{-1}
i	=	1 and 2 ... m_{BL} strata in the baseline
k	=	1, 2, 3, … *K* stand models in the project scenario
t	=	1, 2, 3, ... *t** years elapsed since the start of the AR project activity

Annual carbon stock changes in the living biomass ($\Delta C_{P,LB,ikt}$) was estimated using the Carbon gain-loss method[52] where:

$$\Delta C_{ikt} = \Delta C_{G,ikt} - \Delta C_{L,ikt} \qquad \textbf{(7)}$$

where:

ΔC_{ikt}	Annual carbon stock change in living biomass for stratum *i*, for stand model *k*, time *t*; t CO_2-e yr^{-1}
$\Delta C_{G,ikt}$	Annual increase in carbon stock due to biomass growth for stratum *i*, for stand model *k*, time *t*; t CO_2-e yr^{-1}
$\Delta C_{L,ikt}$	Annual decrease in carbon stock due to biomass loss for stratum *i*, for stand model *k*, time *t;* t CO_2-e yr^{-1}

$$\Delta C_{G,ikt} = A_{ijt} \cdot C_{TOTAL,ikt} \qquad \textbf{(8)}$$

where:

$\Delta C_{G,ikt}$	Annual increase in carbon *stock* due to biomass growth for stratum *i*, for stand model *k*, time *t*; t CO_2-e. yr^{-1}
A_{ijt}	Area of stratum *i*, for stand model *k*, at time *t*; hectare (ha)
$C_{TOTAL,ikt}$	Annual average increment rate in total biomass in units of dry matter for stratum *i* for stand model *k*, time *t*; t d.m. ha^{-1} yr^{-1}

The net greenhouse gas removals by sinks can be calculated by:

$$\Delta C_{TOTAL,ikt} = \sum_{j}^{J} G_{w,ijt} \cdot (1 + R_j) \cdot CF_j \cdot \frac{44}{12} \qquad \textbf{(9)}$$

$$\Delta G_{w,ijt} = I_{v,ijt} \cdot D_j \cdot BEF_{1,j} \qquad \textbf{(10)}$$

where:

$C_{TOTAL,ikt}$	Annual average increment rate in total biomass for stratum *i* for stand model *k*, time *t*; t d.m. ha^{-1} yr^{-1}
$G_{w,ijt}$	Average annual above-ground biomass increment for stratum *i*, species *j*, at time *t*; t d.m. ha^{-1} yr^{-1}
R_j	Root-shoot ratio appropriate to increments for species *j*; dimensionless
CF_j	The carbon fraction for species *j*; t C (t d.m.)$^{-1}$
$I_{v,ijt}$	Average annual increment in merchantable volume for stratum *i*, species *j*; m^3 ha^{-1} yr^{-1}
D_j	Basic wood density for species *j*; t d.m. m^{-3}
$BEF_{1,j}$	Biomass expansion factor for conversion of annual net increment (including bark) in merchantable volume to total above-ground biomass increment for species *j*;

[52] Refers to GPG-LULUCF Equation 3.2.6, Equation 3.2.7, Equation 3.2.8 and Equation 3.2.9.

dimensionless

The parameters used in these equations are presented in table 20, that were introduced in the TARAM Spreadsheet. To calculate the average annual decrease in carbon stocks due to biomass loss, the following equation were used

$$\Delta C_{L,ikt} = L_{hr,ikt} + L_{fw,ikt} + L_{ot,ikt} \quad \textbf{(11)}$$

Where:

$\Delta C_{L,ikt}$	=	average annual decrease in carbon stocks due to biomass loss for stand model *k*, in stratum *i*, at time *t*; tonnes CO_2-e yr^{-1}
$L_{hr,ikt}$	=	annual carbon loss due to commercial harvesting for stand model *k*, in stratum *i*, at time *t*; tonnes CO_2-e yr^{-1}
$L_{fw,ikt}$	=	annual carbon loss due to fuel wood gathering for stand model *k*, in stratum *i*, at time *t*; CO_2-e yr^{-1}.
$L_{ot,ikt}$	=	annual natural losses (mortality) of carbon for stand model *k*, in stratum *i*, at time *t*; CO_2-e yr^{-1}.

Fuel wood gathering in the project sites is expected to be insignificant because most households (98 %)[53] in Costa Rica have access to electricity and the consumption of firewood comes mainly from the coffee plantations. Consequently, for the ex-ante calculations, annual carbon losses due to fuel wood gathering are considered insignificant and assumed to be zero ($L_{fw,ikt} = 0$).

Natural disturbances such as mortality, fire, pest and disease outbreaks are expected to be of low frequency and intensity in the project sites due to the application of good management practices such as 10 % tree replanting, 3x3 tree spacing, the maintenance of fire breaks around each project site, weed control during the first years, and the programmed thinning. Subsequently, annual natural carbon losses due to natural disturbances are assumed to be zero ($L_{ot,ikt} = 0$).

Therefore in equation 11:

$$L_{fw,ikt} = 0 \quad \textbf{(12)}$$

$$L_{ot,ikt} = 0 \text{ and}$$

$$L_{hr,ikt} = A_{ikt} \cdot \sum_{j=1}^{J_k} H_{ijt} \cdot D_j \cdot BEF_{2,j} \cdot CF_j \cdot 44/12 \quad \text{or} \quad \textbf{(13)}$$

$$L_{hr,ikt} = A_{ikt} \cdot \sum_{j=1}^{J_k} BH_{ijt} \cdot CF_j \cdot 44/12 \quad \textbf{(14)}$$

Where:

$L_{hr,ikt}$	=	annual carbon loss due to commercial harvesting for stand model *k*, in stratum *i*, at time *t*; tonnes CO_2-e yr^{-1}

[53] World Bank Human Opportunity Index http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/0,,contentMDK:21919418~pagePK:146736~piPK:146830~theSitePK:258554,00.html, last bullet

$L_{fw,ikt}$ = annual carbon loss due to fuel wood gathering for stand model *k*, in stratum *i*, at time *t*; tonnes CO_2-e yr^{-1}

$L_{ot,ikt}$ = annual natural losses (mortality) of carbon for stand model *k*, in stratum *i*, at time *t*; tonnes CO_2-e yr^{-1}

j = 1, 2, 3, … J_k tree species in stand model *k*

H_{ijt} = annually extracted merchantable volume for species *j*, stand model *k*, in stratum *i*, at time *t*; m^3 ha^{-1} yr^{-1}
Note: The time notation *t* is given here because there is a specific harvesting schedule for stand model.

D_j = wood density for species *j*; tonnes d. m. m^{-3} (See Table on section C.7 and IPCC GPG-LULUCF, 2003 Table 3A.1.9)

$BEF_{2,j}$ = biomass expansion factor for converting volumes of extracted round wood to total above-ground biomass (including bark) applicable to species *j*, in stratum *i*, stand model *k*, at time *t*; dimensionless (see GPG LULUCF, Table 3A.1.10).

BH_{ijt} = annually extracted biomass for species j, stand model k, stratum i, at time t; tonnes d.m ha^{-1} yr^{-1}

CF_j = carbon fraction for species *j*; tonnes C (tonne d. m.)$^{-1}$

A_{ikt} = area of stand model *k*, in stratum *i*, at time *t;* hectare (ha)

Table 21. Variables and values applied in the estimation of the *ex ante* actual net GHG removals by sinks

ID number	Data variable	Data unit	Value applied	Comment
p.1	M_{BL}	dimensionless	2	Baseline number of strata 1. North Hillsides (BLS1) 2. Valley lands and South Hillsides (BLS2)
p.2	K_p	dimensionless	5	Stand models in the project scenario Stand model 1: Gmelina arborea (SM1) Stand model 2: Tectona grandis and/or Eucalyptus (SM2) Stand model 3: Assisted Natural Regenaration (SM3) Stand model 4: Agroforestry- Trees mixed with crops (SM4) Stand Model 5: Silvopastoral. Trees in Pastures (SM5)
p.3	A_{ikt}	hectares	$A_{1\ 1,t}$ =18.32 $A_{1\ 3,t}$ =322.24 $A_{2\ 1,t}$ =72.08 $A_{2\ 2,t}$ =17.81 $A_{2\ 4,t}$ =227.07 $A_{2\ 5,t}$ =160.44	Areas for the strata: $A_{1\ 1,t}$ = area of Melina- North Hillsides $A_{1\ 3,t}$ =area of ANR-North Hillsides $A_{2\ 1,t}$ =area of FP-Melina-Valley Lands and South Hillsides $A_{2\ 2,t}$ =area of FP-Teak and/or

			$A_{2\ 3,t}$= 74.46 Total Area = 892.42	Eucalypt-Valley Lands and South Hillsides $A_{2\ 4,t}$ =area of Agroforestry Valley Lands and South Hillsides $A_{2\ 5,t}$ = area of Silvopastoral - Valley Lands and South Hillsides $A_{2\ 3,t}$ =area of ANR - Valley Lands and South Hillsides A…= total area
p.4	CF_{pre}	dimensionless	0.5	IPCC default value. Conservative estimate for pre-existing vegetation. 2003 IPCC-Good Practice Guidance for Land Use, Land - Use Change and Forestry. Chapter 3.2
p.5	R_j	dimensionless	R..=0.14	Source: 2003 IPCC-Good Practice Guidance for Land Use, Land - Use Change and Forestry (Table 3A.1.8 Default Values of Mean Belowground to aboveground Biomass Ratio (R= Root –shoot Ratio). Lower vale for secondary Tropical and Sub-tropical Forest.
p.6	CF_j	dimensionless	CF. = 0.5	IPCC default value. 2003 IPCC-Good Practice Guidance for Land Use, Land - Use Change and Forestry. Chapter 3.2.
p.7	$I_{v,ijt}$	$m^3\ ha^{-1}\ yr^{-1}$	$I_{v,1\ 1,t}$[54] =6.79 $I_{v,1\ 3,t}$ =10.44 $I_{v,2\ 1,t}$ =11.0 $I_{v,2\ 2,t}$ =12.0 $I_{v,2\ 4,t}$ =3.6 $I_{v,2\ 5,t}$ =3.6 $I_{v,2,3,t}$ = 10.81	Mean annual increment for stratum and stand model identified in the project scenario. Different annual increments are used in different strata for the same species. This is based on the better growth conditions in the Valley and South Hillsides which are expected to lead to higher annual increments (also see section C4). Where a range of values is available, the lowest end of the range is used for the North Hillsides strata while slightly higher number have been used for the Valley/South Hillsides strata Data Sources: $I_{v,\ 1\ 3,t}$ and,$I_{v,2\ 3,t,}$ Fonseca, W. 2006. *Estimation of growth rates in*

[54] Subscripts are the same as for the area earlier in the table. First number in subscript represents the baseline stratum and the second represents the stand model. For example, 2 2 represent Teak and/or Eucalypt in the Valley Lands and South Hillsides

				degraded pastures in the Central Pacific of Costa Rica. Project Ecomercados II (FONAFIFO-GEF-BM). Page 37, $I_{v,1\ 3,t}$ lowest end of range. $I_{v,2\ 3,t,}$ middle of range - $I_{v,1\ 1,t}$ and $I_{v,21t}$:Rojas, F. et al, 2004. Manual for the production of Gmelina trees in Costa Rica. FONAFIFO. Page 179, $I_{v,1\ 1,t}$ as lowest of range for site with low productivity (6.79 – 15.33). $I_{v,2\ 1,t}$ as middle of range for site with low productivity (6.79 – 15.33). - $I_{v,2\ 2,t}$: Fonseca, W. 2004. Manual for the production of Tectona grandis in Costa Rica. FONAFIFO. page 81 maximum for sites with low productivity. - $I_{v,2\ 5,t}$ and $I_{v,2\ 4,t}$ Growth rates for Terminalia amazonia from Montero M., Marcelino and Kanninen, M. 2003. Biomass and carbon in plantations of Terminalia amazonica in the southern zone of Costa Rica. Technical communication. Journal of Central American Forestry (Revista Forestal Centroamericana) figure 1, 40 % of number for 3 by 3 meter spacing to account for lower number of trees
p.8	D_j	tonnes d. m. m^{-3}	$D_{1\ 1} = 0.37$ $D_{1\ 3} = 0.59$ $D_{2\ 1} = 0.37$ $D_{2\ 2} = 0.60$ $D_{2\ 4} = 0.59$ $D_{2\ 5} = 0.59$ $D_{2\ 3} = 0.59$	Wood densities for stand model - Data sources: $D_{1\ 1}$ and $D_{2\ 1}$ Cubero, J. y Rojas , S. 1999. Carbon fixation in plantations of melina (Gmelina Roxb), teak (Tectona grandis L.f) and pochote (quinata Bombacopsis Jacq.) in the cantons of Hojancha and Nicoya, Guanascaste, Costa Rica. Thesis Degree in Forest Sciences with concentration in Forest Handling. Faculty of Sciences of the Earth and the Sea. School of Environmental Sciences. Universidad Nacional. Heredia Costa Rica. 95 p.

				(see pag. 41) $D_{2\,4,}$ and $D_{2\,5}$: Lowest value of: • Terminalia amazonia **0.7** Source: Montero M., Marcelino and Kanninen, M. 2003. Biomass and carbon in plantations of Terminalia amazonica in the southern zone of Costa Rica.Comunicación Tecnica. Revista Forestal Centroamericana.pag 50-55. (See page 52) • Cedrela Odorata: **0.59** Source: CARPENTER F. LYNN, NICHOLS J. D.,y, SANDI E. 2004. Early growth of native and exotic trees planted on degraded tropical pasture. En: Forest Ecology and Management 196. pp: 367–378 (See page 639) • Hyeronima (Pilon) **0.63** Source: Delgado, Adrian. 2002. Growth of plantations of native species and their relationship to the motivation of farmers to reforest the northern Huetar region of Costa Rica. Specialtized Practice Report. Technological Institute of Costa Rica, Costa Rica. 127P.) (See page 7) $D_{1\,3}$ and $D_{2\,3}$: Similar native species are expected as the ones that will be planted (Terminalia amazonia, Cedrela Odorata). However, the final species composition will depend on the seed trees available in the area. This might include species with different wood densities. For the ex-ante calculations, the same value will be used as for planted species: 0.59 representing Cedrela Odorata (see above) $D_{2\,2}$: Pérez Cordero, L.D.; Kanninen, M. Aboveground biomass of Tectona grandis plantations in Costa Rica. 2003. Journal of Tropical Forest Science v. 15(1) p. 199-213) (See page

				202)
p.9	$BEF_{1,j}$	dimensionless	$BEF_{1\,1}$ = 1.315 $BEF_{1\,3}$ = 1.3 $BEF_{2\,1}$ = 1.315 $BEF_{2\,2}$ = 1.3 $BEF_{2\,4}$ = 1.2 $BEF_{2\,5}$ = 1.2 $BEF_{2\,3}$ = 1.3	Data sources: $BEF_{1\,1}$ and $BEF_{2\,1}$ **Biomass Expansion Factor (BEF) for *Gmelina arborea* calculated using information from: Fuwape, J.A et all, 2001. Biomass equations and estimation for *Gmelina arborea* and *Nauclea Diderrichi*i stands in Akure forest reserve. Biomass and Bioenergy No.21: 401-405. **Table 1** ***Biomass Expansion factor= Total Biomass / Stem biomass*** = 264,762 / 201,219 = 1.315 $BEF_{2\,4,}$ and $BEF_{2\,5}$-For agroforestry and silvopastoral based on Terminalia amazonia from Montero M., Marcelino and Kanninen, M. 2003. Biomass and carbon in plantations of Terminalia amazonica in the southern zone of Costa Rica.Comunicación Tecnica. Revista Forestal Centroamericana. (page 1 abstract). . For the rest on the species taken from 2003. IPCC-Good Practice Guidance for Land Use, Land - Use Change and Forestry (Table 3A.1.10 Default Values of Biomass Expansion Factors (BEFS). Lowest estimates for tropical broadleaf.
p.10	H_{ijt}	$m^3\ ha^{-1}$	$H_{1\,1,\,t=5} = 0.3*V_{1\,1,t=5}$ $H_{1\,1,\,t=8} = 0.3*V_{1\,1,t=8}$ $H_{1\,1,t=12} = 1*V_{1\,1,t=12}$ $H_{1\,3,t} = 0$ $H_{2\,1,\,t=5} = 0.3*V_{2\,1,t=5}$ $H_{2\,1,\,t=8} = 0.3*V_{2\,1,t=8}$ $H_{2\,1,t=12} = 1*V_{2\,1,t=12}$ $H_{2\,2,\,t=6} = 0.3*V_{2\,2,t=6}$ $H_{2\,2,\,t=10} = 0.3*V_{2\,2,t=10}$ $H_{2\,2,t=15} = 0.3*V_{2\,2,t=15}$ $H_{2\,2,t=20} = 1*V_{2\,2,t=20}$ $H_{2\,4,t=20} = 1*V_{2\,4,t=20}$ $H_{2\,5,t=20} = 1*V_{2\,5,t=20}$	According to Table 7 on section A.5.4: a) for ANR stands or j=3 (SM3). No harvesting programmed during project operation. b) for Melina FP, or j=1 (SM1) First thinning: 30% of standing volume, at year t=5. Second thinning 30% of standing volume, at year t=8. Final Harvesting, year t=12. c) for Teak, and/or Eucalyptus FP, or j=2 (SM2) First thinning: 30% of standing volume, at year t=6. Second thinning 30% of standing volume, at year t=10. Third thinning 30 of standing volume, at year 15 Final Harvesting, year t=20.

			$H_{2\ 3,t} = 0$	d) For agroforestry systems j=4 and j=5 (SM4 and SM5) No thinnings are programmed, and Final Harvesting will be at year t=20.
p.11	BEF_{2j}	dimensionless	$BEF_{2.}$=2.35	2003. IPCC-Good Practice Guidance for Land Use, Land - Use Change and Forestry (Table 3A.1.10 Default Values of Biomass Expansion Factors (BEFS). Mean of 2 values for tropical species.

B) Estimation of *GHG_E* (increase in GHG emissions by sources within the project boundary as a result of the implementation of an CDM-AR project activity):

As per section 7.2 of AR AM-004 Version 04 methodology, increase in GHG emissions associated with biomass burning in the project need to be considered. As biomass burning is not allowed during site preparation in the project area, the increase in GHG emissions associated biomass burning are treated as zero.

$$GHG_E = E_{BiomassBurn} = \quad 0 \qquad \textbf{(15)})$$

Where:

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

$E_{BiomassBurn}$= Increase in GHG emission as a result of biomass burning within the project boundary; t CO_2-e

A.3 ***Ex ante* net anthropogenic GHG removal by sinks**

The net anthropogenic GHG removals by sinks is the actual net GHG removals by sinks minus the baseline net GHG removals by sinks minus leakage, therefore, the following general formula can be used to calculate the net anthropogenic GHG removals by sinks of an A/R CDM project activity (CAR-CDM), in t CO2-e:

$$C_{AR-CDM} = C_{ACTUAL} - C_{BSL} - LK \qquad \textbf{(16)}$$

where:

C_{AR-CDM} Net anthropogenic greenhouse gas removals by sinks; t CO_2-e
C_{ACTUAL} Actual net greenhouse gas removals by sinks (equation 13); t CO_2-e
C_{BSL} Baseline net greenhouse gas removals by sinks (equation 1 or 2); t CO_2-e
LK Leakage ; t CO_2-e

The estimation of the C_{AR-CDM} for the proposed A/R Project Activity was made using the procedures indicated procedures indicated in sections C, D, and E, and using the TARAM Spreadsheet.

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

>>

The following sources of leakage are covered by the methodology:

- Carbon stock decreases due to deforestation caused by displacement of pre-project agricultural crops, grazing and fuel-wood collection activities.

Carbon stock decreases caused by the increased use of non-renewable wood for fencing are mentioned in the methodology but are not included in the equations. Furthermore, the revision history of the methodology shows that this version takes into account the guidelines provided by the Executive Board during EB 44 (paragraph 37) which considers that this emission source is insignificant. Hence this source was excluded.

Therefore:

$$LK = LK_{ActivityDisplacement} \quad \textbf{(17)}$$

Estimation of $LK_{ActivityDisplacement}$ (leakage due to activity displacement)

Leakage due to activity displacement is estimated as follows:

$$LK_{Activitydisplacement} = LK_{conversion} + LK_{fuelwood} \quad \textbf{(18)}$$

where:

$LK_{ActivityDisplacement}$	Leakage due to activity displacement; t CO_2-e
$LK_{conversion}$	Leakage due to conversion of forest to non-forest; t CO_2-e
$LK_{fuel\text{-}wood}$	Leakage due to the displacement of fuel-wood collection; t CO_2-e

Estimation of $LK_{conversion}$ (Leakage due to conversion of lands)

Leakage due to conversion of lands occurs from (a) conversion for grazing and (b) conversion for cropland. It is estimated as

$$LK_{conversion} = LK_{conv-graz} + LK_{conv-crop} \quad \textbf{(19)}$$

where:

$LK_{conv\text{-}graz}$	Leakage resulting from the conversion for grazing
$LK_{conv\text{-}crop}$	Leakage resulting from the conversion for cropland

Estimation of $LK_{conv\text{-}graz}$ (Leakage due to conversion of land to grazing land)

Leakage from the conversion for grazing may occur when the pre-project animal population, or a fraction of it, may have to be displaced permanently, or temporarily, outside the project boundary.

Since pre-project grazing activities exist in the proposed CDM project activity, this type of leakage has been considered.

In accordance with the methodology, the pre-project animal population in the project area (Na_{BL}) was estimated using local animal census data[55] (also refer to table 2). Based on this:

$Na_{BL} =$ 0.64 animals/ha.

The project includes some silvopastoral systems where the animals can stay within the project however it is conservatively assumed that animals are displaced outside the project area

- $Na_{BL} > Na_{AR,t}$

In this case the total area of grazing land in which the displaced animal population will be maintained can be estimated as follow:

$$GLA = EGL + NGL + XGL \quad \textbf{(20)}$$

where:

GLA	Total grazing land area outside the project boundary needed to feed the displaced animal populations; ha
EGL	Total existing grazing land area outside the project boundary that is under the control of the animal owners (or the project participants) and that will receive part of the displaced animal populations, up to time *t**, ha
NGL	Total new grazing land area outside the project boundary to be converted to grazing land that is under the control of the animal owners (or the project participants) and that will receive another part of the displaced animal populations, up to time *t*;* ha
XGL	Total unidentifiable grazing land area outside the project boundary that will receive the remaining part of displaced animal populations, e.g. when the pre-project animal owners decide to sell the animals, up to time *t**; ha

Most farmers that are participating in the project are small property owners (< 50 ha) that mainly live off the annual income from the incomes from their coffee and cattle raising activities in their farms. Farmers will only include part of their land in the project and animals from these patches of land will usually be replaced to existing grazing land area that is under the control of the animal owners (referred to as *EGL* areas in the methodology).

To show that GHG emissions related to displacement of pre-project grazing activities to these *EGL* areas can be considered insignificant, the guidelines from the EB as available in Annex 13 to the report of the 51st meeting of the EB was applied. In accordance with option (d) of these guidelines, this type of leakage can be considered insignificant if animals are displaced to existing grasslands with the carrying capacity that allows for accommodation of the displaced animals during the entire

[55] CORFOGA 2000. Cattle census (original title Informe del Censo Ganadero del 2000) Figure 2, average for Brunca region. See http://www.corfoga.org/censo.php

period of displacement.

The capacity of the pastures lands in the project area varies from 1,5 to 2.5 head animals/ha[56 57]. With a pre-project animal population in the project area estimated at 0.64 animals/ha that would mean that farmers could decide to reforest more than half of their pastures without exceeding the carrying capacity of the land to which animals are displaced. As discussed above the farmers generally only reforest a small part of their lands and many implement silvo-pastoral systems that would not lead to displacement. . Consequently, the carrying capacity will not be exceeded and therefore under option (d)(ii) of the guidelines, the displacement of pre-project grazing is expected to be insignificant. Therefore this form of leakage will be considered equal to zero.

$LK_{conv\text{-}graz} = 0$

Estimation of $LK_{conv\text{-}crop}$ (Leakage due to conversion of land to crop land, based on area of conversion)

Leakage due to conversion of land to crop land (LKconv-crop) may occur when agricultural activities are displaced to areas outside the project boundary.

To show that GHG emissions attributable to displacement of pre-project crop cultivation activities can be considered insignificant, the guidelines from the EB as available in Annex 14 to the report of the 51st meeting of the EB was applied.

As discussed above, the farmers participating in this project are mostly small property owners (< 50 ha) who will only dedicate part of their land to any of the project activities. It is conservatively assumed that the total area subjected to pre-project crop cultivation activities expected to be displaced is more than 5% of the entire A/R CDM project activity. In that case, paragraph 4(b)(i) of the EB guidelines states that the increase in GHG emissions due to displacement of pre-project crop cultivation activities is insignificant if the pre-project crop cultivation activities are expected to displaced to areas of land that have been subjected to crop cultivation activities during at least one year within a timeframe of five years before the year of the project start or the year of signing contractual agreement for validation, whichever comes earlier.

Any existing forests in the area are unsuitable for farming and protected by law.[58] Therefore farmers cannot displace activities to lands that do not belong to them. Any agricultural activities that will be displaced will therefore be replaced to land that is already being used by the same farmers.. As already discussed in section C.5.1, step 3, the existing land use for these farmers includes cattle raising activities, coffee and other agricultural activities. Most farmers don't specialize in one of these but instead practice several of these activities on their farm. In some cases, farms might contain forest lands. Activities cannot be replaced to these forests as they are protected by law. Furthermore, forested areas are directly eligible for PSA payments while not requiring the initial investments

[56] Personal communication: Ing. Agr. Horacio Chi. Livestock coordinator Brunca region Directorate within the Ministry of agriculture (Coordinador Pecuario, de la Direccion Regional Brunca, del Ministerio de Agricultura y Ganaderia). Contact details available on request

[57] Mora, V. 2007. Description of the value chain of livestock activity in the Atlantic Region of Costa Rica. Ministry of Agriculture and Livestock. Board of the Atlantic Region. (Mora, V. 2007. Descripcion De La Agrocadena De Ganaderia Bovina. Ministry of Agriculture and Livestock, Directorate for the Atlantic Region.) This publication estimates the capacity as 1.8 head/ha (page 13)

[58] Legislative Assembly of the Republic of Costa Rica. 1996. Forestry Law 7575. Title three, article 19. See: http://www.cne.go.cr/cedo_dvd5/files/flash_content/pdf/spa/doc387/doc387-contenido.pdf

required for afforestation/reforestation. Any crop activities that are displaced would therefore be displaced to existing croplands or to pastures (that would be converted to croplands). An analysis of the historic and existing land use/land-cover changes was presented earlier in table 12. This table shows that 100% of the sample areas have maintained their current land use during the last 11 years, and that 90.7% of the areas have maintained pastures or crops for more than 20 years. Therefore under option (b) (i) of the guidelines this means that leakage can be considered as insignificant. Therefore

$LK_{conv\text{-}crop} = 0$

And

$$LK_{conversion} = 0$$

Estimation of $LK_{fuel\text{-}wood}$ (Leakage due to displacement of fuel-wood collection)

Leakage due to displacement of fuel-wood collection depends on pre-project fuel-wood collection activities (including in-site charcoal production), or a fraction of them, which may have to be displaced permanently, or temporarily, outside the project boundary.

In accordance with the methodology:

$$FG_{outside,t} = FG_{BL} - FG_{AR,t} \quad \textbf{(21)}$$

where:

$FG_{outside,t}$	Volume of fuel-wood gathering displaced outside the project area at year *t*; $m^3\ yr^{-1}$
FG_{BL}	Average pre-project annual volume of fuel-wood gathering in the project area; $m^3\ yr^{-1}$
$FG_{AR,t}$	Volume of fuel-wood gathering allowed/planned in the project area under the proposed AR CDM project activity; $m^3\ yr^{-1}$

Leakage due to displacement of fuel-wood collection can be set as zero ($LK_{fuel\text{-}wood} = 0$) if $FG_{BL} < FG_{AR,t}$;

In Costa Rica, most households (98 %[59]) have access to electricity. Where firewood is still used in the project area, it mainly comes from the coffee plantations. In this project, the areas subjected to reforestation belong to the farmers themselves and no households are displaced. Hence if the farmer was using firewood before from its coffee plantations, they now have access to their own reforestation areas. These reforestation areas have higher biomass and firewood collection potential than the coffee plantations and there are no limitations for the farmers to collect the firewood from their own forests. It can therefore safely be assumed that $FG_{BL} < FG_{AR,t}$ and;

$LK_{fuel\text{-}wood} = 0$

[59] World Bank Human Opportunity Index
http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/LACEXT/0,,contentMDK:21919418~pagePK:146736~piPK:146830~theSitePK:258554,00.html, last bullet

In conclusion, $LK_{ActivityDisplacement}$ is considered as zero in the ex-ante calculations.

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

>> The types of activities required to be monitored during project implementation are the project areas, forest establishment and management.

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

• Field surveys concerning the project boundary within which the A/R activity are conducted, site by site;
• Measuring geographical positions (latitude and longitude of each corner polygon sites) using GPS;
• Checking whether the afforested/reforested areas are consistent with the eligible areas as defined in the CDM-AR-PDD;
• If afforestation/reforestation activities fall outside of the project boundary as defined in the CDM-AR-PDD, these lands shall not be accounted as a part of the A/R CDM project activity;
• Input the measured geographical positions into the GIS system and calculate the implemented area of each stratum and stand.

The development of the tree cover shall be monitored periodically all through the crediting period, including through remote sensing as applicable. If tree cover is affected by natural hazards (forest fires, plagues, etc.) or human interventions (harvesting, deforestation) beyond average regional damage levels, location, area of the deforested land and carbon losses shall be identified. These areas shall be treated as separate strata. Similarly, if the planting on certain lands within the project boundary fails these lands will be documented.

Table 22. Data to be collected for monitoring project discrete areas

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
1.01	Sampling Plot Location latitude and longitude of each polygon corner	*Ha and location*	*m*	*5 years*	*100% of parcels*	*Measured using GPS and usual land survey methods*
1.02	*Parcel area*	*ha*	*m*	*5 years*	*100% of parcels*	*Measured during site preparation (refer to 1.1.01)*
1.03	A_{ikt} (Area of	*ha*	*c*	*5 years*	*100% of strata*	*Calculated using data in 1..02*

	stand model *k*, in stratum *i*, at time *t)*					

E.1.1. Monitoring of forest establishment and management:

>>

To ensure that the tree planting in forest plantations and enrichment planting in assisted natural regeneration areas conforms to the practice described in CDM-AR-PDD section A, the following monitoring activities shall be conducted on each parcel in the first three years after planting:

- ♦ Confirm that site preparation is implemented based on practice documented in the CDM-AR-PDD;
- ♦ Monitor use of approved herbicides in site preparation and container disposal as described in the CDM-AR-PDD;
- ♦ Check that tree species and number of seedlings planted on each farm parcel is in line with the CDM-AR-PDD;
- ♦ Assessment of seedling survival;
- ♦ The survival rate of planted trees shall be counted three months after the planting, and re-planting shall be conducted if the survival rate is lower than 90 percent;
- ♦ Check and confirm that the weeding practice is implemented as described in the CDM-AR-PDD, including the use of approved herbicides;
- ♦ Document and justify any deviation from the planned forest establishment.

Forest management practices are important drivers of the GHG balance of the project, and thus must be monitored. Practices to be monitored include:

- ♦ Harvesting: date, location, area, tree species, volumes or biomass removed;
- ♦ Checking and confirming that harvested lands are re-planted, re-sowed or coppiced as planned and/or as required by forest law;
- ♦ Checking and ensuring that good conditions exist for natural regeneration if harvested lands are allowed to regenerate naturally;
- ♦ Monitoring of disturbances: date, location, area (GPS coordinates and remote sensing, as applicable), tree species, type of disturbance, biomass lost, implemented corrective measures, change in the boundary of strata and stands.

Table 23. Data to be collected for monitoring forest establishment and management

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
	Site preparation date	*date*	*m*	*During establishment*	*100% of the parcels*	*Area of parcel under 1.02 above*
1.1.01	*Site preparation activity for parcel*	*NA*	*d*	*During establishment*	*100% of the parcels*	
1.1.03	Planting date per parcel	date	m	*During establishment*	*100% of the parcels*	
1.1.04	*Number of planted trees per ha*	*No. of trees/ha*	*m*	*During establishment*	*100% of the parcels*	
1.1.06	Planted species in parcel	Name	m	*During establishment*	*100% of the parcels*	
1.1.9	Thinning date	Date	m	*According to PDD proposed management*	*100% of the parcels*	No thinning or harvesting operations are allowed in reforestation through assisted natural regeneration discrete areas.
1.1.10	Thinning intensity of parcel	%	e	*According to PDD proposed management*	*100% of the parcels*	
1.1.12	Thinning Volume cut	m^3 ha^{-1}	m	*According to PDD proposed management*	*100% of the parcels*	
1.1.13	Harvesting date of parcel	Date	m	*According to PDD proposed management*	*100% of the parcels*	No thinning or harvesting operations are allowed in reforestation through assisted natural regeneration discrete areas.
1.1.14	Harvesting percentage of parcel	%	m	*According to PDD proposed management*	*100% of the parcels*	
1.1.16	Harvesting volume cut	m^3 ha^{-1}	m	*According to PDD proposed management*	*100% of the parcels*	
1.1.17	Re-planting date	Date	m	*According to PDD proposed*	*100% of the Melina and*	Repeat operations 1.1.01 to 1.1.18 for

				management)	*Deglupta parcels of*	all re-planted parcels

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

>>

To ensure the net anthropogenic GHG removals by sinks to be measured and monitored precisely, credibly, and transparently, a quality assurance and quality control (QA/QC) procedure shall be implemented, including (1) collection of reliable field measurement; (2) verification of methods used to collect field data; (3) verification of data entry and analysis techniques; and (4) data maintenance and archiving. If after implementing the QA/QC plan it is found that the targeted precision level is not met, then additional field measurements need to be conducted until the targeted precision level is achieved.

1.2.1 Reliable field measurements

Collecting reliable field measurement data is an important step in the quality assurance plan. Persons involved in the field measurement work should be fully trained in the field data collection and data analyses. Standard Operating Procedures (SOPs) for each step of the field measurements shall be developed and adhered to at all times. These SOPs should detail all phases of the field measurements and contain provisions for documentation for verification purposes, so that measurements are comparable over time and can be checked and repeated in a consistent fashion. To ensure the collection of reliable field data:

- Field-team members shall be fully aware of all procedures and the importance of collecting data as accurately as possible;
- Field teams shall install test plots if needed in the field and measure all pertinent components using the SOPs;
- Field measurements shall be checked by a qualified person to correct any errors in techniques;
- A document that shows that these steps have been followed shall be presented as a part of the project documents. The document will list all names of the field team and the project leader will certify that the team is trained;
- New staff members are adequately trained.

1.2.2 Verification of field data collection

To verify that plots have been installed and the measurements taken correctly, 10-20% of plots shall be randomly selected and re-measured independently. Key re-measurement elements include the location of plots, DBH and tree height. The re-measurement data shall be compared with the original measurement data. Any deviation between measurement and re-measurement below 5% will be considered tolerable and error above 5%. Any errors found shall be corrected and recorded. Any errors discovered should be expressed as a percentage of all plots that have been rechecked to provide an estimate of the measurement error.

1.2.3 Verification of data entry and analysis

Reliable estimation of carbon stock in pools requires proper entry of data into the data analyses spreadsheets. To minimize the possible errors in this process, the entry of both field data and laboratory data shall be reviewed using expert judgment and, where necessary, comparison with independent data to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve apparent anomalies before the final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

1.2.4 Data maintenance and archiving

Because of the long-term nature of the A/R CDM project activity, data shall be archived and maintained safely. Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to each project participant. All electronic data and reports shall also be copied on durable media such as CDs and copies of the CDs are stored in multiple locations. The archives shall include:

- Copies of all original field measurement data, laboratory data, and data analysis spreadsheet;
- Estimates of the carbon stock changes in all pools and non-CO_2 GHG and corresponding calculation spreadsheets;
- GIS products;
- Copies of the measurement and monitoring reports.

Table 24. Quality control/quality assurance (QA/QC) procedures applied

Check that assumptions and criteria for the selection of activity data, emission factors and other estimation parameters are documented.	• Cross-check descriptions of activity data, emission factors and other estimation parameters with information on source and sink categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and reference.	• Confirm that bibliographical data references are properly cited in the internal documentation. • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions and removals are calculated correctly.	• Reproduce a representative sample of emission or removal calculations. • Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
Check that parameters and units are correctly recorded and that appropriate conversion factors are used.	• Check that units are properly labeled in calculation sheets. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment factors are used correctly.
Check the integrity of database files.	Confirm that the appropriate data processing steps are correctly represented in the database. • Confirm that data relationships are correctly

	represented in the database. • Ensure that data fields are properly labeled and have the correct design specifications. • Ensure that adequate documentation of database and model structure and operation are archived.
Check for consistency in data between categories.	• Identify parameters (e.g., activity data, and constants) that are common to multiple categories of sources and sinks, and confirm that there is consistency in the values used for these parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct	• Check that emission and removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emission and removal data are correctly transcribed between different intermediate products.
Check that uncertainties in emissions and removals are estimated or calculated correctly.	• Check that qualifications of individuals providing expert judgment for uncertainty estimates are appropriate. • Check that qualifications, assumptions and expert judgments are recorded. Check that calculated uncertainties are complete and calculated correctly. • If necessary, duplicate error calculations on a small sample of the probability distributions used by Monte Carlo analyses.
Undertake review of internal documentation	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission and removal and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check integrity of any data archiving arrangements of outside organizations involved in inventory preparation.
Check time series consistency.	• Check for temporal consistency in time series input data for each category of sources and sinks. • Check for consistency in the algorithm/method used for calculations throughout the time series.
Undertake completeness checks.	• Confirm that estimates are reported for all categories of sources and sinks and for all years. • Check that known data gaps that may result in incomplete emissions estimates are documented and treated in a conservative way.
Compare estimates to previous estimates.	• For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain the difference.

E.2. Sampling design and stratification

>> A geo-referenced spatial data base was built in a GIS platform for each parameter used for stratification of the project area under the baseline and the project scenarios. This geo-referenced spatial data base shall be completed at the earliest stages of the implementation of the proposed A/R CDM project activities. The DOE shall verify the stratification and geo-referenced spatial data base at the first verification. The consistency of the actual boundary of the strata and stands as monitored in the field shall be periodically verified as boundary changes may occur. If changes are observed, *ex post* stratification shall be done.

The possible need for *ex post* stratification shall be evaluated at each monitoring event and changes in the strata should be reported to the DOE for verification. These events and changes might include:

- Unexpected disturbances occurring during the crediting period (e.g. due to fire, pests or disease outbreaks;
- Forest management (cleaning, planting, thinning, harvesting, coppicing, re-replanting);
- Two different strata may be similar enough to allow their merging into one stratum.

Monitoring of strata and stand boundaries shall be done using a Geographical Information System (GIS), which allows for integrating data from different sources (including GPS coordinates and Remote Sensing data).

The monitoring of strata and stand boundaries is critical for a transparent and verifiable monitoring of the variable A_{ikt} (area of stratum *i*, stand model *k*, at time *t*), which is of outmost importance for an accurate and precise calculation of net anthropogenic GHG removals by sinks.

Permanent sampling plots will be used for sampling over time to measure and monitor changes in carbon stocks. In order to ensured that the sampling plots are treated in the same way as other lands within the project boundary, e.g., during site and soil preparation, weeding, fertilization, irrigation, thinning, etc., and they are not destroyed over the monitoring interval, staff involved in management activities shall not be aware of the location of monitoring plots. In addition, any local markers shall not be visible.

The initial allocation of the sample plots shall be proportional to the area of the strata and their variation; however, the number of sample units to measure in each stratum shall be at least equal to 4. This restriction is included to have enough data to estimate a standard deviation for each stratum during each monitoring event. Initial estimation of the sample size was made using the equations below which are based on the assumption of equal cost of establishment of a sample plot in each stratum..

$$n = \frac{\left[\sum_{i=1}^{m_{ps}} N_i \cdot st_i\right]^2}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right)^2 + \sum_{i=1}^{m_{ps}} N_i \cdot (st_i)^2} \qquad \textbf{(22)}$$

$$n_i = \frac{\left[\sum_{i=1}^{m_{ps}} N_i \cdot st_i\right]}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right)^2 + \sum_{i=1}^{m_{ps}} N_i \cdot (st_i)^2} \cdot N_i \cdot st_i \qquad \textbf{(23)}$$

Where:

i	=	1, 2, 3, … m_{PS} strata in the project
m_{PS}	=	total number of strata in the project
$z_{\alpha/2}$ =		Value of the statistic z (normal probability density function)
E	=	allowable error (±10% of the mean)
st_i	=	standard deviation of stratum i
n_i	=	Sample size for stratum i. If $n_i < 3$, set $n_i = 4$.
n	=	Sample size (total number of sample plots required) in the project area
N_i	=	Maximum possible number of sample plots in stratum i
N	=	Maximum possible number of sample plots in the project area

Plot size has been set to 500 m^2 to facilitate plot establishment and reduce measurement errors.. During the project implementation and monitoring, a targeted precision level of ±10% of the mean at the 90% confidence level will be used to be consistent with the methodology. For the purpose of the ex-ante calculations, the assumed standard deviation is set to 50% of the mean expected carbon.

Table 25 lists the initial sample size for each stratum and the data used to calculate the sample size. The sample size could be modified after the first monitoring event based on the actual variation of the carbon stocks determined from taking the *n* samples.

Table 25. Proportional allocation of total sample size to each stratum.[60].

Name	**Code[61]**	**Area**	**Mean expected carbon (t C/ha)**	**Assumed standard deviation**	**Stratum sample size**
North Hillsides/ANR	BLS1-SM3	322.24	80.07	40.035	39
North Hillsides/Melina	BLS1-SM1	18.32	14.13	7.06	4
Valley Lands and South Hillsides/Melina	BLS2-SM1	72.08	22.88	11.44	4

[60] Supporting data for these estimations are available in the project files.

[61] Code used in TARAM spreadsheet

plantations					
Valley Lands and South Hillsides /Teak+Eucalyptus plantations	BLS2-SM2	17.81	58.58	29.29	4
Valley Lands and South Hillsides /Agroforestry Trees+Crops	BLS2-SM4	227.07	25.5	12.75	9
Valley Lands and South Hillsides /Silvopastoral Trees + Pastures	BLS2-SM5	160.44	25.5	12.75	7
Valley Lands and South Hillsides/ANR	BLS2-SM3	74.46	82.91	41.46	10
Total					77

Sampling Plot location

To avoid subjective choice of plot locations the permanent sample plots shall be located systematically with a random start in each stratum, which is considered good practice in IPCC GPG-LULUCF. This shall be accomplished using the project GIS platform and a GPS in the field. The geographical position (GPS coordinate), administrative location, stratum and stand, number of each plot shall be recorded and archived. Ensure that the sampling plots are as evenly distributed as possible.

Monitoring frequency

The first monitoring and verification for this project is envisioned in 2012. Following the CDM requirements, subsequent verifications will take place every 5 years. As can be seen in table 21, harvesting and thinning events are not scheduled to follow the same 5 year cycle and hence verifications and peaks in carbon pools will not coincide.

On the other hand, the assessment of socio-economic benefits due to the CDM project within the project area shall be done by FONAFIFO every five years. This assessment shall be complemented with a socio-economic survey applied to project participants prior to annual payment of the environmental services.

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

>> The baseline is determined *ex ante* and remains fixed during the first crediting period. Thus the baseline is not monitored however as per methodology, the following data will be collected at the time of the renewal of the crediting period.

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
2.3.01	National, local and	n.a.	Collected	Start and end	As complete as	

	sectoral policies that may influence land use in the absence of the proposed A/R CDM project activity			of the crediting period	possible	
2.3.02	Natural and anthropogenic factors influencing land use, land cover and natural regeneration	n.a.	Collected	Start and end of the crediting period	As complete as possible	
2.3.03	Stratum ID			20 years	100%	
2.3.04	Carbon stock in above-ground biomass at the end of the crediting period	t CO2-e. yr-1	Calculated based on baseline plot measurement	End of the crediting period	100% of baseline plots	Calculated based on baseline plot measurement for different strata/sub-strata
2.3.05	Carbon stock in above-ground biomass at the start of the crediting period	t CO2-e. yr-1	Calculated based on baseline plot measurement	Start of the crediting period	100% of baseline plots	
2.3.06	Baseline carbon stock change in above-ground biomass	t CO2-e. yr-1	c	20 years		

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

>>

In accordance with the approved methodology, the actual net greenhouse gas removals by sinks will be calculated periodically as:

$$C_{ACTUAL} = \Delta C_{LB} - GHG_E \quad \textbf{(24)}$$

where:

C_{ACTUAL} Actual net greenhouse gas removals by sinks; t CO_2-e

ΔC_{LB} Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO_2-e

GHG_E Sum of the increases in GHG emissions by sources within the project boundary as a result of the implementation of an A/R CDM project activity; t CO_2-e

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

>>

Since carbon stock changes in pools of soil organic matter, litter and dead wood are ignored, the verifiable changes in carbon stock are equal to the carbon stock changes in above and below-ground biomass within the project boundary and is calculated as:

$$\Delta C_{P,LB} = \Delta C_{P,LB_T} - E_{biomasslos} \qquad \textbf{(25)}$$

where:

$\Delta C_{P,LB}$	Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO_2-e
$\Delta C_{P,LB\,T}$	Sum of the changes in living tree biomass carbon stocks (above- and below-ground); t CO_2-e
$E_{biomassloss}$	Decrease in the carbon stock in the living biomass carbon pools of non-tree vegetation in the year of site preparation, up to time *t**; t CO_2-e (as per equation 15)

The sum of the changes in living tree biomass carbon stocks are calculated as

$$\Delta C_{P,LB_T} = \sum_{t=1}^{t^*} \sum_{i=1}^{S_{ps}} \sum_{k=1}^{K} \Delta C_{P,ikt} \qquad \textbf{(26)}$$

where:

$\Delta C_{P,LB}$ Sum of the changes in living biomass carbon stocks (above- and below-ground); t CO_2-e

$\Delta C_{P,ikt}$ Annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t;* t CO_2-e yr^{-1}

i 1, 2, 3, … S_{ps} strata of the project activity

k 1, 2, 3, … *K* stand models

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

and

$$\Delta C_{P,ikt} = (\Delta C_{AB,ikt} + \Delta C_{BB,ikt}) \cdot \frac{44}{12} \quad \textbf{(27)}$$

where:

$\Delta C_{P,ikt}$ Annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t;* t CO_2-e. yr^{-1}

$\Delta C_{AB,ikt}$ Annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}

$\Delta C_{BB,ikt}$ Annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}

The mean change in carbon stocks in above-ground biomass and below-ground biomass per unit area are estimated based on field measurements on permanent plots. The growth of individual trees on plots shall be measured at each monitoring event. Pre-existing (baseline) trees shall conservatively and consistently with the baseline methodology not be measured and accounted for. Although non-tree vegetation such as herbaceous plants, grasses, and shrubs can occur, usually with biomass less than 10 percent, there is also non-tree vegetation on degraded lands and the baseline scenario has assumed the zero stock change for this non-tree biomass. Therefore, non-tree vegetation will not be measured and accounted. The omission of non-tree biomass makes the monitoring conservative. Even if the initial site preparation results in a removal of non-tree biomass, there is no risk to over-estimate the removals.

Where default values are used, Annex 23 of EB50 has been applied by using local or regional where possible in preference to international or global forest or GHG inventory, including IPCC literature,

As allowed by the methodology, two methods are available to calculate above-ground biomass: Biomass Expansion Factors (BEF) method and Allometric Equations method. Both methods might be used in the proposed project activity but depending on the availability of data, one method will be selected per species or group of species used in the project.

BEF method
For species or group of species that use the BEF method, the following steps will be applied:

***Step 1*:** Measure the diameter at breast height (DBH, at 1.3 m above-ground) and preferably height of all the trees in the permanent sample plots above a minimum DBH.

***Step 2*:** Estimate volume of the commercial component of trees or total tree biomass based on locally derived equations (see table 26), then sum for all trees within a plot, and express as volume per unit area (e.g., m^3/ha).

***Step 3*:** Choose BEF and root-shoot ratio (see table 26).

Table 26. Volume equations, wood density, BEF and R values for the tree species without biomass equations in proposed AR project.

Species	Volume Equations	Reference
Gmelina arborea (Melina)	**V** $= e^{-11.6424 + 2.2444 * \text{Ln (DBH)} + 1.1249 * \text{Ln (H)}}$ Where, V = commercial volume with bark (m^3) until a minimum diameter of 10 cm. DBH = diameter at the breast height (1.3 m) in centimeters. H = tree total height in meters. e = 2.71828 D* = wood density average (basic specific weigh) = 370 Kg / m^3 BEF** = biomass expansion factor for conversion of biomass of merchantable volume to aboveground biomass, dimensionless (1.315)	*Rojas F, et all. 2004. Manual para productores de *Gmelina arborea* en Costa Rica. ITCR- FONAFIFO-REFORESTA. Pp 314(See page 192) **Biomass Expansion Factor (BEF) for *Gmelina arborea* calculated using information from: Fuwape, J.A et all, 2001. Biomass equations and estimation for *Gmelina arborea* and *Nauclea Diderrichi*i stands in Akure forest reserve. Biomass and Bioenergy No.21: 401-405. **Table 1** ***Total Biomass / Stem biomass*** = 264,762 / 201,219 = 1.315 ***Biomass Expansion factor*****=** 1.315
For all tree species except cypress.	**Root shoot ratio** R/S = 0.24 (average for tropical zones)	Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. Oecología 111, 1-11 (See page 5)

***Step 4*:** Convert the volume of the commercial component of trees into carbon stock in above-ground biomass and below-ground biomass via basic wood density, BEF root-shoot ratio and carbon fraction, given by:

$$MC_{AB,ijt} = MV_{ijt} \cdot D_j \cdot BEF_j \cdot CF_j \qquad \textbf{(28)}$$

$$MC_{BB,ijt} = MC_{AB,ijt} \cdot R_j \qquad \textbf{(29)}$$

where:

$MC_{AB,ijt}$ Mean carbon stock in above-ground biomass per unit area for stratum *i*, species *j*, time *t;* t C ha^{-1}

$MC_{BB,ijt}$ Mean carbon stock in below-ground biomass per unit area for stratum *i*, species *j*, time *t;* t C ha^{-1}

MV_{ijt} Mean merchantable volume per unit area for stratum *i*, species *j*, time *t;* m^3 ha^{-1}

D_j Volume-weighted average wood density; t d.m. m^{-3} merchantable volume

BEF_j Biomass expansion factor for conversion of biomass of merchantable volume to above-ground biomass; dimensionless

CF_j Carbon fraction; IPCC default value = 0.5; t C (t d.m.)$^{-1}$

R_j Root-shoot ratio; dimensionless

Step 5: Calculate **t**he total carbon stock in living biomass for stratum *i*, species *j*, time *t* from the area for stratum *i*, species *j*, time *t* and the mean carbon stocks in above-ground biomass and below-ground biomass per unit area, as follows:

$$C_{AB,ikt} = A_{ikt} \cdot MC_{AB,ikt} \quad \textbf{(30)}$$

$$C_{BB,ikt} = A_{ikt} \cdot MC_{BB,ikt} \quad \textbf{(31)}$$

where:

$MC_{AB,ijt}$ Mean carbon stock in above-ground biomass per unit area for stratum i, species j, time t; t C ha-1

$MC_{BB,ijt}$ Mean carbon stock in below-ground biomass per unit area for stratum *i*, species *j*, time *t;* t C ha^{-1}

A_{ijt} Area of stratum *i*, species *j*, at time *t*; hectare (ha)

Step 6*:* The change in carbon stock in living biomass over time is given by:

$$\Delta C_{AB,ikt} = \frac{\sum_{j=1}^{J}(C_{AB,ikt_2} - C_{AB,ikt_1})}{T} \quad \textbf{(32)}$$

$$\Delta C_{BB,ikt} = \frac{\sum_{j=1}^{J}(C_{BB,ikt_2} - C_{BB,ikt_1})}{T} \quad \textbf{(33)}$$

where:

$\Delta C_{AB,ikt}$ Annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}

$\Delta C_{BB,ikt}$ Annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t;* t C yr^{-1}

$C_{AB,ijt2}$ Carbon stock in above-ground biomass for stratum *i*, species *j*, calculated at time $t = t_2$; t C

$C_{AB,ijt1}$ Carbon stock in above-ground biomass for stratum *i*, species *j*, calculated at time $t = t_1$; t C

$C_{BB,ijt2}$	Carbon stock in below-ground biomass for stratum *i*, species *j*, calculated at time $t = t_2$; t C
$C_{BB,ijt1}$	Carbon stock in below-ground biomass for stratum *i*, species *j*, calculated at time $t = t_1$; t C
T	Number of years between monitoring time t_2 and t_1 ($T = t_2 - t_1$); years
j	Species *j* (*J* = total number of species)

Allometric equation method
For species or group of species that use an allometric equation, the following steps will be applied:

Step 1: Measure the diameter at breast height (DBH, at 1.3 m above ground) and possibly, depending on the form of the equation, height of all the trees in the permanent sample plots above a minimum DBH.

Step 2: Choose or establish appropriate allometric equations (see table 27).

$$TB_{ABj} = f_j(DBH, H) \quad \textbf{(34)}$$

where:

TB_{ABj}	Above-ground biomass of a tree; kg tree^{-1}
$f_j(DBH,H)$	An allometric equation for species *j* linking above-ground tree biomass (kg tree^{-1}) to diameter at breast height (*DBH*) and possibly tree height (*H*) measured in plots for stratum *i*, species *j*, time *t*

Table 27. Allometric biomass equations for some of the tree species in proposed A/R Project.

Species	Above Ground Biomass Equation	Reference
Terminalia amazonia (Amarillon)	AB_{tr} = Exp [-2.538 + 2.614* Ln (DBH)] Where, AB_{tr} = above-ground biomass for each tree in kg. Ln= natural logarithm. DBH = diameter at the breast height in centimeters. r^2 = 0.99[62]	Quoted in Redondo, A. 2007. Growth, carbon sequestration, and management of native tree plantations in humid regions of Costa Rica. New Forest. 34:253—268 (See page 266). Original equation from Montero, M, Montagnini F (2005) R^2 for equation used is 0.99
Tectona grandis (Teak)	**$\mathbf{Log_{10}}$ AB_{tr} = a + b $\mathbf{log_{10}}$ DBH** a = -0.815, b = 2.382 CF = 1.01, FI = 14.06, r^2 = 0.98, RMSE = 0.055, AIC = -227 , Confidence interval (95%) = -0.952 <a> -0.679 2.281 <b> 2.483 Where, AB_{tr} = aboveground biomass for each tree in kg.	Perez L.D., Kanninen M. 2003. Above ground of *Tectona grandis* plantations in Costa Rica. Journal of Tropical Forest Science. 15 (1): 199-213. (see page 203). Based on 40 trees and R^2 for equation used is 0.98

[62] r^2 = measures the proportion of the variance of Ln (Biomass) explained by the equation.

	Log_{10} = base-10 logarithm. DBH = diameter at the breast height (1.3 m) in centimeters. CF: correction factor FI: Ratio of Furnival AIC: Approach of information Akaike	
Other species	**Shade Tolerant** $AB_{tr\ -ST} = 0.01689\ DBH^{1.6651}\ H^{1.4412}$ Where, $AB_{tr\ -ST}$ = aboveground biomass of an individual shade tolerant tree in kg. DBH= diameter at the breast height (1,3 m) in centimeters. H = tree total height in meters. MSE= 0.0233 Index of Fit = 0.984 Tree Size Range: DBH (cm)= 4 – 115, H (m)= 7 - 38 **Shade – Intolerant and partial Shade Tolerant** $AB_{tr\ -SI} = 0.01363\ DBH^{1.8520}\ H^{1.2611}$ Where, $AB_{tr\ -SI}$ = aboveground biomass of an individual shade tolerant tree in kg. DBH= diameter at the breast height (1,3 m) in centimeters. H = tree total height in meters. MSE= 0.0265 Index of Fit= 0.974 Tree Size Range: DBH (cm)= 12 – 100, H (m)= 14-50	Ortiz, E. 1997. Refinement and Evaluation of two Methods to Estimate Aboveground Tree Biomass in Tropical Forest. Doctoral Dissertation. New York. Pp: 116-118
For all tree species	**Root shoot ratio** R/S = 0.24 (average)	Cairns, M. A., S. Brown, E. H. Helmer, and G. A. Baumgardner. 1997. Root biomass allocation in the world's upland forests. Oecología 111, 1-11 (See page 5)

Step 3: Estimate carbon stock in above-ground biomass per tree using selected allometric equations applied to the tree measurements in Step 1

$$TC_{ABj} = TB_{ABj} \cdot CF_j \qquad \textbf{(35))}$$

where:

TC_{AB} Carbon stock in above-ground biomass per tree; kg C $tree^{-1}$

TB_{ABj} Above-ground biomass of a tree of species *j*; kg $tree^{-1}$

CF Carbon fraction (IPCC default value = 0.5); t C $(t\ d.m.)^{-1}$

Step 4: Calculate the increment of above-ground biomass carbon accumulation at the tree level. Calculate by subtracting the biomass carbon at time 2 from the biomass carbon at time 1 for each tree.

$$\Delta TC_{ABjT} = TC_{ABj,t2} - TC_{ABj,t1} \qquad \textbf{(36)}$$

where:

ΔTC_{ABjT}	Carbon stock change in above-ground biomass per tree of species *j* between two monitoring events; kg C tree^{-1}
$\Delta TC_{ABj,t2}$	Carbon stock change in above-ground biomass per tree of species *j* at monitoring event t_2; kg C tree^{-1}
$\Delta TC_{ABj,t1}$	Carbon stock change in above-ground biomass per tree of species *j* at monitoring event t_1; kg C tree^{-1}

Step 5: Calculate the increment in above-ground biomass carbon per plot on a per area basis. Calculate by summing the change in biomass carbon per tree within each plot and multiplying by a plot expansion factor which is proportional to the area of the measurement plot. This is divided by 1,000 to convert from kg to t.

$$\Delta PC_{ABikT} = \frac{XF \cdot \sum_{tr=1}^{TR} \Delta TC_{ABjT,tr}}{1000} \qquad \textbf{(37)}$$

$$XF = \frac{10,000}{AP} \qquad \textbf{(38)}$$

where:

$\Delta PC_{AB,ijT}$	Plot level carbon stock change in above ground biomass in stratum *i*, species *j*, between two monitoring events; t C ha^{-1}
ΔTC_{ABjT}	Carbon stock change in above-ground biomass per tree of species *j* between two monitoring events; kg C tree^{-1}
XF	Plot expansion factor from per plot values to per hectare values
AP	Plot area; m^2
tr	Tree (*TR* = total number of trees in the plot)

Step 6*:* Calculate mean carbon stock change within each stratum. Calculate by averaging across plots in a stratum or stand:

$$\Delta MC_{ABikT} = \frac{\sum_{pl=1}^{PL_{ik}} \sum_{j}^{J} \Delta PC_{ABikT,pl}}{PL_{ik}} \qquad \textbf{(39)}$$

where:

ΔMC_{ABikT}	Mean carbon stock change in above-ground biomass in stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1}.

ΔPC_{ABijT} Plot level mean carbon stock change in above-ground biomass in stratum *i*, species *j*, between two monitoring events; t C ha^{-1}.

pl Plot number in stratum *i*, species *j*; dimensionless

PL_{ik} Total number of plots in stratum *i*, stand model *k*; dimensionless

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

Step 7: Estimate carbon stock in below-ground biomass using root-shoot ratios (see table 28) and above-ground carbon stock and apply Steps 4 and 5 to below-ground biomass.

$$TC_{BBj} = TC_{ABj} \cdot R_j \quad \textbf{(40)}$$

$$\Delta TC_{BBjT} = TC_{BBj,t2} - TC_{BBj,t1} \quad \textbf{(41)}$$

$$\Delta PC_{BB,ikT} = \frac{XF \cdot \sum_{tr=1}^{TR} \Delta TC_{BBjT}}{1000} \quad \textbf{(42)}$$

$$\Delta MC_{BB,ikT} = \frac{\sum_{pl=1}^{PL_{ik}} \Delta PC_{BBikT,pl}}{PL_{ik}} \quad \textbf{(43)}$$

where:

TC_{BBj} Carbon stock in below-ground biomass per tree of species *j*; kg C tree^{-1}

TC_{ABj} Carbon stock in above-ground biomass per tree of species *j* as calculated in Step 1; kg C tree^{-1}

R_j Root-shoot ratio appropriate to increments for species *j*; dimensionless

ΔTC_{BBjT} Carbon stock change in below-ground biomass per tree of species *j* between two monitoring events; kg C tree^{-1}

$\Delta PC_{BB,\,ijT}$ Plot level carbon stock change in below-ground biomass of species *j* between two monitoring events; t C ha^{-1}

XF Plot expansion factor from per plot values to per hectare values (see equation 80); dimensionless

tr Tree (*TR* = total number of trees in the plot)

ΔMC_{BBikT} Mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1}

ΔPC_{BBikT} Plot level carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1} *pl* = plot number in stratum *i*, stand model *k*; dimensionless

PL_{ik} Total number of plots in stratum *i*, stand model *k*; dimensionless

Table 28. Data to be collected and archived for actual net GHG removals by sinks

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.01	*DLP*	Desired level of precision (e.g. 10%)	%	Defined	Before the start of the project	100%	For the purpose of QA/QC and measuring and monitoring precision control
2.1.2.02	PBB_{ikt}	Average proportion of biomass burnt for stratum *i*, stand model *k*, time *t*	Dimensionless	m	Annually	100%	Sampling survey after slash and burn
2.1.1.03	PL_{ID}	Sample plot ID (1, 2, 3, … pl, …)	Alpha numeric	Defined	Before the start of the project	100%	Numeric series ID will be assigned to each permanent sample plot
2.1.1.04	PL_{ik}	Total number of plots in stratum *i*, stand model *k*	Dimensionless	m	5-year	100%	
2.1.1.05	R_j	Root-shoot ratio	Dimensionless	e	5 year	100% of sampling plots	Local-derived and species-specific value have the priority
2.1.1.06	*16/12*	Ratio of molecular weights of CH_4 and carbon;	Dimensionless	Universal constant			
2.1.1.07	*44/12*	Ratio of molecular weights of carbon and CO_2; dimensionless	Dimensionless	Universal constant			

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.08	*44/28*	Ratio of molecular weights of N_2O and nitrogen; dimensionless	Dimensionless	Universal constant			
2.1.1.09		Confidence level (e.g. 90%)	%	Defined	Before the start of the project	100%	For the purpose of QA/QC and measuring and monitoring precision control
2.1.1.10	*A*	Total size of all strata (A), e.g. the total project area	Hectares	m	Before the start of the project and adjusted thereafter every 5-year	100%	
2.1.1.11	A_i	Area of each stratum	Hectares	m	Before the start of the project and adjusted thereafter every 5-year	100%	
2.1.1.13	A_{ikt}	Area of stratum *i*, stand model *k*, at time *t*;	Hectares	m	Yearly	100%	Measured for different strata and stands
2.1.1.14	A_{B,ikt_sb}	Area of slash and burn in stratum *i*, stand model *k*, at time *t*	Hectares	m	Yearly	100%	Measured for different strata and stands
2.1.1.15	*AP*	Sample plot area	m^2	m	5-year	100%	
2.1.1.16	*BEF*	Biomass expansion factor (BEF)	Dimensionless	e	5 year	100% of sampling plots	Local-derived and species-specific value have the priority (IPCC default in LULUCF GPG 2003, Table 3A.1.10)

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.17	B_{ijt}	Average above-ground bio-mass stock before burning for stratum *i*, species *j*, time *t*	t d.m. ha^{-1}	m	Before burning	Sample plots	
2.1.1.18	*N/C ratio*	Nitrogen/carbon ratio	Dimensionless	e	Once per species or group of species		IPCC default value (0.01) is used if no appropriate value
2.1.1.19	$C_{AB,ijt}$	Carbon stock in above-ground biomass for stratum *i*, species *j*, time *t*	t C	c	5-year	100%	
2.1.1.20	C_{ACTUAL}	Actual net greenhouse gas removals by sinks;	t CO_2-e.	c	5-year	100%	
2.1.1.21	$C_{BB,ijt}$	Carbon stock in below-ground biomass for stratum *i*, species *j*, time *t*	t C	c	5-year	100%	
2.1.1.22	*CE*	Average biomass combustion efficiency	Dimensionless	e	Before the start of the project	100%	IPCC default value (0.5) is used if no appropriate value
2.1.1.23	*CF*	Carbon fraction	t C $(t\ d.m.)^{-1}$	e	Once per crediting period		Local-derived and species-specific value have the priority (IPCC default = 0.5)
2.1.1.24	CF_j	Carbon fraction of species *j*	t C $(t\ d.m.)^{-2}$	e	Once per species	100% of species or species group	Local-derived and species-specific value have the priority (IPCC default = 0.5)
2.1.1.25	C_i	Cost of establishment of a sample plot for each stratum *i*	US$ or local currency	m	5-years	100%	

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.28	*DBH*	Diameter at breast height of living and standing dead trees	cm (living/dead)	m	5 year	100% trees in plots	Measuring at each monitoring time per sampling method
2.1.1.29	D_j	Wood density of species *j*	t d.m. m^{-3}	e	5 year	100% of sampling plots	Local-derived and species-specific value have the priority
2.1.1.30	*D*	Average wood density	t d.m. m^{-3}	e	5 year	100% of sampling plots	Local-derived and species-specific value have the priority
2.1.1.31	*E*	Allowable error	Depends on the variable calculated	c	5-year	100% of the variables	
2.1.1.32	$E_{BiomassBurn}$	Increase in GHG emission as a result of biomass burning within the project boundary	t CO_2-e.	c	5-year	100%	
2.1.1.33	$E_{BiomassBurn,CH4}$	CH_4 emission from biomass burning in slash and burn	t CO_2-e.	c	5-year	100%	
2.1.1.34	$E_{BiomassBurn,N2O}$	N_2O emission from biomass burning in slash and burn	t CO_2-e.	c	5-year	100%	
2.1.1.35	$E_{BiomassBurn,CO2}$	CO_2 emission from biomass burning in slash and burn	t CO_2-e.	c	5-year	100%	
2.1.1.40	ER_{N20}	Emission ratio for N_2O	Dimensionless	e	Yearly		(IPCC default = 0.007)
2.1.1.41	ER_{CH4}	Emission ratio for CH_4	Dimensionless	e	Yearly		(IPCC default = 0.012)

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.42	$f_j(DBH,H)$	Allometric equation for species *j* linking above-ground tree biomass (kg $tree^{-1}$) to diameter at breast height (DBH) and possibly tree height (H) measured in plots for stratum *i*, species *j*, time *t*	kg $tree^{-1}$	m-e-c	Once per species	for all major species or group of species	Use local/global equations validated for local conditions
2.1.1.46	GHG_E	Increase in GHG emission as a result of the implementation of the proposed A/R CDM project activity within the project boundary	t CO_2-e	c	5-year	100%	
2.1.1.47	GWP_{CH4}	Global Warming Potential for CH_4		e	Once per commitment period		(IPCC default = 21)
2.1.1.48	GWP_{N2O}	Global Warming Potential for N_2O		e	Once per commitment period		(IPCC default = 310)
2.1.1.49	H_{ijt}	Annually harvested volume and fuel wood for stratum *i*, species *j*, at time *t*	m^3	c	Annually	100% stands	Annually recorded
2.1.1.50	i_{ID}	Stratum *i*D (1, 2, 3, … m_{SP} project scenario (*ex post*) strata)	Alpha numeric	Defined	At stand establishment	100%	Each stand has a particular year *to* be planted under each stratum
2.1.1.51	ID_{ikt}	Stand ID	Alpha numeric	Defined	At stand establishment	100%	Each stand has a particular year *to* be planted under each stratum

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.52	*lat/long*	Plot location		m	5 years	100%	Using GPS to locate before start of the project and at time of each field measurement
2.1.1.53	$MC_{AB,ijt}$	Mean carbon stock in above-ground biomass per unit area for stratum *i*, species *j*, time *t*	t C ha^{-1}	c	5-year	100%	
2.1.1.54	$MC_{BB,ijt}$	Mean carbon stock in below-ground biomass per unit area for stratum *i*, species *j*, time *t*	t C ha^{-1}	c	5-year	100%	
2.1.1.55	MV_{ijt}	Mean merchantable volume per unit area for stratum *i*, species *j*, time *t*	m^3 ha^{-1}	m^3	5 year	100% of sampling plots	Calculated from 2.1.1.13 and possibly 2.1.1.15 using local-derived equations, or directly measured by field instrument
2.1.1.56	*N*	Maximum possible number of sample plots in the project area	Dimensionless	c	5-years	100%	
2.1.1.57	*n*	Sample size (total number of sample plots required) in the project area	Dimensionless	c	5-years	100%	
2.1.1.58	N_i	Maximum possible number of sample plots in stratum *i*	Dimensionless	c	Before the start of the project and adjusted thereafter every 5-year	100%	

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

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.59	n_i	Sample size for stratum *i*	Dimensionless	c	Before the start of the project and adjusted thereafter every 5-year	100%	Calculated for each stratum
2.1.1.64	nTR_{PLikt}	Number of trees in the sample plot	Number	m	5 years	100% trees in plots	Counted in plot measurement
2.1.1.66	*DLP*	Desired level of precision (e.g. 10%)	%	Defined	Before the start of the project	100%	For the purpose of QA/QC and measuring and monitoring precision control
2.1.1.67	PBB_{ikt}	Proportion of biomass burnt	Dimensionless	m	Annually	100%	Sampling survey after slash and burn
2.1.1.68	PBB_{ikt}	Average proportion of biomass burnt for stratum *i*, stand model *k*, time *t*	Dimensionless	e	Before burning	Sample plots	Used for estimating numbers of sample plots of each stratum and stand, as necessary
2.1.1.69	PL_{ID}	Sample plot ID (1, 2, 3, … pl, …)	Alpha numeric	Defined	Before the start of the project	100%	Numeric series ID will be assigned to each permanent sample plot
2.1.1.70	PL_{ik}	Total number of plots in stratum *i*, stand model *k*	Dimensionless	m	5-year	100%	
2.1.1.71	R_j	Root-shoot ratio	Dimensionless	e	5 year	100% of sampling plots	Local-derived and species-specific value have the priority
2.1.1.72	st_i	Standard deviation for each stratum *i*; dimensionless		e	At each monitoring event	100%	Used for estimating numbers of sample plots of each stratum and stand, as necessary
2.1.1.73	TB_{ABj}	Above-ground biomass of a tree	kg dry matter $tree^{-1}$	c	5-year	100%	

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.74	TC_{ABj}	Carbon stock in above-ground biomass per tree of species *j*	kg C $tree^{-1}$	c	5-year	100%	
2.1.1.75	*tID*	Age of plantation (1, 2, 3, … years)	year	m	At stand establishment	100%	Counted since the planted year
2.1.1.76	tr_{ID}	Tree ID (1, 2, 3, … tr … TR = total number of trees in the plot)	Dimensionless	m	5-year	100%	
2.1.1.77	*XF*	Plot expansion factor from per plot values to per hectare values)	Dimensionless	c	5-year	100%	
2.1.1.78	$z_{\alpha/2}$	Value of the statistic z (normal probability density function), for α = 0.1 (implying a 90% confidence level)	Dimensionless	m	5-years	0%	
2.1.1.79	$\Delta C_{AB,ijt}$	Annual carbon stock change in above-ground biomass for stratum *i*, species *j*, time *t*;	t C yr^{-1}	c	5-year	100%	
2.1.1.80	$\Delta C_{AB,ikt}$	Annual carbon stock change in above-ground biomass for stratum *i*, stand model *k*, time *t*;	t C yr^{-1}	c	5-year	100%	
2.1.1.81	$\Delta C_{BB,ijt}$	Annual carbon stock change in below-ground biomass for stratum *i*, species *j*, time *t*;	t C yr^{-1}	c	5-year	100%	

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.82	$\Delta C_{BB,ikt}$	Annual carbon stock change in below-ground biomass for stratum *i*, stand model *k*, time *t*;	t C yr^{-1}	c	5-year	100%	
2.1.1.83	$\Delta C_{LB,ikt}$	Annual carbon stock change in living biomass for stratum *i*, stand model *k*, time *t*	t CO_2-e. yr^{-1}	c	5-year	100%	
2.1.1.84	$\Delta C_{P,LB}$	Sum of the changes in living biomass carbon stocks (above- and below-ground)	t CO_2-e	c	5-year	100%	
2.1.1.85	ΔMC_{ABikT}	Mean carbons stock change in above-ground biomass stratum *i*, stand model *k*, between two monitoring events	t C ha^{-1}	c	5-year	100%	
2.1.1.86	ΔMC_{ABikt}	Mean carbons stock change in above-ground biomass stratum *i*, stand model *k*, between two monitoring events	t C ha^{-1}	c	5-year	100%	
2.1.1.87	$\Delta MC_{BB,ikt}$	Mean carbons stock change in below-ground biomass stratum *i*, stand model *k*	t C ha^{-1}	c	5-year	100%	
2.1.1.88	ΔMC_{BBikT}	Mean carbons stock change in below-ground biomass stratum *i*, stand model *k*, between two monitoring events	t C ha^{-1}	c	5-year	100%	

ID number	Data Variable		Data unit	Measured (m) calculated (c) estimated (e) or default	Recording frequency	Proportion of data monitored	Comment
2.1.1.89	$\Delta PC_{AB,ijT}$	Plot level mean carbon stock change in above-ground biomass ins stratum *i*, species *j* between two monitoring events	t C ha^{-1}	c	5-year	100%	
2.1.1.90	$\Delta PC_{BB,ijT}$	Plot level mean carbon stock change in above-ground biomass in stratum *i*, species *j* between two monitoring events	t C ha^{-1}	c	5-year	100%	
2.1.1.91	ΔTC_{ABjt}	Carbon stock change in above-ground biomass per tree of species *j* in year *t*	kg C $tree^{-1}$	c	5-year	100%	
2.1.1.92	ΔTC_{ABjT}	Carbon stock change in above-ground biomass per tree of species *j* between two monitoring events	kg C $tree^{-1}$	c	5-year	100%	
2.1.1.93	ΔTC_{BBjt}	Carbon stock change in below-ground biomass per tree of species *j* in year *t*	kg C $tree^{-1}$	c	5-year	100%	
2.1.1.94	ΔTC_{BBjT}	Carbon stock change in below-ground biomass per tree of species *j* between two monitoring events	kg C $tree^{-1}$	c	5-year	100%	

Step 8: Calculate the annual carbon stock change by dividing the carbon changes between two monitoring events by the number of years between monitoring events.

$$\Delta MC_{ABikt} = \frac{\Delta MC_{ABikT}}{T} \tag{44}$$

$$\Delta MC_{BBikt} = \frac{\Delta MC_{BBikT}}{T} \tag{45}$$

where:

$\Delta MC_{AB,ikt}$	Annual mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, at year *t*; t C ha^{-1} yr^{-1}
$\Delta MC_{BB,ikt}$	Annual mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, at year *t*; t C ha^{-1} yr^{-1}
ΔMC_{ABikT}	Mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1} yr^{-1}
ΔMC_{BBikT}	Mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, between two monitoring events; t C ha^{-1} yr^{-1}
T	Number of years between two monitoring events which in this methodology is 5 years

Step 9*:* The annual carbon stock change in living biomass for each stratum *i*, species *j*, stand model *k*, at time *t* is calculated from the area of each stratum *i*, species *j*, stand model *k*, at time *t* and the annual mean carbon stock change in above-ground biomass and below-ground biomass per unit area, given by:

$$\Delta C_{AB,ikt} = A_{ikt} \cdot \Delta MC_{AB,ikt} \tag{46}$$

$$\Delta C_{BB,ikt} = A_{ikt} \cdot \Delta MC_{BB,ikt} \tag{47}$$

where:

A_{ikt}	Area of stratum *i*, stand model *k*, at time *t*; hectare (ha)
$\Delta C_{AB,ikt}$	Changes in carbon stock in above-ground biomass for stratum *i*, stand model *k*, at time *t*; t C yr^{-1}
$\Delta C_{BB,ikt}$	Changes in carbon stock in below-ground biomass for stratum *i*, stand model *k*, at time *t*; t C yr^{-1}
$\Delta MC_{AB,ikt}$	Annual mean carbon stock change in above-ground biomass for stratum *i*, stand model *k*, at year *t*; t C ha^{-1} yr^{-1}
$\Delta MC_{BB,ikt}$	Annual mean carbon stock change in below-ground biomass for stratum *i*, stand model *k*, at year *t*; t C ha^{-1} yr^{-1}

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

>> As per the methodology, the increase in GHG emission as a result of the implementation of the proposed A/R CDM project activity within the project boundary should be estimated by:

$$GHG_E = E_{BiomassBurn} \quad \textbf{(48)}$$

where:

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

$E_{BiomassBurn}$ Increase in GHG emission as a result of biomass burning within the project boundary; t CO_2-e

As per the methodology, $E_{BiomassBurn}$ should be assessed when slash and burn or removal of pre-existing vegetation occurs during site preparation before planting and/or replanting. According to project design biomass burning is not allowed during site preparation. Therefore there is no increase in GHG emission as a result of biomass burning following the implementation of the proposed A/R CDM project activity..Therefore the increase in GHG emission as a result of the implementation of the proposed A/R CDM project activity is zero.

E.5. Leakage:

>>

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

>>
As discussed in section D.2, leakage in this project is considered insignificant and hence will not need to be monitored.

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

>>
Not applicable

ID number	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or	Recording frequency	Number of data points	Comment

			default (d)			

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

>>Not applicable.

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

>>

Table 29. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored not included in section E.1.2.

Data (Indicate ID number)	**Uncertainty level of data (High/Medium/Low)**	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**
1.01 Plot location	low	Random plot verification using GPS to ensue the consistent measuring and monitoring of the carbon
1.02 Stratum ID	low	Random verification over the project area to ensure the stratum is correctly assigned
1.03 Tree species	low	Random verification over the project area to ensure the area of each tree species is correctly measured
1.04 Planting date	low	Random verification over the project area to ensure the area in terms of plantation age is correctly
1.05 Parcel area	High	Random plot verification using high precision instruments. Use procedure in section 1.2.2.
1.06 Number of trees	low	Random plot verification
1.07 Diameter at breast height(DBH)	medium	Random plot verification of measurement in trees.
1.08 Tree height	high	Verification of measurement in trees
1.09Merchantable volume	high	All equations used to calculate these values shall be verified. Use procedure presented in section 1.2.3
1.10 Wood density	low	Data that deviate significantly from IPCC default value shall be verified
1.11 Biomass expansion factor(BEF)	low	Data that deviate significantly from IPCC default value shall be verified
1.12 Carbon fraction	low	Data that deviate significantly from IPCC default value shall be verified
1.13 Rootshoot ratio	low	Data that deviate significantly from IPCC default value shall be verified

1.14 Average carbon stock of mature forest	medium	Random verification over the area affected by project activities to ensure the carbon stock is correctly and precisely estimated

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

>> ***National Forestry Financing Fund (FONAFIFO)*** will have overall responsibility for the project. It will be the leading agency with responsibility to deliver project implementation and monitoring for the whole crediting period. Local NGOs will provide technical and legal support to the farmers participating in the proposed A/R CDM project. Small and medium farmers participating in the project of the will sign a PSA contract with FONAFIFO transferring the carbon rights to this entity in order to participate in the project.

The operational and management structure for the monitoring of actual net GHG removals by sinks and any leakage generated by the proposed A/R CDM project activities includes the following elements:

A Project Implementation Unit (PIU) shall be formed within FONAFIFO. This unit shall be responsible for day to day activities of the project implementation and coordination of the project monitoring plan, including verification and reporting. The PIU shall ensure the implementation of the Monitoring Plan (EMP) and shall annually monitor the project progress and measure the impact of project activities against the baseline scenario. The PIU shall take on a systematic analysis of the project activities and the results of the monitoring activities shall be fed back into the implementation process. The PIU shall be responsible for the following activities:

a) Coordinate project implementation.
b) Request PSA annual payments to farmers after field verification of tree and forests growth in project parcels.
c) Verify the application of recommended techniques for development of the selected A/R activities.
d) Establish and maintain monitoring permanent plots in the farmer parcels.
e) Maintain and update project GIS system.
f) Maintain project files for future verification including data collection and storage in digital format.
g) Prepare annual reports of project implementation.
h) Estimate net anthropogenic GHG removals by sinks
i) Facilitate verification of project progress.
j) Assist local organizations to implement training programs for participating farmers.

FONAFIFO shall have a Project Coordinator that is responsible for coordinating the project implementation.

FONAFIFO shall also form a Project Steering Committee, which will be responsible for coordinating the activities in the field and with other local organizations. The Project Coordinator shall serve as the secretariat for the Committee. The tasks of the committee would include dissemination of information on

project implementation and best practices, and coordination between local organizations and FONAFIFO regarding project finances and supervision.

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

>>

Name	Jorge Mario Rodriguez Zuñiga/ Oscar Sanchez Chaves
Title:	Executive Director/Coordinator PSA program FONAFIFO
Direct FAX:	(506) 257-9695 or (506) 258-1614
Direct tel:	(506) 257-8475 or (506) 258-1614
Personal E-Mail:	jrodriguez@fonafifo.go.cr/Osanchez@fonafifo.go.cr

FONAFIFO is a project participant. Further contact details are listed in annex 1 of the PDD.

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

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

>> The analysis of the environmental impacts of the proposed project activities highlights the positive impacts of this project.

The expected environmental impacts of the project are:

Soil conservation:

- ♦ Conservation of topsoil and reduction of soil erosion.
- ♦ Improved soil conditions such as water infiltration.
- ♦ Increased soil organic matter accumulation.

Biodiversity:

- ♦ Increased forest cover (this contributes to the connectivity of forest patches.)
- ♦ Increased habitats for bird and small mammal.
- ♦ Increased flora diversity in the project areas through reforestation by natural regeneration and planting of native species.

Water resources:

- ♦ Increased water quality derived from higher water infiltration rates.
- ♦ Flow regulation derived from improved water infiltration.

In order to derive the positive environmental impacts of the project, suitable measures should be implemented as part of the project. The following measures are illustrative of the actions needed to enhance the positive impacts.

- ♦ Forest fires may occur. Proper fire protection measures such as firebreaks around the parcels of natural regeneration and forest plantations.

- Cattle may enter the project areas. Proper measures such as fences around the parcels are included in the plantation design.

Scoring the environmental impacts
The environmental impacts of the baseline and project scenarios are scored on a scale of -3 to 3 in order to compare the baseline and project scenarios regarding the environmental criteria. The comparative assessment of environmental impact scores of the baseline and project scenarios helps to implement the specific measures that can enhance positive impacts and minimize the negative impacts.

Baseline environmental impacts

The environmental impacts of the baseline scenario are summarized in Table 30. It shows that the baseline scenario has significant negative impacts on soil, and water. In the absence of the CDM project, negative impacts such as unsustainable land use are expected to continue and can result in more adverse impacts on soil and water resources.

Table 30. Environmental impacts of the baseline scenario

LAND USE CATEGORY	SOIL	WATER	CLIMATE	CO_2	FLORA	FAUNA	LANDSCAPE
Crops	-3	-3	0	+1	0	+1	+1
Pastures	-2	-2	0	+0	0	+1	+1
Total without CDM project	-5	-5	0	+1	0	+2	+2

Note: Likely impacts were evaluated on a scale of –3 to +3, where –3 refers to major negative impacts, and +3 refers to major positive impacts.

Project scenario environmental impacts.

Table 31 shows the short term and long term environmental impacts of the CDM project activities (short term: < 3 years, long term: project period). The impacts were estimated using expert judgment by Dr. Edgar Ortiz[63] by comparing the baseline with the benefits of environmental services of forest plantations. The assigned values and the scale are also based on expert judgment.

All project long term impacts are expected to be positive. The positive impacts of the project are particularly stronger under Forest Plantation and Natural Regeneration activities since they affect most of the ecosystem components such as soil, water, flora, and fauna.

Table 31: Short and long term environmental impacts of the CDM project.

ACTIVITY	SOILS		WATER		FLORA		FAUNA		LANDSCAPE	
	ST	LT	ST	LT	ST	LT	ST	LT	ST	LT
Soil preparation	+1	+3	0	0	0	0	0	0	0	0

[63] Dr. Ortiz is a director at the Technological Institute of Costa Rica (Instituto Tecnológico de Costa Rica (ITCR)) and has a doctorate (Ph.D.) in forest resource management.

Planting	+1	+2	0	+3	0	+3	0	+3	+2	+3
Maintenance	0	0	0	+1	0	+1	0	0	0	+2
Replanting	+1	+1	0	+1	0	+1	0	+2	0	+1
Harvesting	-1	-1	-1	-1	0	0	-1	-1	-1	-2
Wood hauling	0	-1	0	-1	0	0	-1	0	-1	-1
With Project	+2	+4	-1	+3	0	+5	-2	+3	0	+3

Note: Likely impacts are evaluated on a scale from –3 to +3, where –3 refers to major negative impacts, and +3 refers to major positive impacts. No road construction is planned. ST = short term (< 3 years), LT = long term (20 years).

The project is not expected to have negative impacts outside the project area. Rather reforestation activities are expected to have a positive impact on water and fauna. As described in section A.5.3, the non-native species used in this project have already been planted in many other regions of Costa Rica. There are no reports of negative impacts when the plantations are established on terrain with low slope and proper management (especially in the case of Teak). Also there aren't any reports of invasiveness for these two species in the country.

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

>> No significant negative impacts have been identified due to the environmental-friendly techniques adopted in the proposed A/R CDM project activities, e.g., site preparation is reduced to the tree hole, (which shall be done manually); proper choice of tree species and their spatial arrangement. An environmental impact assessment is not required by the Government of Costa Rica for the project activity as per Executive Decree 31849, which provides a list of activities that do require environmental impact assessment and excludes the project activity.[64]

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

>>

Although, no significant negative impacts have been identified an environmental monitoring plan and remedial measures for any risks will be implemented. Measures such as maintaining firebreaks around the project parcels, keeping the areas free of fire hazards and far from the main roads will be promoted to reduce the fire risk in the project areas. Also, parcels shall be fenced when necessary if there is a danger of damage from cattle.

[64] Executive Decree 31849-MINAE-SALUD-MOPT-MAG-MEIC: General Regulations on Procedures for Environmental Impact Assessment. 28 June 2004.) (Executive Decree 31849-MINAE-SALUD-MOPT-MAG-MEIC: Reglamento General sobre los procedimientos de Evaluación de Impacto Ambiental (EIA) *(General Regulation on Procedures for Environmental Impact Assessment),* 28 June 2004.)

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

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

>>

The project proposes reforestation through natural regeneration in degraded hillsides, agroforestry and forest plantations in the good sites. It is ideal to areas where maximization of social and environmental benefits is needed. Agroforestry allows farmers to improve their cash flow, and the management of their land to increase the provision of environmental services, such as water protection, control of soil erosion, and recovery of wildlife populations –especially small mammals and bird populations. This model does not compete with the present land uses of the farmers, because they can select a specific forestry activity according with the land use capacity of their farms. For example, reforestation by natural regeneration in the hillsides, agroforestry in the good croplands, and forestry plantations in the good sites with pastures. The project does not propose the establishment of large forest plantations, but a diverse landscape of areas in recovery by natural regeneration, blocks of plantation with native (50%) and non-native species, and trees mixed with crops. As a result, the project will improve land management in the CDM project area and promote sustainable rural livelihoods. Through this combination of activities, it will be possible to obtain a well-balanced mix of social, environmental benefits, and at the same time, the production of the carbon offsets required for the BioCarbonFund.

Expected CDM project impacts:

- Increase soil conservation and consequently improve productivity of lands.
- Ensure wood supply in order to contribute to maintain stable timber prices.
- Creation of employment opportunities to local people in land preparation, planting, weeding, tending, protection, thinning and harvesting. Planting, protection, thinning, and harvesting activities are the major sources of employment.

The following measures are expected to further enhance the project impacts and serve as mitigation measures to address implementation issues.

- Economic benefit to local communities in the short term without jeopardizing the positive environmental benefits. A good balance between economic and environmental benefits will have to be found in order to protect the project areas.

Legal issues.

- Provision of incentives and design of improved PSA contracts for benefit-sharing mechanisms.

Capacity and technical assistance.

- Harmonizing the afforestation activities with agricultural operations to generate continuous employment opportunities to rural communities.
- Developing integrated and participatory land-use planning in order to avoid land-use conflicts.

• Training local communities in forest management.

The net effect of project activities on local livelihoods is expected to be positive:

Net effect of project activities regarding employment.

- ♦ Increasing job opportunities in the project area through nursery and plantation jobs and collection of timber forest products. Reforestation and agroforestry activities will require labor that is normally supplied by the farmer and his or her family. The estimates of labor requirements for agroforestry activities depend on the system type. For example, for windbreaks, it is 30.8, 7.8, and 8.7 (day persons/year) for the first, second, and third year respectively, for planting trees in fences it is 28.9, 6.7, and 7.2 (day persons/year), and for tree mixed with crops it is 6.2, 1.5, and 0.5 (persons/year). Labor requirements for forest plantation are higher: 24.3, 15.3, 15.4, 11.0, 6.9, and 5.5 (day persons/year/ha) for the first, second, third, fourth, fifth and sixth year respectively. The estimation of labor force for reforestation by natural regeneration is estimated in 10 to 12 day persons per year/ha. Due to the size of the farmer lands, and the diversity of landowners that will participate in the project, the risk of immigration into the project area is low. Labor shortages may occur for reforestation through forest plantations. In other to mitigate labor shortages tree planting must be done from May to September, that is, when the "Zafra" (sugarcane harvest) and the coffee harvest have finished in the region.

Net effect of project activities regarding income:

- ♦ Increasing property owners' annual income.
- ♦ Reducing the need to work outside the farm.

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

>> Negative social impacts have not been reported. The project activities are integrated with the production activities of the farmers, which voluntarily will dedicate part of their farms to reforestation or agroforestry. In this way, the CDM project is developing an equilibrated carbon sequestration project that creates a diverse landscape, and at same time allows local farmers to maintain food security and their present incomes. In addition, downstream communities will benefit from the environmental benefits produced by upstream farmers when they adopt forest production activities, such as water protection (quality and flow regulation), flood mitigation, protection of air quality, scenic beauty, etc.

The likely economic impacts of the project implementation have been assessed through an economic study and the findings support the project's positive impacts. Due to the small size of project parcels, farmers will not be required to abandon their current activities. In addition, other studies[65] have confirmed the positive social impacts of the PSA program in Costa Rica.

[65] Impact of Program Payments for Environmental Services in Costa Rica as a means of reducing poverty in rural areas, Ortiz et all, 2003.

Socioeconomic Impact of a Financial Mechanism for Forest Plantations: The Case of Payment Program for Environmental Services in the Northern Zone of Costa Rica, Rojas V, 2005, Master Thesis, CATIE.

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

>> The impacts of PSA-program are measured by FONAFIFO, which contracts periodical technical and social evaluations. It is expected that these studies would continue, and that the socio-economic impacts of the proposed CDM project will be evaluated as part of these studies. The results of the evaluation are public, and if there were any communities negatively affected they will be able to provide inputs for the design of alternative measures to correct the implementation of the project. However, given the wide participation of farmers in the project, and that it will be implemented through the Payments for Environmental Services (PSA) program, we do not anticipate negative socio-economic impacts. These studies will be complemented by an annual survey applied by COOPEAGRI staff to property owners during one of their visits to COOPEAGRI's Forestry Department.

COOPEAGRI is responsible for the promotion of the project among their affiliates. COOPEAGRI staff has prepared both printed and audio-visual materials. COOPEAGRI has presented the project to the farmers in their communities, and its staff will provide training to the farmers and the community members.

COOPEAGRI is well-consolidated organization that includes in its operation rural committees to audit the operations of the organization. As part of their activities, they provide to their members training in several topics including both agriculture production activities, and communal organization. The project will rely on the COOPEAGRI`s social structure to audit the operation of the CDM project. Coordinators and delegates represent COOPEAGRI affiliates. They constitute the General Assembly and four committees: Administration, Surveillance, Education, and Family Development. In the 2002-2003 period this structure had 170 delegates, 120 coordinators, and 149 alternate delegates. In the year 2003, COOPEAGRI invested US$ 24,800 in education and information, these programs included: coordinator meetings, general assembly meetings, delegate meetings, field days, courses, posters, and publications.

SECTION H. Stakeholders' comments:

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

>> Stakeholder consultations were undertaken during project preparation in the form of meetings and a survey. Communities in the area were directly invited to the meetings by Coopeagri. The following consultations highlight the issues discussed in the consultation process.

- 3 August 2005 – preliminary project presentation to Mr. William Alpizar from the OCIC – MINAE (Costa Rican Office of Joint Implementation – Ministry of Environment and Energy) to inform them about FONAFIFO's initiative to submit a CDM project for carbon certification registration.

- 16th, 17th and 18th August 2005 – project presentation to potential participants (COOPEAGRI affiliates) in the project area.

Analysis of environmental and social benefits derived from using the Watershed Protection Mechanism of Payment for Environmental Services (PES) in Costa Rica. Tiffer, R. 2006

- 29 August 2005. CDM Project presentation to Mr. William Alpizar (OCIC – MINAE) to obtain feedback and government support to this initiative.

H.2. Summary of the comments received:

>> Three towns were visited by FONAFIFO and COOPEAGRI' staff during the month of August 2005.

- The first meeting was 16 August 2005 in a town called Quizarra (Valley sub-region) at 3:00 pm. Twenty-five property owners attended. Their questions were mostly related to clarifications of the rules to participate in the proposed CDM project. Some of them asked about other species to include in the proposed CDM such as Cypress, Pine and Poro. They also asked about the ownership of the produced wood in the project activities.

- The second meeting was 17 August 2005 in a town called Pueblo Nuevo (North Hillsides sub-region) at 3:00 pm. Forty property owners attended. Again most of the questions were related to the rules for participating in the CDM project, some of the questions were regarding the payments for the establishment and maintenance of the project activities and if they need to return any money at the end of the 20 years.

- The third meeting was 18 August 2005 in San Rafael de Platanares (South Hillsides sub-region) at 3:00 pm. Twenty-five property owners attended. Once more, many of the questions were related to the requirements for participating in the CDM project. Someone asked how many project areas he/she could have on their farm and how these areas will be measured. There was a discussion about the opportunity cost of the project activities versus cattle farming or crops. Some one mention that they could have 1 or 2 cows per hectare, and that they could lease their pastures for $4.12/month (₡2000 at ₡485/$) to $6.18/month per cow (₡3000 at ₡485/$), however the leases are not per year, only for six months. These data shows that the enhanced PSA program may compete with cattle in marginal areas. A socio-economic survey was distributed to all the property owners who attended the meetings to assist in the evaluation of the proposed CDM project and determine the initial socio-economic conditions of the potential participants.

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

>> Most of the recommendations (such as land eligibility, utilization of the new A/R CDM additionality tool) given by Mr. William Alpizar from the OCIC-MINAE were incorporated in to the documents.
The farmers' suggestions to use other tree species in the project activities was accepted under the condition that the species selected would be well known and not invasive.

Annex 1

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

Organization:	National Forestry Financing Fund (FONAFIFO)
Street/P.O.Box:	Avenida 7, Calles 5 y 3 / Apartado Postal 594-210
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State/Region:	
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URL:	www.fonafifo.go.cr
Represented by:	Jorge Mario Rodriguez Zuñiga
Title:	Executive Director
Salutation:	Mr.
Last Name:	Rodriguez Zuñiga
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Represented by:	Ms. Joelle Chassard
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Salutation:	Ms.
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Telephone:	613-992-2110
FAX:	613-944-0064
E-Mail:	
URL:	http://www.international.gc.ca/enviro/index.aspx?lang=en
Represented by:	Mr. Gary Pringle
Title:	
Salutation:	Mr.
Last Name:	Pringle
Middle Name:	
First Name:	Gary
Department:	Environment Department
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Direct FAX:	613-992-2110
Direct tel:	613-944-0064
Personal E-Mail:	Gary.Pringle@international.gc.ca

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

No funding is expected from the Official Development Assistance and the Parties to the Annex I of the Kyoto Protocol for undertaking the project.

Annex 3:
BASELINE INFORMATION

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Annex 4

MONITORING PLAN

The following Monitoring Plan includes the monitoring of the following elements:

1. Monitoring of the baseline net GHG removals for possible renewable crediting periods.
2. Monitoring of proposed A/R CDM project activities including project boundary, forest establishment, forest management activities, and payments to farmers.
3. Monitoring of actual net GHG removals by sinks including changes in carbon stock in above-ground biomass and below-ground biomass, increase in GHG emissions within the project boundary.

Leakage in this project is considered insignificant and hence will not need to be monitored.

In addition, the Monitoring Plan includes a Quality Assurance/Quality Control plan, including field measurements, data collection verification, data entry and archiving to ensure the integrity of the collected data.

All monitoring activities will be conducted by FONAFIFO, either by contracting out some of the activities or by using its own staff. Results of the monitoring will be inserted into database and stored in electronic and paper form.

1. Information on the baseline net GHG removals for purpose of renewing crediting periods.

The A/R CDM project includes two more renewable crediting periods, relevant data on the baseline will be used for the purposes of the renewal of the baseline at the end of first and second crediting periods.

2. Monitoring of proposed A/R CDM project activities including project boundary, forest establishment, and forest management activities.

The purpose of monitoring is to demonstrate that the proposed A/R CDM project activities are implemented according to the practices described in CDM-AR-PDD. Payments for environmental services (including carbon payments) to the farmers participating in the A/R CDM project shall be tied to verification of project implemented on the the farm parcels.

2.1 Monitoring of the boundary of the proposed CDM-AR project activities

This is meant to demonstrate that the actual area reforested conforms to the reforestation area outlined in the project’s design document (CDM-AR-PDD). The following sub-steps shall be followed:

2.1.1 Field surveys concerning the actual project boundary, within which the project activity has occurred, shall be done using compass, tape, and clinometer.

2.1.2 Measurement of geographical positions (latitude and longitude of each corner polygon sites) using GPS.

2.1.3 Input the survey data on farm parcels into the project GIS platform in order to calculate the eligible area of each farm parcel and area of stratum.

2.1.4 Checks of actual boundary to ensure consistency with the description in the CDM-AR-PDD using the project GIS platform.

2.1.6 Input the new measured geographical positions into the GIS system and calculate the eligible area of each stratum and stand.

The project boundary shall be monitored periodically through field visits or remote sensing as applicable. These monitoring activities could be tied to the field visits. If the project area changes during the crediting period, for instance, because of deforestation or fire etc., the specific location and area of the area shall be identified using GPS. Similarly, if the planting on certain lands within the project boundary fails these lands shall be documented.

2.2 Monitoring of forest establishment of the proposed CDM-AR project activities.

2.2.1 Monitoring Natural Regeneration

To ensure that induced natural regeneration activities are well-implemented and conform to the practice described in the CDM-AR-PDD, the following monitoring activities shall be conducted in the induced natural regeneration parcels.

- Confirm that cattle are keep out the farm parcels;
- Confirm that farm parcels are well fenced and properly signed in the field;
- Confirm that farm parcels are protected with proper fire breaks;
- Confirm that poaching and hunting are not allowed in the farm parcels.

2.2.2 Monitoring Forest Plantations and Agro-Forestry Systems.

To ensure that the tree planting quality conforms to the practice described in CDM-AR-PDD and is well-implemented, the following monitoring activities shall be conducted on each farm parcel in the first three years after planting:

- Confirm that site preparation is implemented based on practice documented in the CDM-AR-PDD;
- Monitor use of approved herbicides in site preparation and container disposal as described in the CDM-AR-PDD;
- Check that tree species and number of trees planted on each farm parcel are in line with the CDM-AR-PDD;
- Seedling survival checks are implemented:
- The initial survival rate of planted seedlings shall be counted three months after the planting, and re-planting shall be conducted if the survival rate is lower than 90 percent;
- Final checking after three years of planting;
- The survival checks shall be conducted using permanent sample plots;
- Check and confirm that the weeding practice is implemented as described in the CDM-AR-PDD, including the use of approved herbicides;
- Survey and check that species and planting for each stratum are in line with the CDM-AR-PDD;
- Document and justify any deviation from the planned forest establishment.

2.3 Monitoring of forest management of the proposed CDM-AR project activities.

2.3.1 Monitoring Natural Regeneration

Practices to be monitored include:

Farm parcels should be visited to check that forest is allowed to grow naturally from seeds of nearby forest patches or from seed banks. If after three years it is obvious that natural regeneration failed, then farmers shall undertake enrichment planting. Seedlings of local native pioneer species shall be produced by farmers and planted on the project parcels.

2.3.2 Monitoring Forest Plantations and Agro-Forestry Systems

Practices to be monitored include:

- Cleaning and site preparation measures: date, location, area, herbicide application (amount and type of herbicide), biomass removed.
- Planting: date, location, area, tree species (establishment of the stand models);
- Fertilization: date, location, area, tree species, amount and type of fertilizer applied;
- Thinning: date, location, area, tree species, number of trees removed, volume or biomass removed ;
- Harvesting: date, location, area, tree species, number of trees removed, volumes or biomass removed;
- Checking and confirming that harvested lands are re-planted, re-sown or coppiced as planned;
- Checking and ensuring that good conditions exist for natural regeneration if harvested lands are allowed to regenerate naturally;
- Monitoring of forest disturbances: date, location, area (GPS coordinates, remote sensing, as applicable, and project GIS), tree species, type of disturbance, number of trees lost, volumes or biomass lost, implemented corrective measures, change in the boundary of strata and stands,
- Forest protection:
  - Confirm that cattle are keep out the farm parcels;
  - Confirm that farm parcels are well fenced and properly signed in the field;
  - Confirm that farm parcels are protected with proper fire breaks;
  - Confirm that poaching and hunting are not allowed in the farm parcels.
  - Confirm use of approved pesticides and proper container discarding during forest protection activities.

3. Monitoring of actual net GHG removals by sinks.

3.1. Carbon stock changes in above- ground biomass and below-ground biomass.

3.1.1. <u>Stratification:</u> Details of the initial stratification of the project area are presented in section C4 of this document. However, post stratification will be conducted after the first monitoring event to address the possible changes of project boundary and planting year in

comparison to the project design. The post-stratification will address the change in carbon stocks if they are more or less variable than it is expected. Strata or substrata may be grouped into one stratum or substratum if they have similar carbon stock, carbon stock change and spatial variation. Otherwise, new strata may be defined.

3.1.2. Sampling frame:

3.1.2.1. Calculation of number of sample plots: the initial stratification led to 7 strata, and the number of sample plots for each stratum is estimated based on a 10% accuracy level.

The number of sample plots shall be recalculated after second or third monitoring event using actual data to determine a standard deviation for each stratum (st_i). Equations recommend in the methodology AR-AM004 shall be used for this recalculation. The allowable error can be estimated as ±10 % of the observed overall mean biomass carbon stock increment per hectare. It is possible to reasonably modify the strata limits and the sample size after each monitoring event based on the actual variation of the carbon stock changes determined from taking "*n*" sample plots.

3.1.2.2. Sample plots location shall be done systematically with a random start in each stratum using the project GIS platform and a GPS in the field. The geographical position (GPS coordinate), administrative location, stratum and stand, series number of each plot shall be recorded and archived in electronic and paper format.

Sampling plots must be as evenly distributed as possible. For example, if one stratum consists of three geographically separated sites, then it is proposed to

- Divide the total stratum area by the number of plots, resulting in the average area represented by each plot;
- Divide the area of each site by this average area per plot, and assign the integer part of the result to this site. e.g., if the division results in 6.3 plots, then 6 plots are assigned to this site and 0.3 plots are carried over to the next site, and so on.

Because delineation of plot and stand area is vital in the quantification of biomass and forests. The sample plot area has to be accurately determined to allow for the calculation of accurate mean values per hectare (volume/ha, dry matter/ha, etc.). In a similar way, an accurate stand area or forest allows for an accurate estimation of forest totals through statistical methods (Bark, Cris. 1999).

Since plot area is calculated from an orthogonal projection, in other words, area in a horizontal plane and not in a sloping plane, any length measurements must be equivalent to the horizontal distance and not the slope distance. In the case of short distances, horizontal distance shall be directly measured with a measurement tape held horizontally. In the case of long distances, horizontal distance shall be measured using a series of short horizontal steps, an approach

called step chaining (Bark, Cristopher. 1999).

Most lands in the project region have slopes >10%, therefore it is highly probable that step chaining will be needed to measure plot radius (in case of a circular plot) or plot length/width (in case of a rectangular plot). If step chaining is not feasible, horizontal distance shall be determined indirectly from the slope distance and the angle of the slope using the following formula[66]:

$$H_{Dist} = S_{Dist} * \cos \theta$$

Where:

H_{Dist} = true horizontal distance (m).
S_{Dist} = slope distance measured in the field along the slope (m).
θ = slope in degrees (which must be converted to radians).
cos = cosine of the angle.

Radians = Degrees * π/180º
π = 3.14159265

The area of circular plots shall be calculated by,

- $A_{cp} = \pi * r^2$

Where,
A_{cp} = area of circular plot (m^2)
r = true horizontal plot radius (m).

The area of rectangular plots shall be calculated by

- $A_{rp} = W_p * L_p$

Where,
A = area of a rectangular plot (m^2)
W_p = plot width[67] (m)
L_p = plot length[125] (m)

Sample plots will be permanently marked in the field with metal stakes to guide future monitoring efforts in delimiting plot boundaries.

3.1.3. Monitoring frequency:

[66] Brack, Cris. 1999. Plot and stand area. Department of Forestry. Australian National University. (http://www.birdlist.org/downloads/ecology/forest_m&m_brack.pdf)

[67] True horizontal distance measured directly using the step chaining approach or indirectly using the slope distance approach.

27. Ex-post estimation of changes in carbon stocks, and actual net greenhouse gas removals will be done using field data. The monitoring frequency for data collection is five years.

3.1.4. Monitoring and estimating carbon stock changes over time: the mean change in carbon stocks in above-ground biomass and below-ground biomass per unit area is estimated based on field measurements that correspond to the growth of individual trees in permanent plots. Therefore, DBH and height of individual trees in each plot shall be measured every 5 years at each monitoring event. A team of two or three people is recommended to measure the trees. Pre-existing (baseline) trees and non-tree vegetation should conservatively and consistently with the baseline methodology not be measured and accounted for over time. The carbon stock changes in living biomass on each plot are then estimated through Biomass Expansion Factors (BEF) method or allometric equations method as shown on section C.4.1.3.1. Each measured tree shall be tagged during the first monitoring event using either a loop of thin wire twisted around the trunk and a tag attached or a aluminium tag and a nail[68]

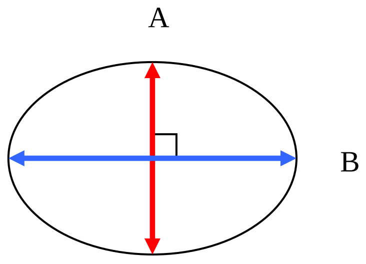
3.1.4.1. Tree diameter: each tree within a sampling plot (with exception of pre-existing trees) shall be measured at breast height (DBH = 1.3 m). If DBH is > 5 cm use a diameter tape, if DBH is < 5 cm use a caliper. If a diameter tape is not available a normal measuring tape can be used to measure the circumference of the tree and calculate the DBH (DBH = circumference / π). When taking diameter measurements with a tape loosen and re-tighten the tape a couple of times or slide it around the trunk to ensure the tape lies flat and it is not obstructed by any swollen parts of the trunk. If a caliper is used to measure trees with an obviously elliptical cross-section, the DBH should be the average of any two caliper measurements taken at right-angle (Figure 11) (AFGRCON. 2006)[69]. Regardless of the instrument used for measuring DBH, it should be ensured that the measurement is made perpendicular to the longitudinal axis of the tree trunk. The appropriate protocol for DBH measurement in a variety of situations is shown on Figure 12[70]. The point(s) of measurement shall be clearly marked with paint for future measurements.

[68] Aluminium tags and nails should only be used on trees with DBH > 3.0 cm to avoid permanent damage by nailing.

[69] Agriculture, Fisheries and Conservation Department (AFGRCON). 2006. Measurement of Diameter at Breast Height (DBH). Nature Conservation Practice Note. No. 2 (AF GR CON 21/2). 6 pp. (http://www.afcd.gov.hk/english/conservation/con_tech/files/common/NCPN_No.02_measurement_of_DBH_ver.2006.pdf).

[70] Nova Scotia Department of Natural Resources (NSDNR). 2004. Forest Inventory Permanent Sample Plot Field Measurement Methods and Specifications. Renewable Resources Branch, Forestry Division, Forest Inventory Section. Version 2004-1.2. 66 pp.

Figure 11. Proper Caliper measurement for a tree of elliptical cross-section. DBH = (A+B)/2, where A= 1st measurement taken at any direction (cm) and B = 2nd measurement taken at right angle to the 1st one (cm).



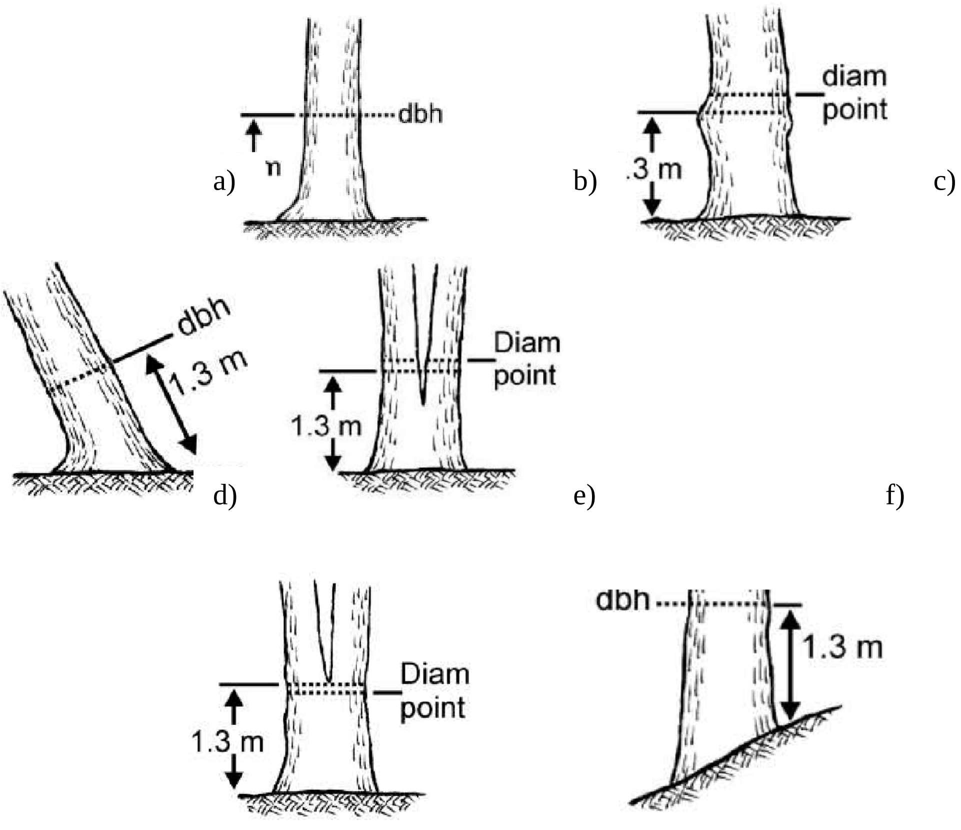


Figure 12. Proper DBH measurements in a variety of situations (NSDNR.2004): a) normal tree on level ground, b) tree with a deformity at 1.3 m breast height, c) DBH on leaned tree, d) tree with bifurcation at 1.3 m breast height, e) forked tree with twin stem below 1.3 m breast height, measure both stems, f) tree on slope.

3.1.4.2. Tree height: shall be measured for each tree within the sampling plot, with exception to pre-existing trees. Whenever possible, tree height shall be measured directly using a Height rod[71]. If a height rod is not available or it cannot be used, tree height shall be measured indirectly with a Suunto clinometer. If this is not available, other hypsometer instruments[72] such as Abney, Haga, Blume Leiss, etc. could be used. Field protocols described below for height rod and suunto clinometer were developed by Brack and Wood 1997[73].

3.1.4.2.1. Height rod: when using a height rod, it is recommended a team of three people, especially if the height of the trees is greater than 10 m. The first person is the recorder and observer, the second one is the rod person and the third one (if available) is the assistant. The recorder stands away from the tree but without losing contact with the rod person, and should have a clear view of the rods as they are raised up the tree and advice of any danger (i.e. falling dry braches or large fruits). He or she must be alert and active at all times. In addition to record data and make sure that parallax error is minimized, the recorder is responsible for following the progress of the rods up the tree from a propitious viewing position and informing the other team members when the tip of the rods begins to spread away. The rod person raises the rods up the tree keeping them safely against the stem and avoiding branches where possible. He or she should be gazing upwards most of the time. The assistant, if available, handles the rods to the hands of the rod person, thus the rod person can concentrate on feeding the rods up the tree. The assistant must stand close to the rod person in order to give or take back one by one the rods from the rod person.

- Prior to measuring the height of any tree, observe the branching pattern and other features such as dead branches or large fruits and select a position that will ease the measurement process. Do not select a position at which the rod person will be facing the sun.
- In case of leaning trees that have self corrected, raise the rods from a position directly underneath the point of correction.
- In case of leaning trees, not self corrected, try to lay the rods along the upper side of the trunk.
- The rod person should maintain the center of gravity of the rods between him/herand the tree to avoid the rods from falling out of the tree.

[71] A Height rod has less than 1% instrument error. Usually each rod is 1.5 m long. It is not recommended for trees with tree height greater than 20 m (Brack and Wood 1997).

[72] Hypsometers are devices used for indirectly measuring the height of a standing tree by triangulation. Most hypsometers have an instrument error of about 2.5 % when properly calibrated and used (Brack and Wood 1997).

[73] Brack L., Cristopher and Wood B., Geoffrey. 1997. Overview of Forest Mensuration. Department of Forestry. Australian National University. Canberra, Australia. (http://fennerschool-associated.anu.edu.au/mensuration/height.htm#vtu)

- Count the rods as they are raised up the tree. If upward movement of the rods is prevented by a branch or large fruit, shake the rods laterally and push upwards to direct the tip onto a new pathway. If pressure is felt when pushing up the rods, pause, take back one rod and find a new pathway. If rods begin to spread away on the side of the tree opposite to the rod person, retrieve several rods, move closer to the tree and re-direct the rods. On the other hand, if rods being to spread away behind the rod person, take back several rods, step back 30 to 100 cm from the tree base, hold the basal rods vertical and continue redirecting the rods. If the rods begin to spread away to the point that they start to fall out of the tree, try to direct them down, so that they will fall flat on the ground.
- The observer should find a position at right angles to plane of tree trunk and upper set of rods to avoid parallax error[74] as the rods approach the tree tip.
- The rod person should position the graduated rod against the base of the tree and write down the measurement when the rods have reached the tip of the tree.
- The rod person should count the number of rods as they are retrieved to make sure that no error was made and that rods are not left hanging in the tree.
- When retrieving the rods, the person should maintain his/her feet well apart and the rods right in front of him/her.
- Do not pull the rods suddenly downwards, take them back smoothly.
- Do not use this method if there are strong winds.

When using this method, hard hats, protective glasses and field boots should be worn. Height rods should be properly maintained for crew safety. Rods should be cleaned every day and periodically checked for straightness and smooth sliding of rods.

3.1.4.2.2. Suunto Clinometer: is one of the instruments that combined with trigonometric principles allows for the indirect estimation of height of a standing tree on flat or slope areas (Figure 13). For estimations of tree height on flat areas the following assumptions have to be made:

- The tree is in fact vertical
- The eye of the operator (D) is above the tree base level (C)
- The distance to the tree (DC) is the horizontal distance from the tree center and the operator

In order to estimate the height of the tree the operator stands at any distance (DC) from the tree that is convenient for the observation of both, the tip and base of the tree. The distance DC is measured with a

[74] Parallax error: an apparent change in the direction of an object caused by a change in observational position that provides a new line of sight (http://dictionary.reference.com/browse/parallax)

measuring tape and the angles between the horizontal plain and the tree top (ADC=θ) as well as the horizontal plain and the tree base (CDB=β) are measured with a suunto clinometer (Figure 23 a.). The total tree height (AB) is subsequently calculated by adding AC and CB,

$$H = DC * [TAN(\theta) + TAN(\beta)]$$

Where,

H = estimated tree height (m)
DC = horizontal distance from the operator to the center of the tree trunk (m)
Tan (θ) = tangent of the θ angle (radians)
Tan (β) = tangent of the β angle (radians)

In the case of sloping areas the operator's eye is not above the level of the tree base and it may be difficult to measure the horizontal distance from the operator to the tree center (DC) (Figure 23 b.). In this situation the horizontal distance must be calculated from the slope distance (DB), the angle BDC and the subtraction of BC length from AC length:

$$H = AC - BC$$
$$AC = DC * TAN(\theta+\beta)$$
$$BC = DC * TAN(\beta)$$
$$DC = DB * COS(\beta)$$
$$H = (DC * TAN(\theta+\beta)) – (DC * TAN(\beta))$$
$$H = DC (TAN(\theta+\beta) - TAN(\beta))$$
$$H = DB * COS(\beta) * [TAN(\theta+\beta) - TAN(\beta)]$$

Where,

H = estimated tree height (m)
AC = distance from A to C in (m)
BC = distance from B to C in (m)
DC = horizontal distance, operator to the tree center in (m)
DB = distance measured along the slope, operator to the tree center in (m)
TAN (θ+β) = tangent of the added angles θ and β (radians)
TAN (β) = tangent of the angle β (radians)
COS (β) = cosine of the angle β (radians)

Alternatively the horizontal distance (DC) can be measured using the step chaining method (see section 3.1.2.2 of the monitoring plan).

When measuring angles with Suunto clinometer follow the steps below:

1. Measure the horizontal distance from the tree base to a position where both the tree tip and base can be seen.
2. Look at the tip of the tree. Close one eye and simultaneously look through the Suunto at the scale and beside the Suunto at the tree. The operator should decide where the horizontal line on the Suunto scale crosses the tip of the tree.
3. Read from the percent scale and multiply this percentage by the horizontal distance measured in step 1.
4. Look at the base of the tree and repeat steps 2 and 3
5. Combine the height estimates from steps 3 and 4 to estimate the total tree height:
    a. Add the two heights if the operator looks up to the tip of the tree and down to the base of the tree.
    b. Subtract the height to the base of the tree from the height to the tip of the tree if the operator had to look up to both, the tip and the base of the trip.
6. Review all readings and calculations.

It is recommended that when making height measurements with this type of instruments two readings from independent positions should be taken. These readings should agree within the limits of the instrument error (approx. 2.5 %). This is an absolute verification on instrument and

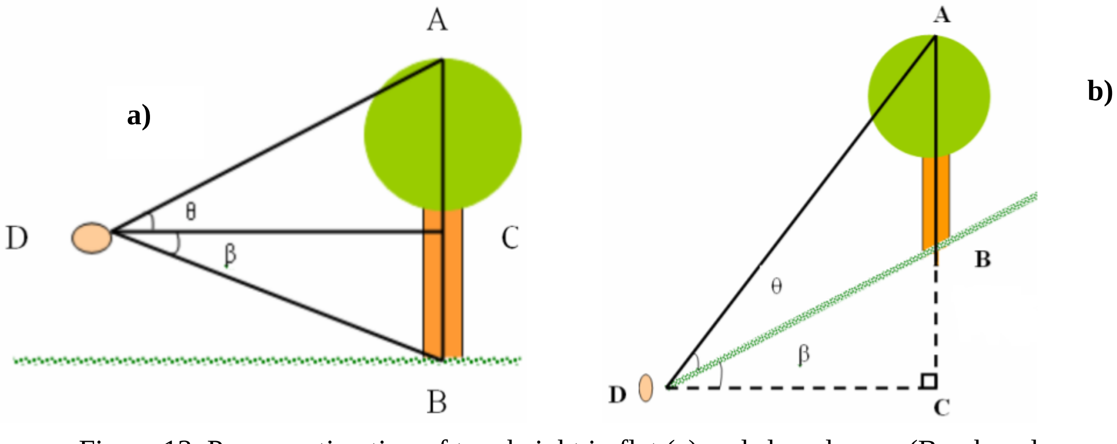


Figure 13. Proper estimation of tree height in flat (a) and sloped areas (Brack and Wood 1997).

3.2. <u>Increase in GHG emissions within the project boundary:</u>

The GHG emissions as a result of the project implementation are not anticipated as no biomass burning is practiced in the project area. Therefore, as per the methodology monitoring of project emissions is not required.

As per the decisions EB42 and EB44, emissions from fertilizer and fossil fuel use are not significant and need not be monitored. Therefore, these emissions will not be monitored in the project.

4. Monitoring of leakage attributable to A/R CDM project activities.

As discussed in section D.2, leakage in this project is considered insignificant and hence will not need to be monitored.

5. Quality Assurance/Quality Control

To ensure that the net anthropogenic GHG removals by sinks are measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure shall be implemented, including (1) collection of reliable field measurement; (2) verification of methods used to collect field data; (3) verification of data entry and analysis techniques; and (4) data maintenance and archiving. If after implementing the QA/QC plan it is found that the targeted precision level is not met, then additional field measurements need to be conducted until the targeted precision level is achieved.

5.1 Reliable field measurements

Persons involved in field measurement work should be fully trained in field data collection and data analyses. Standard Operating Procedures (SOPs) for each step of the field measurements shall be developed prior to the establishment of the project activities and adhered to at all times. These SOPs should detail all phases of field measurements and contain provisions for documentation needed for verification purposes, so that measurements are comparable over time and can be checked and repeated in a consistent fashion. To ensure the collection of reliable field data,

- Field-team members shall be fully aware of all procedures and the importance of collecting data as accurately as possible;
- Field teams shall install test plots if needed in the field and measure all pertinent components using the SOPs;
- Field measurements shall be checked by a qualified person to correct any errors in techniques;
- New staff should be adequately trained;
- A document that shows that these steps have been followed shall be presented as a part of the project documents. The document will list all names of the field team and the project leader will certify that the team is trained;

5.2 Verification of field data collection

To verify that plots have been installed and measurements have been taken correctly, 10-20% of plots shall be randomly selected and re-measured independently during each monitoring event. Key re-measurement elements include the location of plots, *DBH* and tree height. The re-measurement data shall be compared with the original measurement data. Any deviation between measurement and re-measurement below 5% will be considered tolerable, and any deviation above 5 % will be considered an error. Any errors found shall be corrected and recorded, as well as expressed as a percentage of all plots that have been rechecked to provide an estimate of measurement error.

5.3 Verification of data entry and analysis

Reliable estimation of carbon stock in pools requires proper data entry into the data analyses spreadsheets. To minimize the possible errors in this process, the entry of both field data shall be reviewed using expert judgment and, where necessary, comparison with independent data to ensure that the data are realistic. Communication between all personnel involved in measuring and analyzing data should be used to resolve any apparent anomalies before final analysis of the monitoring data is completed. If there are any problems with the monitoring plot data that cannot be resolved, the plot should not be used in the analysis.

5.4 Data maintenance and archiving

Because of the long-term nature of the CDM-AR project activity, data shall be archived and maintained safely. Data archiving shall take both electronic and paper forms, and copies of all data shall be provided to each project participant. All electronic data and reports shall also be copied on durable media such as CDs. Copies of the CDs shall be stored in multiple locations. The archives shall include:

- Copies of all original field measurement data and data analysis spreadsheets;

- Estimates of the carbon stock changes in living biomass, non-CO_2 GHG emissions, leakage and corresponding calculation spreadsheets;
- GIS products;
- Copies of measuring and monitoring reports.

Table 32. Quality control activities and procedures

QC activity	Procedures
Check that assumptions and criteria for the selection of activity data, emission factors and other estimation parameters are documented.	• Cross-check descriptions of activity data, emission factors and other estimation parameters with information on source and sink categories and ensure that these are properly recorded and archived.
Check for transcription errors in data input and reference.	• Confirm that bibliographical data references are properly cited in the internal documentation • Cross-check a sample of input data from each source category (either measurements or parameters used in calculations) for transcription errors.
Check that emissions and removals are calculated correctly.	• Reproduce a representative sample of emission or removal calculations. • Selectively mimic complex model calculations with abbreviated calculations to judge relative accuracy.
Check that parameter and units are correctly recorded and that appropriate conversion factors are used.	• Check that units are properly labeled in calculation sheets. • Check that units are correctly carried through from beginning to end of calculations. • Check that conversion factors are correct. • Check that temporal and spatial adjustment factors are used correctly.
Check the integrity of database files.	• Confirm that the appropriate data processing steps are correctly represented in the database. • Confirm that data relationships are correctly represented in the database. • Ensure that data fields are properly labeled and have the correct design specifications. • Ensure that adequate documentation of database and model structure and operation are archived..
Check for consistency in data between categories.	• Identify parameters (e.g., activity data, and constants) that are common to multiple categories of sources and sinks, and confirm that there is consistency in the values used for these parameters in the emissions calculations.
Check that the movement of inventory data among processing steps is correct	• Check that emission and removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries. • Check that emission and removal data are correctly transcribed between different intermediate products.

Check that uncertainties in emissions and removals are estimated or calculated correctly.	• Check that qualifications of individuals providing expert judgment for uncertainty estimates are appropriate. • Check that qualifications, assumptions and expert judgments are recorded. Check that calculated uncertainties are complete and calculated correctly.
Undertake review of internal documentation	• Check that there is detailed internal documentation to support the estimates and enable reproduction of the emission and removal and uncertainty estimates. • Check that inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review. • Check integrity of data archiving arrangements of outside organizations involved in inventory preparation.
Check time series consistency.	• Check for temporal consistency in time series input data for each category of sources and sinks. • Check for consistency in the algorithm/method used for calculations throughout the time series.
Undertake completeness checks.	• Confirm that estimates are reported for all categories of sources and sinks and for all years. • Check that known data gaps that may result in incomplete emissions estimates are documented and treated in a conservative way.
Compare estimates to previous estimates.	• For each category, current inventory estimates should be compared to previous estimates, if available. If there are significant changes or departures from expected trends, re-check estimates and explain the difference.

ANNEX 5
Areas Included in the Project Boundary and their GPS Coordinates

Table 5.1. List of discrete parcels of land under the control of the project participants at the start date of the proposed A/R CDM project activities.

Contract Number	Farmers´ Name	Area under AR CDM (ha)	Modality	Baseline Stratum ID	Project Activity Stratum
SJ-02-20-0148-2009	AGROINVERSIONES MONTE VERDE DEL SUR S.A.	7.484362329190	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-20-0341-2007	ALVAREZ AZOFEIFA ISIDRO	2.037806997270	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-20-0067-2007	AMADOR HIDALGO ISIDRO	5.847799126560	Forest Plantation	BLS2	Teak FP+SM2
SJ-02-23-0044-2009	AMADOR NARANJO MINOR	1.866199303530	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-231-0021-2009	ANAPIAN DEL SUSR S.A	2.221326926613	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-28-0094-2009	ANGULO ALVARADO LEDA	3.106400071620	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-28-0003-2007	ANGULO ARIAS JORGE ARTURO	16.985714457900	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-28-0033-2006	ANGULO SERRANO SANTIAGO	24.305062978700	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0052-2007	ARCE ESPINOZA SALVADOR	1.569635455430	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0058-2006	ARCE ESPINOZA SALVADOR	2.706537360980	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0040-2007	ARGUEDAS CORDERO JOSE LUIS	2.240445208660	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0049-2006	ARIAS GAMBOA EDITH DEYANIRA	2.047840660120	Forest Plantation	BLS1	Melina FP+SM1

SJ-02-23-0044-2007	ARIAS JIMENEZ MARIO ULISES	3.000716508760	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0069-2008	ARIAS SEGURA WILSON	1.263840163010	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0041-2008	ARIAS VARGAS EFREN	1.042611038090	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0179-2009	BADILLA FALLAS MILTON	0.431439948605	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0081-2006	BARBOZA MESEN JOSE	0.871463729951	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0051-2006	BARRANTES CALDERON OVIDIO	7.588043015440	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0092-2008	BLANCO CHINCHILLA FERNANDO	1.535356065210	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0164-2007	BORBON BORBON ADRIAN	2.570320445992	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0268-2009	BORBON URENA DULCE MARIA	0.897807492796	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-28-0138-2007	BRENES BARRANTES CEMAGGO S.A.	17.731203427100	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0312-2009	BUENAVENTURA VALVERDE CAMAHO	1.875115429880	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0228-2008	CALDERON FONSECA MIGUEL ANGEL	2.839835417746	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0229-2007	CALDERON SANDI GABRIEL	9.051109096930	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0035-2009	CAMPOS DULCE MARIA ASTUA Y PORTUGUEZ CARLOS LUIS	1.597078388690	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0174-2007	CAMPOS MENA BENIGNO	7.026534528910	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0139-2008	CAMPOS ROJAS EULOGIO	1.262180557250	Agroforestry	BLS2	Agroforestry+SM4

SJ-02-23-0075-2006	CARRANZA VARELA ELI ANGEL	1.080015993980	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0355-2007	CARVAJAL ARIAS ALEXIS	0.999574753981	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0033-2009	CARVAJAL ARIAS EVELIA	0.820572609773	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0046-2007	CARVAJAL ARIAS MIRTA LILLIAM	1.034516303570	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0047-2007	CARVAJAL ARIAS MIRTA LILLIAM	1.068174493090	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-28-0307-2009	CASTRO CHINCHILLA MARITZA	22.285345371800	Assisted Nat. Regene	BLS2	Assisted Nat. Regeneration
SJ-02-23-0092-2006	CERVANTES MOLINA HUGO	1.383447857770	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-20-0069-2007	CERVANTES VARGAS MARITZA	1.005956134110	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0070-2008	CESPEDES ARIAS JOSE	3.043095893570	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-231-0045-2009	CESPEDES GAMBOA OLDEMAR	2.341050316230	Agroforestry Coffe	BLS2	Agroforestry+SM4
SJ-02-23-0035-2007	CHAVARRIA MONTERO ALICIA	2.023768822624	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0170-2007	CHINCHILLA NARANJO YAMILETH	4.492343318420	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0321-2009	CORDERO CASTRO DIRIAN	1.099805820850	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0038-2008	CORDERO QUIROS NELSON	3.507482958560	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0065-2008	CORDERO QUIROS NELSON	1.906269604564	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-20-0064-2007	CORDERO SALAZAR GIOVANNY	1.658216695980	Forest Plantation	BLS2	Melina FP+SM1

SJ-02-20-0065-2007	CORDERO SALAZAR GIOVANNY	2.521449847848	Forest Plantation	BLS1	Melina FP+SM1
SJ-02-20-0066-2007	CORDERO SALAZAR GIOVANNY	1.644814407750	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-20-0072-2007	CORDERO SALAZAR ISLAND	3.228722522640	Forest Plantation	BLS1	Melina FP+SM1
SJ-02-20-0169-2006	CORDERO SANCHEZ ROSITA	7.879495267760	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0034-2009	CORPORACION EFESTOS S.A.	1.705318168820	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0308-2009	CORRALES CAMPOS RONALD	2.840219816410	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-20-0151-2009	CUBILLO DIAZ MINOR	10.517905037150	Forest Plantation	BLS1	Melina FP+SM1
SJ-02-23-0059-2007	DELGADO MORA NERY MANUEL	1.557685292080	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0053-2006	DELGADO NARANJO MINOR	1.556043939170	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0059-2008	DIAZ DE AURA S.A.	7.998211373070	Forest Plantation	BLS2	Eucalipto FP+SM2
SJ-02-23-0020-2007	DURAN FALLAS GERMAN	2.533490366370	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0309-2009	ELIA FALLAS BARRANTES	1.308865494470	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0042-2009	ELIZONDO ARIAS DIMAS	1.847525640670	Agroforestry Coffe	BLS2	Agroforestry+SM4
SJ-02-23-0175-2007	ELIZONDO CHAVEZ GREDIN	5.019538478740	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0229-2008	ELIZONDO CHAVEZ GREDIN	3.052523758940	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0168-2008	ELIZONDO VALVERDE ALBERTO	7.793948293500	Agroforestry	BLS2	Agroforestry+SM4

SJ-02-20-0004-2007	ESTRADA CAMPOS ALBERTO	1.746752357130	Forest Plantation	BLS2	Teak FP+SM2
SJ-02-20-0007-2007	ESTRADA CAMPOS ALBERTO	2.214337688460	Forest Plantation	BLS2	Teak FP+SM2
SJ-02-20-0082-2006	ESTRADA CAMPOS ALBERTO	4.064321678880	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-20-0085-2006	ESTRADA CAMPOS ALBERTO	4.259478168320	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-20-0086-2006	ESTRADA CAMPOS ALBERTO	5.135427833150	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0048-2009	ESTRADA CAMPOS PABLO	5.145310299370	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0325-2009	FALLAS BLANCO XINIA	1.688726887240	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0053-2009	FALLAS MORA BENJAMIN	1.435086134231	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0055-2007	FALLAS QUESADA ROBERTO	1.479410859840	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0058-2007	FALLAS VARGAS RODOLFO	1.228853560080	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0245-2008	FERNANDEZ FALLAS PEDRO	1.161660282580	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0249-2008	FERNANDEZ FALLAS PEDRO	1.247267919940	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0310-2009	FERNANDEZ Y ASOCIADOS S.A.	3.694534400921	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0194-2008	FINCA VISTA DEL VALLE VERDE S.A.	1.027186116690	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0201-2008	FLORES MONTERO BENIGNO	5.981426162398	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0182-2008	FONSECA NAVARRO ALFREDO	1.645716013641	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0136-2007	FONSECA SEGURA MIREYA	2.268018847990	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0168-2006	FONSECA VALVERDE FABIO	25.447108062600	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0042-2007	GONZALEZ GARCIA JOSEFA	1.058239100670	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0074-2007	GRANADOS DUARTE MIREYA	1.021116504400	Agroforestry	BLS2	Agroforestry+SM4

SJ-02-23-0268-2008	GRUPO GEMAZA GMZ S.A.	1.733899724715	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0028-2009	GUZMAN PORTUGUEZ LUIS HUMBERTO	0.822145690435	Agroforestry Coffe	BLS2	Agroforestry+SM4
SJ-02-23-0112-2006	HERNANDEZ CORDERO HENRY	2.387394762310	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0064-2006	HERNANDEZ UMANA JUAN ANTONIO	1.094560484620	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0358-2007	HIDALGO NAVARRO EVANGELISTA	2.222416488125	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0251-2009	INGENIERIA GONZALEZ S.A	2.767625795940	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0195-2008	INVERSIONES AGROPECUARIAS ARAYA NARANJO REM DEL SUR S.A.	8.605631448190	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0072-2008	INVERSIONES LEANZU DE PEREZ ZELEDON S.A.	2.555737368408	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0307-2008	INVERSIONES LEANZU DE PEREZ ZELEDON S.A.	2.623214761900	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0267-2009	INVERSIONES Y BIENES RAICES YURIDIA DE SAN PEDRO S.A.	4.586984777977	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0036-2007	JIMENEZ FERNANDEZ DULCELINA	2.643666773864	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0354-2007	JIMENEZ FERNANDEZ JOSE LUIS	1.503554764080	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0138-2008	JIMENEZ HERNANDEZ JULIO	1.232842998480	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0228-2007	JIMENEZ HERNANDEZ JULIO	1.029194294200	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0250-2008	JIMENEZ LEIVA BERNAN	3.068886115310	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0032-2006	JIMENEZ VILLALOBOS OMAR	97.031010308300	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-28-0087-2006	JIREH SALOM S.A.	10.705726771400	Assisted Nat. Regene	BLS2	Assisted Nat. Regeneration
SJ-02-28-0088-2006	JIREH SALOM S.A.	41.470706561400	Assisted Nat. Regene	BLS2	Assisted Nat. Regeneration

SJ-02-231-0043-2009	JOSE ALBINO BEJARANO ELIZONDO	0.892772028619	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0311-2009	JOSE MANUEL RODRIGUEZ HIDALGO	6.493582629478	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0181-2009	KATTIA CARRANZA RAMIREZ	5.129765271138	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0005-2007	LAMBERTI ROBERTO	18.095312005600	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0249-2009	LAMBO GENERAL S.A	1.805687618390	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0203-2008	LAS BRISAS DE LA MONTANA DE SAN AGUSTIN S.A.	3.965818781640	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0092-2009	LEIVA MARTINEZ ELADIO	1.316563260997	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0047-2009	MACYNRI A CH S.A	1.351876597160	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0314-2007	MARIN RAMIREZ MARIA ELENA	2.520442248040	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0146-2009	MARTINEZ MARIN CRISTOBAL	1.240153412090	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0169-2007	MENA GODINEZ JUAN CARLOS	8.387633211040	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0171-2008	MENA VARGAS MINOR	0.953730401893	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0266-2008	MENDEZ CASTRO WELDEL	1.042663805050	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0040-2009	MONGE QUIROS MARTIN	0.871011940119	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0114-2008	MORA BLANCO OLGER	1.262067155674	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0328-2007	MORA CAMACHO DORIS	1.553274751033	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-231-0051-2009	MORA FONSECA OSCAR	3.501741024204	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0222-2007	MORA MORA JORGE	1.010754901897	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0260-2007	MORA QUESADA CARLOS LUIS	1.447096791470	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0169-2008	MORALES DIAZ ALEJANDRO	3.151248685550	Forest Plantation	BLS2	Melina FP+SM1

SJ-02-23-0041-2007	MORALES HIDALGO JOSE ROBERTINO	1.736710603884	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0046-2009	NARANJO LOPEZ CARLOS	6.690054016067	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0351-2007	NARANJO LOPEZ CARLOS	2.319174809344	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0071-2007	NARANJO MORALES WILBER AURELIO	1.042083065150	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0052-2006	NARANJO URENA ORLANDO	1.762622735010	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0105-2006	NARANJO URENA ORLANDO	1.100735285950	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0205-2007	NARANJO URENA ORLANDO	1.045225385240	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0277-2009	NAVARRO BARRANTES DANILO	1.686387412920	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0049-2007	NAVARRO CASTRO REPARADO	1.507131811360	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0062-2008	NAVARRO CASTRO REPARADO	3.217545094084	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0260-2009	NAVARRO SANCHEZ CARLOS Y FAUSTINO NAVARRO JOBO	2.434317992136	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0068-2008	NAVARRO VARGAS DORA EMILIA	2.798503426720	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0263-2007	ORTEGA CAMACHO ARNOLDO	1.569049181230	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-20-0050-2006	PADILLA GAMBOA RODRIGO	1.411914974830	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0047-2008	PADILLA SABORIO WILBERTH	1.970948632590	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0174-2006	PAGUA S.A.	1.238471117810	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0309-2007	PENA MORALES LORELLY	1.576167782890	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0263-2009	PESETA DEL SUR SA.	9.636689627620	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0041-2009	PIEDADES GAMBOA JIMENEZ	8.047656186400	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0051-2007	PIEDRA ORTIZ ROY	1.512727625050	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0106-2006	PIEDRA UMANA MARIO ALBERTO	4.745722085720	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0149-2007	PORTUGUEZ ARIAS FRANCO	2.768891557350	Agroforestry	BLS2	Agroforestry+SM5

SJ-02-28-0029-2007	PORTUGUEZ ARIAS FRANCO	16.264750744000	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0053-2007	QUESADA DUARTE SIDNEY	2.550533753940	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-231-0253-2009	QUESADA MORA YADIRA	1.089144421420	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0258-2007	QUESADA VARGAS ARMANDO HUMBERTO	2.496802263362	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-20-0048-2006	QUIROS GARBANZO OVIDIO	1.494158659970	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0313-2007	QUOCUNQUE NOMINE S.A.	5.001306432960	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0039-2009	RAMIREZ ACUNA ISIDRO	0.888444532124	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0073-2007	RAMIREZ ACUNA ISIDRO	3.054083355600	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0140-2008	RAMIREZ ACUNA ISIDRO	1.031557014010	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0247-2007	RAMIREZ MORALES OLGER	1.301284886150	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0060-2007	RAMIREZ QUIROS MARIO	3.166643298729	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0101-2006	RAMIREZ RETANA REGINALDO	6.294988630110	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-20-0149-2009	RAMQ M Y Q S.A.	6.811602582520	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0064-2008	RETANA ELIZONDO LAURA EMILIA	3.203752910060	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0323-2009	RETANA SIBAJA GERARDO ISAIAS	2.992873772561	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0156-2008	RIGOBERTO ZUNIGA VARGAS	1.728615077650	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0038-2006	ROBLES SANTAMARIA ELIAN	61.209652518500	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0322-2009	RODOLFO QUESADA NAVARRO	2.003782133580	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0073-2006	RODRIGUEZ BADILLA ANGEL	1.783491567290	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0278-2009	RODRIGUEZ BLANCO RONALD Y OLDEMAR	1.862429798680	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0070-2006	ROJAS ARGUEDAS ELVIA	2.138095283590	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0043-2007	ROJAS GONZALEZ MARIBELL	3.022400566160	Agroforestry	BLS2	Agroforestry+SM4

SJ-02-23-0224-2007	ROJAS MENA LUIS EMILIO	2.732084510211	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0229-2009	ROMERO VALVERDE MARTA	1.604758081316	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0311-2007	SALAZAR ANCHIA JHONNY	3.575365620000	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0095-2008	SALAZAR FALLAS ALEXIS	13.894049443400	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0350-2007	SANCHEZ FONSECA VICTOR HUGO	1.677666637580	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0108-2008	SANCHEZ MORA LUIS ABILIO	1.575048133590	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0037-2007	SANCHEZ ROJAS EFRAIN	1.425562062840	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0155-2008	SEGURA MENA GILBERTO	2.928985664260	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0039-2007	SEGURA ROBLES GLORIA ELENA	1.269236714544	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0057-2007	SIBAJA DUARTE MICHAEL	1.564473276980	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0226-2007	SIBAJA DUARTE MICHAEL	1.259165749830	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0272-2008	SIBAJA DUARTE MICHAEL	2.251152731560	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0097-2008	SOLANO CASCANTE NELLY	1.510951023520	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0167-2007	SOLIS PADILLA GERARDO	1.070670262770	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0168-2007	SOLIS PADILLA GERARDO	1.076817695280	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0140-2007	TABASH MORA NEFTALI	1.701157756264	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0137-2007	TORRES MONGE DARIO	1.751010602310	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-28-0170-2006	TORRES ZUNIGA YORLENY	9.338260610900	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0342-2007	UNIPELOP S.A	2.529192185203	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0074-2006	URENA BARRANTES HILARIO	2.578405117590	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0265-2007	VALVERDE QUESADA GILBERT	1.238823670560	Agroforestry	BLS2	Agroforestry+SM5

SJ-02-23-0181-2008	VALVERDE ROMERO MARIA ISABEL	2.755364479807	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-28-0095-2009	VALVERDE ZAMORA DAMARIS	8.146115578700	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-231-0098-2009	VARGAS GARITA MANUEL	0.897157794868	Agroforestry Coffe	BLS2	Agroforestry+SM5
SJ-02-23-0022-2007	VARGAS MORA OSCAR	2.972841866840	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0036-2009	VARGAS MORA OSCAR	1.803950132290	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0096-2008	VARGAS PICADO ABEL ALBERTO	1.229841785240	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-20-0046-2006	VARGAS Y GARCIA S.A.	1.074165536780	Forest Plantation	BLS2	Melina FP+SM1
SJ-02-23-0116-2008	VARGAS Y GARCIA S.A.	1.490599972230	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0252-2007	VASQUEZ ARBUSTINI ELIECER	2.511869042250	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0057-2006	VASQUEZ ARBUSTINI JOSE LUIS	3.746361211000	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0221-2008	VEGA CASTRO VICTOR MANUEL	6.508458099192	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0077-2006	VENEGAS DIAZ JOSE ANGEL	7.160455408320	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0256-2008	VENEGAS ZUNIGA FERNANDO	1.009888742988	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0257-2008	VENEGAS ZUNIGA FERNANDO	1.139792064289	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-28-0035-2006	VILLAREVIA ELIZONDO JOSE JOAQUIN	10.685173049300	Assisted Nat. Regene	BLS1	Assisted Nat. Regeneration
SJ-02-23-0038-2009	VILLAREVIA URENA FAUSTINO	5.447584021310	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0052-2009	VILLAREVIA URENA FAUSTINO	1.980850455991	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0183-2009	ZAMORA PEREZ HILDA	1.580656046060	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0037-2009	ZUNIGA SANCHEZ LIZETH	2.575708735416	Agroforestry	BLS2	Agroforestry+SM4
SJ-02-23-0157-2008	ZUNIGA VARGAS RIGOBERTO	1.181809841660	Agroforestry	BLS2	Agroforestry+SM5
SJ-02-23-0170-2008	ZUNIGA VARGAS WILLIAN	1.968192963383	Agroforestry	BLS2	Agroforestry+SM4

Table 5.2. List of discrete parcels of land under the control of the project participants and location of the parcel centroids (WGS84 Latitude and Longitude).

Farmers´ Name	Contract Number	LONGITUD	LATITUDE
AGROINVERSIONES MONTE VERDE DEL SUR S.A.	SJ-02-20-0148-2009	-83.478510	9.290510
	SJ-02-20-0148-2009	-83.479390	9.288930
ALVAREZ AZOFEIFA ISIDRO	SJ-02-20-0341-2007	-83.565580	9.212060
AMADOR HIDALGO ISIDRO	SJ-02-20-0067-2007	-83.577400	9.240590
	SJ-02-20-0067-2007	-83.576130	9.241060
AMADOR NARANJO MINOR	SJ-02-23-0044-2009	-83.593070	9.227730
ANAPIAN DEL SUSR S.A	SJ-02-231-0021-2009	-83.753270	9.393010
	SJ-02-231-0021-2009	-83.753290	9.392040
	SJ-02-231-0021-2009	-83.753440	9.394340
	SJ-02-231-0021-2009	-83.753700	9.393810
	SJ-02-231-0021-2009	-83.753960	9.393340
ANGULO ALVARADO LEDA	SJ-02-28-0094-2009	-83.651540	9.525050
ANGULO ARIAS JORGE ARTURO	SJ-02-28-0003-2007	-83.632750	9.518080
ANGULO SERRANO SANTIAGO	SJ-02-28-0033-2006	-83.635670	9.512720
ARCE ESPINOZA SALVADOR	SJ-02-23-0052-2007	-83.531990	9.091760
ARCE ESPINOZA SALVADOR	SJ-02-23-0058-2006	-83.530530	9.091460
ARGUEDAS CORDERO JOSE LUIS	SJ-02-23-0040-2007	-83.654440	9.366160
ARIAS GAMBOA EDITH DEYANIRA	SJ-02-20-0049-2006	-83.706030	9.496840
ARIAS JIMENEZ MARIO ULISES	SJ-02-23-0044-2007	-83.525830	9.293290
	SJ-02-23-0044-2007	-83.523900	9.292310
ARIAS SEGURA WILSON	SJ-02-23-0069-2008	-83.541440	9.264060
ARIAS VARGAS EFREN	SJ-02-23-0041-2008	-83.605470	9.158560
BADILLA FALLAS MILTON	SJ-02-23-0179-2009	-83.561900	9.258360
BARBOZA MESEN JOSE	SJ-02-23-0081-2006	-83.576910	9.143560
BARRANTES CALDERON OVIDIO	SJ-02-23-0051-2006	-83.734950	9.455210
BLANCO CHINCHILLA FERNANDO	SJ-02-23-0092-2008	-83.653850	9.172200
BORBON BORBON ADRIAN	SJ-02-23-0164-2007	-83.652360	9.496880
	SJ-02-23-0164-2007	-83.653700	9.493770
BORBON URENA DULCE MARIA	SJ-02-23-0268-2009	-83.481700	9.284580
	SJ-02-23-0268-2009	-83.481460	9.284900
BRENES BARRANTES CEMAGGO S.A.	SJ-02-28-0138-2007	-83.650100	9.468560
BUENAVENTURA VALVERDE CAMAHO	SJ-02-23-0312-2009	-83.707340	9.500120
CALDERON FONSECA MIGUEL ANGEL	SJ-02-23-0228-2008	-83.659440	9.440660
	SJ-02-23-0228-2008	-83.659600	9.439450
	SJ-02-23-0228-2008	-83.660220	9.440180
CALDERON SANDI GABRIEL	SJ-02-23-0229-2007	-83.514220	9.294590
CAMPOS DULCE MARIA ASTUA Y PORTUGUEZ CARLOS LUIS	SJ-02-23-0035-2009	-83.538550	9.143190
CAMPOS MENA BENIGNO	SJ-02-23-0174-2007	-83.586370	9.209610
CAMPOS ROJAS EULOGIO	SJ-02-23-0139-2008	-83.630340	9.231700
CARRANZA VARELA ELI ANGEL	SJ-02-23-0075-2006	-83.635050	9.166620

CARVAJAL ARIAS ALEXIS	SJ-02-20-0355-2007	-83.594280	9.162550
CARVAJAL ARIAS EVELIA	SJ-02-23-0033-2009	-83.609090	9.171860
CARVAJAL ARIAS MIRTA LILLIAM	SJ-02-23-0046-2007	-83.620860	9.166870
CARVAJAL ARIAS MIRTA LILLIAM	SJ-02-23-0047-2007	-83.621790	9.166360
CASTRO CHINCHILLA MARITZA	SJ-02-28-0307-2009	-83.516830	9.128100
CERVANTES MOLINA HUGO	SJ-02-23-0092-2006	-83.705510	9.317350
CERVANTES VARGAS MARITZA	SJ-02-20-0069-2007	-83.705190	9.316790
CESPEDES ARIAS JOSE	SJ-02-23-0070-2008	-83.545460	9.300490
CESPEDES GAMBOA OLDEMAR	SJ-02-231-0045-2009	-83.510710	9.301740
CHAVARRIA MONTERO ALICIA	SJ-02-23-0035-2007	-83.583590	9.257310
	SJ-02-23-0035-2007	-83.582320	9.256640
CHINCHILLA NARANJO YAMILETH	SJ-02-23-0170-2007	-83.543600	9.189950
CORDERO CASTRO DIRIAN	SJ-02-23-0321-2009	-83.652560	9.418450
CORDERO QUIROS NELSON	SJ-02-23-0038-2008	-83.768800	9.390120
	SJ-02-23-0038-2008	-83.768320	9.390090
CORDERO QUIROS NELSON	SJ-02-23-0065-2008	-83.768490	9.388040
	SJ-02-23-0065-2008	-83.768000	9.388020
CORDERO SALAZAR GIOVANNY	SJ-02-20-0064-2007	-83.646980	9.308130
CORDERO SALAZAR GIOVANNY	SJ-02-20-0065-2007	-83.530250	9.304150
	SJ-02-20-0065-2007	-83.530690	9.304910
	SJ-02-20-0065-2007	-83.529970	9.306530
CORDERO SALAZAR GIOVANNY	SJ-02-20-0066-2007	-83.646200	9.307980
CORDERO SALAZAR ISLAND	SJ-02-20-0072-2007	-83.535470	9.314160
CORDERO SANCHEZ ROSITA	SJ-02-20-0169-2006	-83.741800	9.383350
CORPORACION EFESTOS S.A.	SJ-02-23-0034-2009	-83.670000	9.428920
CORRALES CAMPOS RONALD	SJ-02-231-0308-2009	-83.520410	9.303550
CUBILLO DIAZ MINOR	SJ-02-20-0151-2009	-83.711700	9.474210
	SJ-02-20-0151-2009	-83.712110	9.476490
DELGADO MORA NERY MANUEL	SJ-02-23-0059-2007	-83.587500	9.329590
DELGADO NARANJO MINOR	SJ-02-23-0053-2006	-83.604910	9.241810
DIAZ DE AURA S.A.	SJ-02-20-0059-2008	-83.773070	9.355140
DURAN FALLAS GERMAN	SJ-02-23-0020-2007	-83.602280	9.162480
	SJ-02-23-0020-2007	-83.602810	9.161970
ELIA FALLAS BARRANTES	SJ-02-23-0309-2009	-83.706560	9.442010
ELIZONDO ARIAS DIMAS	SJ-02-231-0042-2009	-83.616200	9.161250
ELIZONDO CHAVEZ GREDIN	SJ-02-23-0175-2007	-83.543300	9.096570
	SJ-02-23-0175-2007	-83.543820	9.097320
	SJ-02-23-0175-2007	-83.542450	9.097990
ELIZONDO CHAVEZ GREDIN	SJ-02-23-0229-2008	-83.541880	9.096600
	SJ-02-23-0229-2008	-83.543500	9.097760
ELIZONDO VALVERDE ALBERTO	SJ-02-23-0168-2008	-83.541470	9.136310
	SJ-02-23-0168-2008	-83.541150	9.135370
	SJ-02-23-0168-2008	-83.541400	9.137010
ESTRADA CAMPOS ALBERTO	SJ-02-20-0004-2007	-83.545960	9.280980
ESTRADA CAMPOS ALBERTO	SJ-02-20-0007-2007	-83.545360	9.280690
ESTRADA CAMPOS ALBERTO	SJ-02-20-0082-2006	-83.551190	9.299550

ESTRADA CAMPOS ALBERTO	SJ-02-20-0085-2006	-83.549140	9.298590
ESTRADA CAMPOS ALBERTO	SJ-02-20-0086-2006	-83.548480	9.301290
ESTRADA CAMPOS PABLO	SJ-02-23-0048-2009	-83.561740	9.238290
FALLAS BLANCO XINIA	SJ-02-231-0325-2009	-83.638030	9.181870
FALLAS MORA BENJAMIN	SJ-02-23-0053-2009	-83.686630	9.251390
	SJ-02-23-0053-2009	-83.686050	9.250580
FALLAS QUESADA ROBERTO	SJ-02-23-0055-2007	-83.620360	9.171720
FALLAS VARGAS RODOLFO	SJ-02-23-0058-2007	-83.602980	9.155030
FERNANDEZ FALLAS PEDRO	SJ-02-23-0245-2008	-83.612880	9.248820
FERNANDEZ FALLAS PEDRO	SJ-02-23-0249-2008	-83.612770	9.247230
FERNANDEZ Y ASOCIADOS S.A.	SJ-02-23-0310-2009	-83.535600	9.123850
	SJ-02-23-0310-2009	-83.535150	9.121980
	SJ-02-23-0310-2009	-83.535070	9.123120
FINCA VISTA DEL VALLE VERDE S.A.	SJ-02-23-0194-2008	-83.732590	9.315650
FLORES MONTERO BENIGNO	SJ-02-23-0201-2008	-83.746130	9.376850
	SJ-02-23-0201-2008	-83.745210	9.377220
	SJ-02-23-0201-2008	-83.746470	9.377380
FONSECA NAVARRO ALFREDO	SJ-02-23-0182-2008	-83.660000	9.450000
	SJ-02-23-0182-2008	-83.660270	9.448070
FONSECA SEGURA MIREYA	SJ-02-23-0136-2007	-83.509040	9.347470
FONSECA VALVERDE FABIO	SJ-02-28-0168-2006	-83.646980	9.486530
GONZALEZ GARCIA JOSEFA	SJ-02-23-0042-2007	-83.602470	9.319240
GRANADOS DUARTE MIREYA	SJ-02-23-0074-2007	-83.491110	9.297530
GRUPO GEMAZA GMZ S.A.	SJ-02-23-0268-2008	-83.619060	9.272550
	SJ-02-23-0268-2008	-83.620040	9.271730
GUZMAN PORTUGUEZ LUIS HUMBERTO	SJ-02-231-0028-2009	-83.611660	9.361620
HERNANDEZ CORDERO HENRY	SJ-02-23-0112-2006	-83.602910	9.242410
HERNANDEZ UMANA JUAN ANTONIO	SJ-02-23-0064-2006	-83.545470	9.099470
HIDALGO NAVARRO EVANGELISTA	SJ-02-20-0358-2007	-83.745300	9.352880
	SJ-02-20-0358-2007	-83.745000	9.354000
INGENIERIA GONZALEZ S.A	SJ-02-23-0251-2009	-83.557750	9.253700
INVERSIONES AGROPECUARIAS ARAYA NARANJO REM DEL SUR S.A.	SJ-02-20-0195-2008	-83.533100	9.180090
INVERSIONES LEANZU DE PEREZ ZELEDON S.A.	SJ-02-23-0072-2008	-83.550700	9.315880
	SJ-02-23-0072-2008	-83.550570	9.317400
	SJ-02-23-0072-2008	-83.550590	9.316370
	SJ-02-23-0072-2008	-83.550440	9.315260
CASTRO CHINCHILLA MARITZA	SJ-02-23-0307-2008	-83.549110	9.314260
INVERSIONES Y BIENES RAICES YURIDIA DE SAN PEDRO S.A.	SJ-02-23-0267-2009	-83.516000	9.322000
	SJ-02-23-0267-2009	-83.513340	9.321170
	SJ-02-23-0267-2009	-83.514680	9.323160
JIMENEZ FERNANDEZ DULCELINA	SJ-02-23-0036-2007	-83.721740	9.425100
	SJ-02-23-0036-2007	-83.722400	9.425420
JIMENEZ FERNANDEZ JOSE LUIS	SJ-02-20-0354-2007	-83.516400	9.242610
JIMENEZ HERNANDEZ JULIO	SJ-02-23-0138-2008	-83.636380	9.177360

JIMENEZ HERNANDEZ JULIO	SJ-02-23-0228-2007	-83.639330	9.180590
JIMENEZ LEIVA BERNAN	SJ-02-23-0250-2008	-83.535700	9.320760
	SJ-02-23-0250-2008	-83.535820	9.321440
JIMENEZ VILLALOBOS OMAR	SJ-02-28-0032-2006	-83.621090	9.527320
JIREH SALOM S.A.	SJ-02-28-0087-2006	-83.787060	9.371170
JIREH SALOM S.A.	SJ-02-28-0088-2006	-83.779000	9.374410
JOSE ALBINO BEJARANO ELIZONDO	SJ-02-231-0043-2009	-83.610710	9.161030
JOSE MANUEL RODRIGUEZ HIDALGO	SJ-02-23-0311-2009	-83.592510	9.328830
	SJ-02-23-0311-2009	-83.593650	9.329640
	SJ-02-23-0311-2009	-83.594680	9.330400
	SJ-02-23-0311-2009	-83.593040	9.328440
	SJ-02-23-0311-2009	-83.594140	9.329190
	SJ-02-23-0311-2009	-83.595290	9.329790
KATTIA CARRANZA RAMIREZ	SJ-02-23-0181-2009	-83.651320	9.174220
	SJ-02-23-0181-2009	-83.651640	9.173560
	SJ-02-23-0181-2009	-83.652000	9.173110
	SJ-02-23-0181-2009	-83.652330	9.172730
LAMBERTI ROBERTO	SJ-02-28-0005-2007	-83.578210	9.463310
LAMBO GENERAL S.A	SJ-02-23-0249-2009	-83.638490	9.346430
LAS BRISAS DE LA MONTANA DE SAN AGUSTIN S.A.	SJ-02-23-0203-2008	-83.685400	9.261800
	SJ-02-23-0203-2008	-83.685770	9.263110
LEIVA MARTINEZ ELADIO	SJ-02-23-0092-2009	-83.660990	9.221110
	SJ-02-23-0092-2009	-83.661360	9.220750
MACYNRI A CH S.A	SJ-02-23-0047-2009	-83.628190	9.320880
MARIN RAMIREZ MARIA ELENA	SJ-02-23-0314-2007	-83.535320	9.135850
MARTINEZ MARIN CRISTOBAL	SJ-02-231-0146-2009	-83.626010	9.439210
MENA GODINEZ JUAN CARLOS	SJ-02-23-0169-2007	-83.577410	9.347040
MENA VARGAS MINOR	SJ-02-23-0171-2008	-83.804670	9.403560
MENDEZ CASTRO WELDEL	SJ-02-23-0266-2008	-83.636080	9.427370
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MONGE QUIROS MARTIN	SJ-02-23-0040-2009	-83.707990	9.281180
MORA BLANCO OLGER	SJ-02-23-0114-2008	-83.635160	9.444970
	SJ-02-23-0114-2008	-83.634710	9.445530
MORA CAMACHO DORIS	SJ-02-23-0328-2007	-83.623480	9.238790
	SJ-02-23-0328-2007	-83.624030	9.238870
MORA FONSECA OSCAR	SJ-02-231-0051-2009	-83.480000	9.300000
	SJ-02-231-0051-2009	-83.480670	9.300730
	SJ-02-231-0051-2009	-83.480170	9.300560
	SJ-02-231-0051-2009	-83.481260	9.300050
MORA MORA JORGE	SJ-02-23-0222-2007	-83.669100	9.206900
	SJ-02-23-0222-2007	-83.668720	9.206700
MORA QUESADA CARLOS LUIS	SJ-02-23-0260-2007	-83.658970	9.177210
MORALES DIAZ ALEJANDRO	SJ-02-20-0169-2008	-83.671810	9.236300
MORALES HIDALGO JOSE ROBERTINO	SJ-02-23-0041-2007	-83.537690	9.134790
	SJ-02-23-0041-2007	-83.539710	9.136170
NARANJO LOPEZ CARLOS	SJ-02-23-0046-2009	-83.600700	9.238150

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	SJ-02-23-0046-2009	-83.600160	9.237810
	SJ-02-23-0046-2009	-83.603000	9.239000
NARANJO LOPEZ CARLOS	SJ-02-23-0351-2007	-83.604000	9.240000
	SJ-02-23-0351-2007	-83.600000	9.380000
	SJ-02-23-0351-2007	-83.602810	9.239340
NARANJO MORALES WILBER AURELIO	SJ-02-23-0071-2007	-83.535820	9.206130
NARANJO URENA ORLANDO	SJ-02-23-0052-2006	-83.524600	9.185770
NARANJO URENA ORLANDO	SJ-02-23-0105-2006	-83.523470	9.185940
NARANJO URENA ORLANDO	SJ-02-23-0205-2007	-83.518900	9.185090
NAVARRO BARRANTES DANILO	SJ-02-23-0277-2009	-83.745090	9.306580
NAVARRO CASTRO REPARADO	SJ-02-23-0049-2007	-83.704230	9.326380
NAVARRO CASTRO REPARADO	SJ-02-23-0062-2008	-83.704330	9.325590
	SJ-02-23-0062-2008	-83.704800	9.324970
NAVARRO SANCHEZ CARLOS Y FAUSTINO NAVARRO JOBO	SJ-02-23-0260-2009	-83.610730	9.229890
	SJ-02-23-0260-2009	-83.610850	9.229160
NAVARRO VARGAS DORA EMILIA	SJ-02-23-0068-2008	-83.590470	9.302800
	SJ-02-23-0068-2008	-83.589890	9.302340
ORTEGA CAMACHO ARNOLDO	SJ-02-23-0263-2007	-83.611370	9.217240
PADILLA GAMBOA RODRIGO	SJ-02-20-0050-2006	-83.703810	9.333470
PADILLA SABORIO WILBERTH	SJ-02-23-0047-2008	-83.635570	9.424470
PAGUA S.A.	SJ-02-23-0174-2006	-83.584040	9.139680
PENA MORALES LORELLY	SJ-02-23-0309-2007	-83.609600	9.146130
	SJ-02-23-0309-2007	-83.610430	9.146840
PESETA DEL SUR SA.	SJ-02-20-0263-2009	-83.685150	9.274000
	SJ-02-20-0263-2009	-83.683010	9.272640
	SJ-02-20-0263-2009	-83.684260	9.271240
PIEDADES GAMBOA JIMENEZ	SJ-02-23-0041-2009	-83.517590	9.298710
	SJ-02-23-0041-2009	-83.516820	9.299710
	SJ-02-23-0041-2009	-83.516750	9.301040
PIEDRA ORTIZ ROY	SJ-02-23-0051-2007	-83.800750	9.432070
PIEDRA UMANA MARIO ALBERTO	SJ-02-23-0106-2006	-83.509100	9.280400
PORTUGUEZ ARIAS FRANCO	SJ-02-23-0149-2007	-83.633550	9.495410
PORTUGUEZ ARIAS FRANCO	SJ-02-28-0029-2007	-83.628410	9.500030
QUESADA DUARTE SIDNEY	SJ-02-23-0053-2007	-83.670080	9.232110
QUESADA MORA YADIRA	SJ-02-231-0253-2009	-83.627440	9.162550
QUESADA VARGAS ARMANDO HUMBERTO	SJ-02-23-0258-2007	-83.608730	9.161090
	SJ-02-23-0258-2007	-83.608450	9.161760
QUIROS GARBANZO OVIDIO	SJ-02-20-0048-2006	-83.602930	9.164720
QUOCUNQUE NOMINE S.A.	SJ-02-23-0313-2007	-83.676440	9.410180
RAMIREZ ACUNA ISIDRO	SJ-02-23-0039-2009	-83.610920	9.246740
RAMIREZ ACUNA ISIDRO	SJ-02-23-0073-2007	-83.609470	9.249400
	SJ-02-23-0073-2007	-83.607710	9.250040
RAMIREZ ACUNA ISIDRO	SJ-02-23-0140-2008	-83.605800	9.244040

RAMIREZ MORALES OLGER	SJ-02-23-0247-2007	-83.617960	9.483190
RAMIREZ QUIROS MARIO	SJ-02-23-0060-2007	-83.549370	9.148200
	SJ-02-23-0060-2007	-83.547200	9.147710
RAMIREZ RETANA REGINALDO	SJ-02-23-0101-2006	-83.501360	9.286910
RAMQ M Y Q S.A.	SJ-02-20-0149-2009	-83.571200	9.204500
	SJ-02-20-0149-2009	-83.569480	9.203390
RETANA ELIZONDO LAURA EMILIA	SJ-02-23-0064-2008	-83.691740	9.491060
	SJ-02-23-0064-2008	-83.692300	9.489980
RETANA SIBAJA GERARDO ISAIAS	SJ-02-23-0323-2009	-83.737800	9.389940
	SJ-02-23-0323-2009	-83.736220	9.391410
	SJ-02-23-0323-2009	-83.735700	9.391310
	SJ-02-23-0323-2009	-83.734720	9.391800
RIGOBERTO ZUNIGA VARGAS	SJ-02-23-0156-2008	-83.560550	9.130530
ROBLES SANTAMARIA ELIAN	SJ-02-28-0038-2006	-83.600290	9.510950
RODOLFO QUESADA NAVARRO	SJ-02-23-0322-2009	-83.639260	9.158990
RODRIGUEZ BADILLA ANGEL	SJ-02-23-0073-2006	-83.604610	9.165360
RODRIGUEZ BLANCO RONALD Y OLDEMAR	SJ-02-23-0278-2009	-83.490860	9.146630
ROJAS ARGUEDAS ELVIA	SJ-02-23-0070-2006	-83.506390	9.147950
ROJAS GONZALEZ MARIBELL	SJ-02-23-0043-2007	-83.613900	9.207280
ROJAS MENA LUIS EMILIO	SJ-02-23-0224-2007	-83.787830	9.398890
	SJ-02-23-0224-2007	-83.787910	9.398320
	SJ-02-23-0224-2007	-83.786740	9.398440
ROMERO VALVERDE MARTA	SJ-02-23-0229-2009	-83.640240	9.395600
	SJ-02-23-0229-2009	-83.640220	9.397150
SALAZAR ANCHIA JHONNY	SJ-02-23-0311-2007	-83.609880	9.175270
SALAZAR FALLAS ALEXIS	SJ-02-28-0095-2008	-83.693470	9.523790
SANCHEZ FONSECA VICTOR HUGO	SJ-02-23-0350-2007	-83.684730	9.230730
SANCHEZ MORA LUIS ABILIO	SJ-02-23-0108-2008	-83.687230	9.234950
SANCHEZ ROJAS EFRAIN	SJ-02-23-0037-2007	-83.639280	9.370280
SEGURA MENA GILBERTO	SJ-02-23-0155-2008	-83.504350	9.308580
SEGURA ROBLES GLORIA ELENA	SJ-02-23-0039-2007	-83.526260	9.234190
	SJ-02-23-0039-2007	-83.524030	9.235970
	SJ-02-23-0039-2007	-83.524640	9.234140
SIBAJA DUARTE MICHAEL	SJ-02-23-0057-2007	-83.588670	9.204350
SIBAJA DUARTE MICHAEL	SJ-02-23-0226-2007	-83.588410	9.205810
SIBAJA DUARTE MICHAEL	SJ-02-23-0272-2008	-83.622040	9.211720
SOLANO CASCANTE NELLY	SJ-02-23-0097-2008	-83.478260	9.123050
SOLIS PADILLA GERARDO	SJ-02-23-0167-2007	-83.645630	9.435510
SOLIS PADILLA GERARDO	SJ-02-23-0168-2007	-83.645630	9.435510
TABASH MORA NEFTALI	SJ-02-23-0140-2007	-83.539440	9.185710
	SJ-02-23-0140-2007	-83.538810	9.186350
TORRES MONGE DARIO	SJ-02-23-0137-2007	-83.591610	9.265830
	SJ-02-23-0137-2007	-83.592340	9.265840
	SJ-02-23-0137-2007	-83.592610	9.265950
TORRES ZUNIGA YORLENY	SJ-02-28-0170-2006	-83.635220	9.502200
UNIPELOP S.A	SJ-02-23-0342-2007	-83.582390	9.233650
	SJ-02-23-0342-2007	-83.583680	9.231590

	SJ-02-23-0342-2007	-83.581340	9.232290
URENA BARRANTES HILARIO	SJ-02-23-0074-2006	-83.680050	9.494560
VALVERDE QUESADA GILBERT	SJ-02-23-0265-2007	-83.643740	9.436350
VALVERDE ROMERO MARIA ISABEL	SJ-02-23-0181-2008	-83.707030	9.432440
	SJ-02-23-0181-2008	-83.706150	9.432710
VALVERDE ZAMORA DAMARIS	SJ-02-28-0095-2009	-83.690740	9.445160
VARGAS GARITA MANUEL	SJ-02-231-0098-2009	-83.602630	9.477320
VARGAS MORA OSCAR	SJ-02-23-0022-2007	-83.624750	9.157990
VARGAS MORA OSCAR	SJ-02-23-0036-2009	-83.624790	9.164940
VARGAS PICADO ABEL ALBERTO	SJ-02-23-0096-2008	-83.719100	9.399560
VARGAS Y GARCIA S.A.	SJ-02-20-0046-2006	-83.547190	9.094500
	SJ-02-20-0046-2006	-83.547340	9.093290
VARGAS Y GARCIA S.A.	SJ-02-23-0116-2008	-83.547500	9.091250
VASQUEZ ARBUSTINI ELIECER	SJ-02-23-0252-2007	-83.621800	9.345480
VASQUEZ ARBUSTINI JOSE LUIS	SJ-02-23-0057-2006	-83.613120	9.336710
VEGA CASTRO VICTOR MANUEL	SJ-02-23-0221-2008	-83.651820	9.436620
	SJ-02-23-0221-2008	-83.651700	9.435940
	SJ-02-23-0221-2008	-83.652510	9.435740
	SJ-02-23-0221-2008	-83.653200	9.435990
VENEGAS DIAZ JOSE ANGEL	SJ-02-23-0077-2006	-83.542510	9.364180
VENEGAS ZUNIGA FERNANDO	SJ-02-23-0256-2008	-83.552000	9.354100
	SJ-02-23-0256-2008	-83.554300	9.353780
	SJ-02-23-0256-2008	-83.554180	9.353700
VENEGAS ZUNIGA FERNANDO	SJ-02-23-0257-2008	-83.555920	9.352550
	SJ-02-23-0257-2008	-83.556000	9.354000
VILLAREVIA ELIZONDO JOSE JOAQUIN	SJ-02-28-0035-2006	-83.605630	9.494410
VILLAREVIA URENA FAUSTINO	SJ-02-23-0038-2009	-83.607890	9.473620
VILLAREVIA URENA FAUSTINO	SJ-02-23-0052-2009	-83.630310	9.484680
	SJ-02-23-0052-2009	-83.630550	9.485440
ZAMORA PEREZ HILDA	SJ-02-23-0183-2009	-83.637070	9.206540
ZUNIGA SANCHEZ LIZETH	SJ-02-23-0037-2009	-83.760520	9.426800
	SJ-02-23-0037-2009	-83.759610	9.427290
ZUNIGA VARGAS RIGOBERTO	SJ-02-23-0157-2008	-83.561520	9.130940
ZUNIGA VARGAS WILLIAN	SJ-02-23-0170-2008	-83.563820	9.128390
	SJ-02-23-0170-2008	-83.564470	9.128530