CLEAN DEVELOPMENT MECHANISM
PROJECT DESIGN DOCUMENT FORM FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD) Version 03

CONTENTS
PROJECT DESIGN DOCUMENT FOR AFFORESTATION AND REFORESTATION PROJECT ACTIVITIES (CDM-AR-PDD)

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

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

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PROCUENCA: Forestry Project to Restore the Watershed of the Chinchiná River, an Environmental and Productive Alternative for the City of Manizales and the Surrounding Region. Version 3, March 1, 2007.

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

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PROCUENCA-FAO, the forestry project to restore the Chinchiná River watershed, is an environmental, productive and social alternative for the region. It was conceived in 2001 on the basis of the "Environmental Management Plan for the Chinchiná River watershed" prepared by the regional environmental authority, CORPOCALDAS, considering the Clean Development Mechanism as a co-financing source. The Institute for Financing, Promotion and Development of Manizales, INFIMANIZALES, is the organizational and promotional entity of the project.

In June 2001 an agreement for unilateral cooperation, UTF, was signed between INFIMANIZALES and the United Nations Food and Agriculture Organization – FAO, establishing the CDM as a key co-financing source[1]. The FAO affords cooperation in specific programs, provides technical assistance, and offers the fiduciary administration of financial resources, on the basis of its world-wide experience in the handling of similar projects.

The primary objective of this project is to regulate and improve the quantity and quality of fresh water for the region's communities by restoring the microwatersheds that supply their water systems, each duly identified as part of the Chinchiná River watershed restoration program. The program's activities involve ecological restoration through natural assisted regeneration and reforestation. The project is supported by the participation of its institutional beneficiaries and the many economic actors, strengthening the sustainable uses of the ecosystems and their forest resources. According to studies conducted by the IDEAM, by the year 2025 the river basin will be affected by hydric deficit, in absence of regional reforestation projects. Ecological restoration focuses on areas of hydric importance, such as sources, wetlands (*humedales*) and river and stream banks. Reforestation seeks the regulation of hydric volumes of importance to the population living in the river basin[2], which has been threatened by uncontrolled deforestation and extension of the agricultural and cattle frontier over the course of the last century. The project seeks to mitigate erosive processes and sedimentation, favor the increase of biodiversity, improve the connectivity of strategic ecosystems and increase CO2 capture.

This umbrella project promotes the use and sustainable management of the planted forest, by means of a community participation scheme that improves the living conditions of the local communities, through job generation, increase of economic income, training in forestry and agroforestry activities, creation and strengthening of local organizations and support to food security. An Association of Agroforestry Producers - AGROFORESTAL - was organized to facilitate participation of the landowners in decision-making and commercialization of tCERs and forestry products.

[1] FAO Project UTF/Col/025/Col, June 21, 2001

[2] Today 528,000 inhabitants, according to DANE 2005. Available: www.dane.gov.co

Project activities consist of the establishment of forest plantations, agroforestry, sylvopastoral systems and assisted natural regeneration models, in areas whose uses have been and will continue to be, in the absence of the CDM, traditional extensive cattle farming and coffee (*Coffea arabica*) cultivation, mainly in monoculture with technically modern arrangements. In addition, PROCUENCA FAO promotes the strengthening of the forest productive chain encouraging investments in projects to transform the raw material produced to added value.

PROCUENCA FAO conducted a feasibility study for the application of the CDM Marrakech Accords and the COP9 decisions in the areas of interest of the project[3]. Based on the results of the CDM pre-feasibility study and the emergence of approved methodologies, it became feasible to formulate the CDM project. Since 2001, before initiating the plantations, the Ministry of the Environment, Housing and Territorial Development, the NDACDM for Colombia, included the project in the country's CDM portfolio and has been accompanying its application process to the CDM.

In order to measure and document the changes in biodiversity promoted by the changes in land use from pastures and coffee to the sustainable forest models of the project, PROCUENCA FAO, in association with Conservación International Colombia and the PROAVES Foundation, designed methodologies and indicators to be simultaneously implemented with the process of application of the carbon capture methodologies and indicators. The results of the biodiversity change measurements will be presented quinquennially and parallel to the stored carbon monitoring and verification process. Thus, buyers of tCERs from PROCUENCA FAO will be acquiring compliance-ready credits from the Kyoto Protocol, complemented by quantified and verified results with respect to the increase in biological diversity brought about by the project activity, at this biodiversity hotspot of the Andes.

[3] BLACK, T., V. H. GUTIERREZ, A. M. GÓMEZ, A. M. SANTACRUZ, W. G. LAGUADO Y M. ZAPATA. 2003-. Estudio de prefactibilidad para implementar el mecanismo de desarrollo limpio (MDL) en el proyecto PROCUENCA. Centro Andino para la Economía del Medio Ambiente (CAEMA)- Centro de Investigación Carbono y Bosques (C&B), Bogotá-Medellín.

A.3. Project participants:

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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)
Colombia is the host Party	• -Institute for the Advancement, Promotion and Development of Manizales (INFIMANIZALES)	NO
Colombia is the host Party	• - Association of Agroforestry Producers of Caldas (AGROFORESTAL)	NO

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

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

A.4.1.1. Host Party(ies):

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Colombia

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

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Department of Caldas

A.4.1.3. City/Town/Community etc:

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Manizles and the communities of the Chinchiná River watershed.

A.4.1.4. Detailed geographic delineation of the project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

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The direct area of influence of the project is the watershed of the Chinchiná River, located in the central-south subregion of the Department of Caldas, Colombia (Figure 1). As shown in Figure 2, this area is characterized by its rich water sources, formed by the areas of the municipalities of Manizales, Villamaría, Neira, Chinchiná and Palestina. The region covers approximately 15% of the area of the department (112,675 ha) and is the zone with the highest population density in the department (467 inhab/km^2).

FIGURE 1. Location of the Chinchiná River watershed. Source: CORPOCALDAS, Planning and Systems Subdirectorate. Scale 1:50,000

Table 1. *Geographical location of the municipalities belonging to the Chinchiná River watershed, where the project is carried out.*

Department	Municipality	Latitude (degrees N)	Longitude (degrees E)	Elevation (m.a.s.l.)
Caldas	Manizales, Chinchiná, Villamaría, Neira, Palestina	4º 48’ 12.9” to 5º 12’ 9.7”	75º 19’ 11.5” to 75º 42’ 33.6”	780 to 5200

See Figure 4.

A.4.1.5. Description of the present environmental conditions of the area planned for the proposed A/R CDM project activity, including a brief description of climate, hydrology, soils, ecosystems (including land use):

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From the ecological point of view, the watershed extends from the highest points of the Central Cordillera, at the sources of the Claro, Chinchiná and Guacaica rivers, at an altitude of 5200 m, located in the active volcano of Nevado del Ruiz, flowing down to an altitude of 800 m, in the sector where the waters of the Chinchiná River flows into the Cauca River. (CORPOCALDAS & PROCUENCA-FAO, 2006)[4].

In the high zone of Los Nevados Natural National Park there are two strategic ecosystems affected by climate change: the tropical glaciers Nevado del Ruiz and Santa Isabel which are progressively losing their layer of ice, and the Paramos which are losing their capacity to regulate the water cycle.

The protective forest reserve of Río Blanco, which is part of the buffer zone of Los Nevados Natural National Park, has been determined by national and regional guiding policies as of environmental interest from the point of view of a water resource and due to the presence of threatened flora and fauna species (see table 5). This reserve supplies nearly 35% of the water demand of the city of Manizales, with the presence of very important wetlands and with high potential to develop ecotourism and recreation projects.

Climate

There are three climate ranges, determined by altitude differences along the watershed: there is a warm climate on the western bank, which is the lowest part of the watershed, with temperatures between 22 and 28ºC; medium climate in the intermediate zone of the watershed, with temperatures ranging between 18 and 22ºC, corresponding to the coffee-growing zone; and a colder climate in the higher portion of the watershed, reaching below zero temperatures in the zone of the Nevado del Ruíz. (Figure 2)

[4] Corporación Autónoma Regional de Caldas (CORPOCALDAS). Proyecto Forestal para la cuenca del río Chinchiná – PROCUENCA–FAO. 2006. Restauración ecológica y reforestación en zonas de importancia hídrica en la cuenca del río Chinchiná, Caldas.

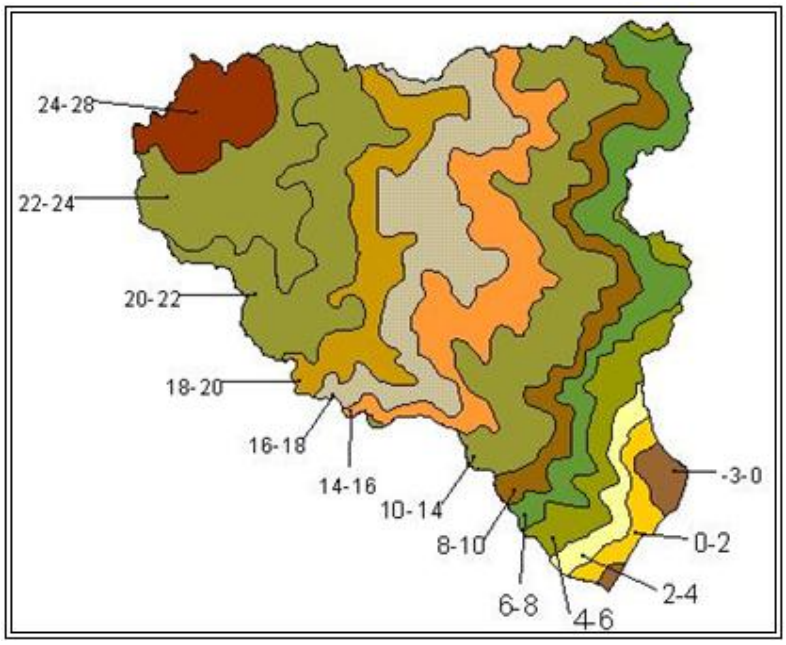


FIGURE 2. Temperature distribution in the Chinchiná River watershed (ºC)

Average annual precipitation

Precipitation values for the Chinchiná River watershed range between 2000 and 2200 mm/year. In general the lower portion of the watershed is rainier than the higher portion. The less rainy areas are found at the southern end, in the portions closest to the Santa Isabel snowcapped mountain, with 600-800 mm/year (Figure 3). Precipitation intensity is high in the lower portion of the watershed, a fact which promotes erosive processes, accentuated below 2200 meter altitudes.

Hydrology

At the highest points of the Central Cordillera we find the sources of the Claro, Chinchiná and Guacaica Rivers, at an altitude of 5200 m. The Los Nevados Natural National Park is considered one of the large water reserves as in its peaks are the sources of the main rivers and streams that flow down the east and west sides of the Colombian Central Cordillera. On its west side it feeds the drainage basins of the departments of Quindío, Risaralda and Caldas (Figures 4 and 5).

Geomorphology and Soils

The most outstanding features of the area are its mountainous relief with a deep, active and structurally controlled dissection modeling, which aspects contribute to the high instability of the slopes, manifest in the abundant mass movements.

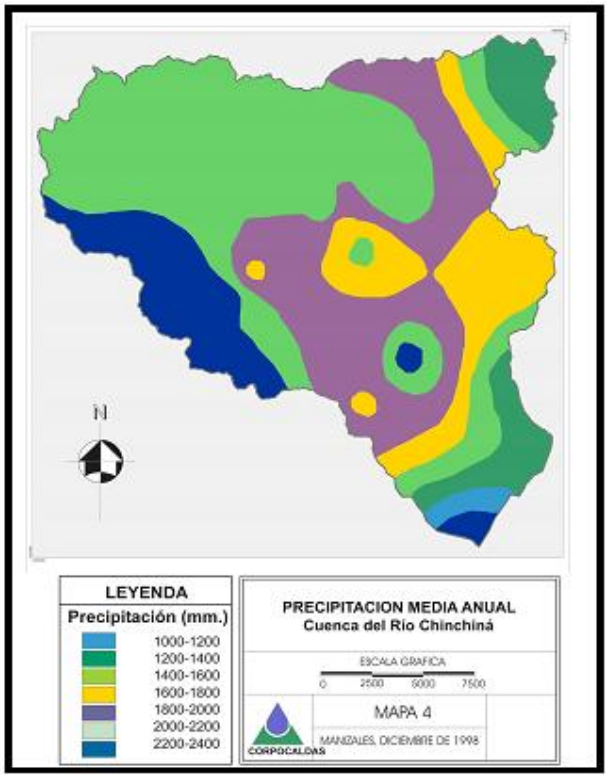


FIGURE 3. Average annual precipitation in the Chinchiná River watershed

The area presents constant seismic activity. The recent volcanic cover over the fractured and altered substratum constitutes a differential resistance factor of the rocks. The thick pyroclastic cover, given its weight, the steep inclines and wet climate, contribute to the instability of the slopes. The type of geomorphologic modeling is of a fluvio-volcanic nature, which is constituted by deposits or accumulations resulting from the interaction between volcanism and glaciation.

The origin of these soils is influenced by the volcanic tectonic activity of the Ruiz and Tolima volcanoes. This activity molded the great regional landscape dominated by steep slopes, domes and volcanic structures.

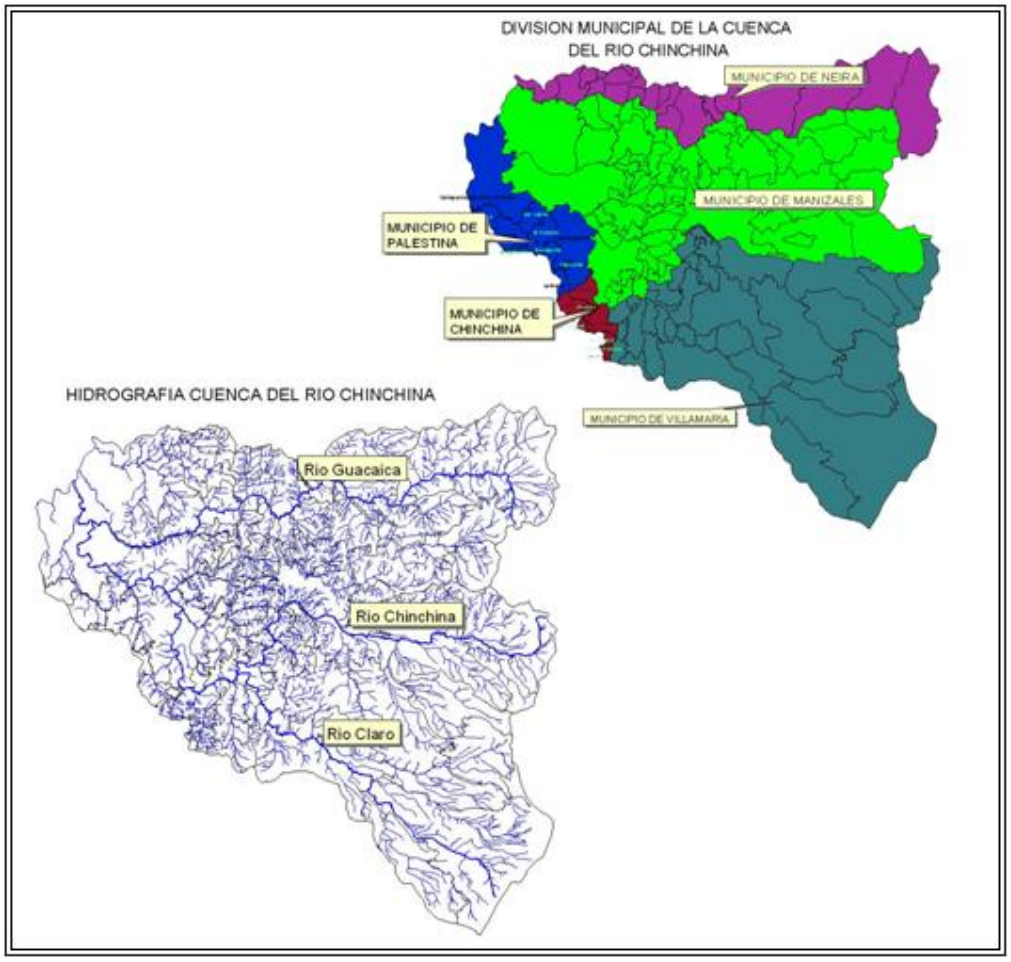


FIGURE 4. Municipalities that are part of the PROCUENCA project and water system of the Chinchiná River watershed.

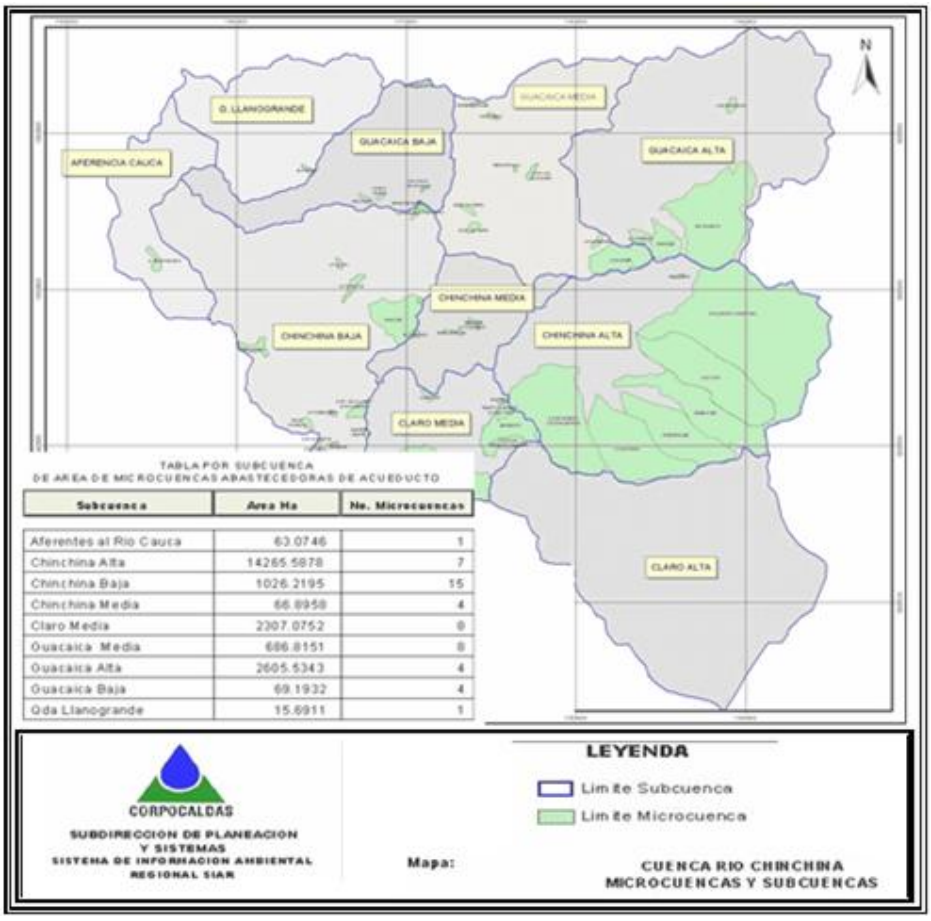


FIGURE 5. Water system supplier microwatersheds in the Chinchiná River watershed

Horizon A is of variable thickness and has variable assimilable calcium, magnesium, potassium and phosphorus contents and high organic matter contents. The agrological characteristics of these soils are their fine and coherent structure, with good moisture retention, slightly evolved, erosion resistant, with the presence of krotovinas (spheres built by insects) and without limitations on their use and management.

According to the soil classification of the Department of Caldas, made by the IGAC in 1988, the consociations and associations of the different types of soils present a location pattern that coincides with the elevation changes of the land. The soil formations present clearly differentiated sections such as:

Between the altitudes of 850 and 1,900 m, we find two types of Chinchiná associations – Sulfonated and Lutaina. The former is widely predominant in the coffee-growing area, corresponds to soils developed from volcanic ash with ample base saturation and good conditions for agricultural activity with limitations on account of their broken topography. The characteristics of this type of soil have permitted a significant development of agricultural and livestock activities in the sector, but geological and

anthropic erosion have degraded it to a large extent, presenting severe erosive phenomena and mass removals.

The Lutaina consociation is located on the western margin of the watershed, in the geomorphological hill area. It corresponds to soils developed from sedimentary clays which form an undulating to broken relief with short gentle to moderate slopes. The use of the soil is mainly cattle raising with improved grasses which has favored the appearance of erosive phenomena of slight intensity. As a special characteristic, there is an inverted Calcium-Magnesium relationship, a factor which may affect crop production.

Between 1,900 and 3,000 meters, the predominant formation is the Santa Isabel consociation, which is widely predominant in the high zones of the municipalities of Manizales, Villa María and Neira. These are soils of volcanic origin, deep and well drained, with abundant organic matter content, suitable for agricultural and livestock tasks, but with limitations on their use due to the degrees of slope, given that their geomorphological location corresponds to broken, very broken and precipitous relief mountainside areas, with steep slopes. The lands are currently used for extensive cattle raising with kikuyo grass (*Penisetum clandestinum*). Loss of forest mass and overgrazing have favored the generation of severe erosive processes and mass removals. The assisted natural regeneration models proposed in the A/R activity under the CDM will be established and a large portion of the A/R activity proposed for the CDM will be carried out in this type of soils.

Ecosystems

The diverse climate range in the Chinchiná River watershed allows for the existence of nine major life zones, according to the ecological classification system proposed by Holdridge (see table 5 and Figure 6).

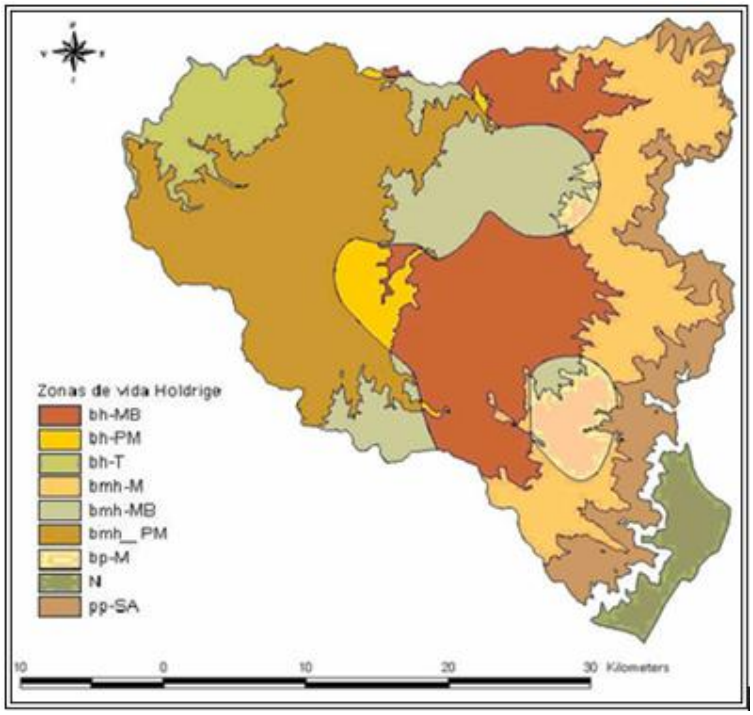
TABLE 5. *Life zones in the Chinchiná River watershed. (Corpocaldas 2001)*

Life zone	%
Bh-MB	19.8
Bh-PM	2.6
Bh-T	5.1
bmh-PM	27.5
bmh-M	16.4
bmh-MB	11.7
bp-M	3.7
N	3.9
pp-SA	9.3

Source: Corpocaldas, 2001

Nival (N)

Is located in the Nevado del Ruiz, near the perennial snows; its temperature is below 3ºC, with an annual precipitation of 500 mm in the form of rain and snow. It belongs to the humid-superhumid province; vegetation is quite scarce due to frequent temperature drops which occasionally reach several degrees below zero. It occupies 3.9% of the watershed.



Source: Corpocaldas, Planning and Systems Subdirectorate. Reduced from its original 1:50,000 scale

FIGURE 6. Life zones in the Chinchiná River watershed (according to Holdridge)

Pluvial sub-Andean paramo (pp-SA)

Located in the Nevado del Ruiz, with a temperature between 1 and 3ºC, precipitation of 1000 to 5000 mm/year, predominant vegetation frailejones and mosses. It belongs to the superhumid humidity province. There is little evapotranspiration due to the low temperatures. Thus, water falling in the form of rain flows through runoff and contributes to the formation of surface sources, such as rivers and streams. It occupies 9.3% of the watershed area.

Montane pluvial forest (bp-M)

Located in the subparamo, in the eastern portion of the municipalities of Neira, Manizales and Villamaría. This life zone integrates with the paramo strip that runs through the department. In general, the climatic limits correspond to an approximate average temperature between 6 and 12ºC, with an average annual rainfall above 2000 mm, belonging to the superhumid humidity province. This life zone begins at an altitude of 2800-2900 m. It occupies 3.7% of the watershed area.

Montane very humid forest (bmh-M)

Located in the southern part of the region in the paramo zone. Its temperature limits are between 6 and 12ºC, with an average annual rainfall of 1000 to 2000 mm; it belongs to the superhumid humidity province which begins approximately at an altitude of 2900 m. The primary forest present in the area is

highly reduced and has been displaced by pasturelands and potato (*Solanum tuberosum*) fields. It occupies 16.4% of the watershed area.

Low montane very humid forest (bmh-M)

Is located in the central sector of the region and comprises the municipalities of Neira, Manizales and Villamaría, on both sides of the Central Cordillera, at an altitude of 1900 to 2900 m; its temperature ranges from 12 to 18ºC, with an annual precipitation of 2000 to 4000 mm; the topography is rough and enables the continuance of threatened forest species such as oak (*Quercus humboldtii*) and wax palm (*Ceroxylon quindiuense)*. It occupies 11.7% of the total watershed area.

Very humid premontane forest (bmh-PM)

Located in an elevation range beginning at 1000 meters and going up to an altitude of 2000 m. Found in flat to undulating and steep areas, the remaining natural vegetation being composed of species such as: guamo (*Inga sp*.), guadua or giant bamboo (*Guadua angustifolia*) and guayacán or pink trumpet tree (*Tabebuia rosea*), which are displaced by grasses, coffee or semi-annual crops. It is located in all municipalities of the project's area of influence, particularly in the western sector, in the coffee-growing strip. Average temperature ranges from 18 to 24ºC. Precipitation levels fluctuate between 1500 and 2500 mm, and relative humidity varies between 70 and 90 %. It represents 26% of the watershed area.

Premontane humid forest in transition to dry warm (bh-PM-t-CS or bh-T)

Is located in the area near the Cauca River, in the municipalities of Chinchiná, Palestina, Manizales and Neira. Its elevation is between 850 meters at the place where the Chinchiná River flows into the Cauca, and goes up to 1100 m. The average temperature in the zone is 20 to 24 ºC, average annual precipitation is 1500 mm to 2800 mm and relative humidity fluctuates between 70 and 90%.

Cover Distribution:

Starting in the second half of the 19th century, the Chinchiná River basin was highly intervened, with large areas being deforested to expand the agricultural and stock raising frontier. Coffee production, brought to the area at the end of the 19th century, began with the introduction of the caturra variety in the mid-20th century, establishing clean and unshaded plantations, which led to the consequent almost total displacement of the native plant cover in zones with altitudes between 1000 and 2000 meters. During the "soqueo" or stumping back process and during land preparation, all existing vegetation is eliminated; during planting tasks the soil is removed and exposed to erosion triggering factors.

Stock breeding activity has been present in several sectors of the basin, extensively above 2000 meter altitudes and below the coffee belt, where it has been developed both intensively and extensively. In all cases, the criterion of open pastures with no trees has prevailed, following the guidelines of the green revolution. In fact, the clearing and burning system has been constantly used, as in the case of the paramos and subparamos of Los Nevados Natural National Park and its buffer zone. This background allows us to establish a current use as a consequence of the activities carried on within the watershed during previous years (Table 6)

TABLE 6 *Distribution of covers present in the Chinchiná River watershed at the start of the project.*

Type of cover	Percentage (%)
Agricultural	20.9
Agroforestry	4.2
Constructions	2.2
Bodies of water	1.5
Forest	28.3
Livestock	40.0
Uncultivated Lands	2.9
Grand Total	**100.0**

Source: POACCH (1999)

A.4.1.6. Description of the presence, if any, of rare or endangered species and their habitats:

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Threatened species

Human intervention has endangered the existence of many flora and fauna species in the zone, due, mainly, to indiscriminate hunting and changes in land uses which cause destruction and fragmentation of the habitat. The main threatened species in the Chinchiná River watershed are shown in Table 7.

The existing threat against the ecosystem known as cloud forest, present in the Chinchiná River watershed, has been recognized worldwide. This is a unique and frail ecosystem, where a large number of threatened and endemic flora and fauna species are concentrated, and which furthermore provides a fundamental environmental service: its water supply function. Although all tropical forests are under this threat, this ecosystem must face the pressures imposed both by human activity and by the impacts of climate change, given that a temperature increase could alter the precipitation patterns and cloud formation in these mountain areas, which constitutes a high potential risk to the flora and fauna communities established here. There are animal and plant species whose habitat is restricted to cloud forests, such as certain fungi, bryophytes, amphibians and birds which are particularly sensitive to atmospheric humidity levels. In fact, according to the UNEP, urgent efforts are required in order to conserve this type of ecosystems.

Flora

In the Paramos the predominant species are frailejones. In the flora study made for the Chinchiná River watershed[5], 184 species belonging to 57 families were reported, most of them being typical of secondary

[5] Corporación Autónoma Regional de Caldas (CORPOCALDAS). Proyecto Forestal para la cuenca del río Chinchiná – PROCUENCA–FAO. 2006. Restauración ecológica y reforestación en zonas de importancia hídrica en la cuenca del río Chinchiná, Caldas.

forests. Guadua (*Guadua angustifolia*) forests are found mainly in the protection strips of the rivers and streams, in the Chinchiná river and the Llanogrande stream.

TABLE 7. *Threatened species in the Chinchiná River watershed. VU, vulnerable; EN, endangered; CR, in critical danger; D, insufficient data.*

Scientific Name	Common Name	Category
Mammals		
Alouatta seniculus	Red howler monkey	*CR*
Aotus lemurinus	Gray-bellied night monkey	*VU*
Cebus albifrons	White-fronted capuchin	*CR*
Cebus apella	Tufted or brown capuchin	*CR*
Tremarctos ornatus	Spectacled bear	*EN*
Felis pardalis	Ocelot	*VU*
Leopardus tigrina	Oncilla or tiger cat	*VU*
Felis wiedii	Margay	*VU*
Felis concolor	Puma or cougar	*VU*
Tapirus pinchaque	Mountain tapir	*CR*
Odocoileus virginianus	White-tailed deer	*VU*
Agouti paca	Paca	*CR*
Agouti taczanowskii	Mountain paca	*CR*
Birds		
Podiceps occipitalis	Silvery grebe	*EN*
Sarkidiornis melanotos	Comb duck, knob-billed duck	*EN*
Anas georgica	Tellow-billed pintail	*EN*
Anas cyanoptera	Cinnamon teal	*EN*
Netta erythrophthalma	Southern pochard	*CR*
Oxyura jamaicensis	Ruddy duck	*EN*
Vultur gryphus	Andean condor	*EN*
Accipiter collaris	Semicollared hawk	*EN*
Odontophorus melanonotus	Dark-backed wood-quail	*EN*
Odontophorus strophium	Gorgeted wood-quail	*CR*
Rallus semiplumbeus	Bogota rail	*EN*
Neocrex columbianus	Colombian crake	*DD*
Gallinula melanops	Spot-flanked gallinule	*CR*
Pyrrhura calliptera	Brown-breasted conure, Flame-winged parakeet	*VU*
Leptosittaca branickii	Golden-plumed conure; golden-plumed parakeet	*VU*
Ognorhynchus icterotis	Yellow-eared conure; yellow-eared parrot	*CR*
Bolborhynchus ferrugineifrons	Rufuous-fronted parakeet	*VU*
Touit stictoptera	Spot-winged parrotlet	*CR*
Pionopsitta pyrilia	Saffron-headed parrot	*VU*
Hapalopsittaca amazonina	Rusty-faced parrot	*VU*

Hapalopsittaca fuertesi	Indigo-winged parrot or Fuertes' parrot	*CR*
Cypseloides lemosi	White-chested swift	*CR*
Tachornis furcata	Pygmy swift	*DD*
Coeligena prunellei	Black Inca	*VU*
Eriocnemis godini	Turquoise-throated puffleg	*DD*
Eriocnemis mirabilis	Colorful puffleg	*CR*
Heliangelus zusii	Bogota sunangel	*DD*
Metallura iracunda	Perija metaltail	*EN*
Acestrura bombus	Little woodstar	*VU*
Grallaria alleni	Moustached antpitta	*EN*
Grallaria gigantea	Giant antpitta	*EN*
Grallaria kaestneri	Cundinamarca antpitta	*EN*
Grallaria milleri	Brown-banded antpitta	*EN*
Grallaria rufocinerea	Bicolored antpitta	*VU*
Grallaricula lineifrons	Crescent-faced antpitta	*VU*
Reptiles		
Chelydra serpentina acutirostris	Ecuadorian snapping turtle	*DD*
Rhinoclemmys diademata	Diadem wood turtle or Maracaibo wood turtle	*VU*
Amphibians		
Dendrobates lehmanni		*CR*
Epipedobates andinus		*VU*
Epipedobates pictus		*CR*

VU: Vulnerable **EN:** Endangered **CR:** In critical danger **DD:** Insufficient data[6].

Flora

In the paramos the predominant species are frailejones. In the flora study made for the Chinchiná River watershed[7], 184 species belonging to 57 families were reported, most of them being typical of secondary forests. Guadua (*Guadua angustifolia*) forests are found mainly in the protection strips of the rivers and streams, in the Chinchiná river and the Llanogrande stream.

[6] RENGIFO, L. M., A. M. FRANCO-MAYA, J. D. AMAYA-ESPINEL, G. H. KATTAN Y B. LÓPEZ-LANÚS (eds.). 2002. Libro rojo de aves de Colombia. Libros Rojos de Especies Amenazadas de Colombia Series. Alexander von Humboldt Biological Resource Research Institute and Ministry of the Environment. Bogotá, Colombia.
CASTAÑO-MORA, O. V. (editor). 2002. Libro rojo de reptiles de Colombia. Libros Rojos de Especies Amenazadas de Colombia Series. Institute of Natural Science - Colombian National University and Ministry of the Environment. Bogotá, Colombia.
RUEDA-ALMONACID, J. V., J. D. LYNCH & A. AMÉZQUITA (eds.). 2004. Libro rojo de anfibios de Colombia. Libros Rojos de Especies Amenazadas de Colombia Series. Conservation International Colombia, Institute of Natural Science – Colombian National University, Ministry of the Environment. Bogotá, Colombia. 384 pp.

[7] Corporación Autónoma Regional de Caldas (CORPOCALDAS). Proyecto Forestal para la cuenca del río Chinchiná – PROCUENCA–FAO. 2006. Restauración ecológica y reforestación en zonas de importancia hídrica en la cuenca del río Chinchiná, Caldas.

The families found in order of abundance are *asteracaceae* (39 species), *mimosaceae, orchidaceae* (70 species) and *melastomataceae,* (24 species). The endemic species are mainly located in the paramo zone and in the high Andean cloud forest, with species such as the marsh leaf (*Gunnera magnifica*), passionflower (*Passiflora parritae*) and frailejón (*Espeletia grandiflora*). The flora species in danger of extinction are found in the cattle breeding and low areas of the watershed, due to anthropic pressures and to the extended changes in land use systems. (see Table 8)

TABLE 8. *Threatened flora species in the Chinchiná River watershed Uppercase: Worldwide status, abbreviations in Lower case: National status, VU: vulnerable EN: endangered, cr: in critical danger.*

Family	Scientific name	Common name	Threat category
Arecaceae	*Ceroxylon quindiuense*	Wax palm	VU
Bruneliaceae	*Brunellia boqueronensis*	Ratón(no English name found)	VU
Caesalpinaceae	*Brownea ariza*	Mountain rose	vu/en
Fagaceae	*Quercus humboldtii*	AndeanOak	Vu
Juglandaceae	*Juglans neotropica*	Andeanwalnut	Vu
Lauraceae	*Aniba perutilis*	Comino(no English name found)	en/cr
Orchidaceae	*Masdevallia trochilus*	Masdevallia orchid	vu/en
Podacarpaceae	*Decussocarpus rospigliossi*	Colombian pine tree	vu/en
Passifloraceae	*Passiflora parritae*	Passionflower	VU/EN

Uppercase: Worldwide status, abbreviations in Lower case: National status, VU: vulnerable EN: endangered, cr: in critical danger[8].

A.4.2. Species and varieties selected for the proposed A/R CDM project activity:

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The most frequently used species in plantations of a commercial nature and their implementation within the framework of the PROCUENCA-FAO project are selected based on knowledge of the technological packages or the so-called sustainable management systems, marketing possibilities, the environmental offer of the zone and experience with these species in the region. Thus, the following species have been considered (Figure 8):

The commercial forest species considered in the project are: patula pine (*Pinus patula*), tecunumani pine (*Pinus tecunumanii*), cypress (*Cupressus lusitanica*), alder (*Alnus acuminata*), walnut (*Cordia alliodora*), teak (*Tectona grandis*), gmelina (*Gmelina arborea*), Caribbean pine (*Pinus caribaea*) and eucalyptus (*Eucalyptus Grandis*).

Pinus patula[9]*:* This species grows at altitudes between 2000 and 2800 m, requires average annual temperatures between 13 and 10ºC and average annual precipitation ranges between 1600 and 2500 mm.

[8] RENGIFO, L. M., A. FRANCO-MAYA, J. AMAYA-ESPINEL, G. KATTAN, B. LÓPEZ-LANÚS. (eds.) 2002. Libro rojo de aves de Colombia. Alexander von Humboldt Biological Resource Research Institute and Ministry of the Environment. Bogotá, Colombia.

It grows in the low montane humid forest (bh-MB) and montane humid forest (bh-M) life zones. Develops well in soils with good drainage, and shows high adaptability in degraded soils.

Pinus tecunumanii[10]*:* This species has a wide altitudinal range, from 440 to 2800 m. The distribution of this species is determined by geology and precipitation, occurring in moderately fertile and deep, slightly acid, well drained soils, with precipitations between 790 and 2200 mm and mean annual temperatures between 14 and 25ºC.

Cupressus lusitanica[11]: This species grows at altitudes between 1500 and 2800 m, requires average annual temperatures between 14 and 20ºC and average annual precipitation between 1500 and 3000 mm. It grows in low montane very humid forest and montane humid forest life zones. It develops in well drained soils, with the presence of organic matter.

Gmelina arborea: Grows in optimal conditions up to 1000 m in altitude, requiring mean annual temperatures between 24 and 35ºC and mean annual precipitations between 750 and 2000 mm. It grows in the tropical dry forest life zone, in well drained soils which contain organic matter and are moderately alkaline.

Tectona grandis: Grows in optimal conditions up to 1000 m in altitude, requiring mean annual temperatures between 18 and 32ºC and mean annual precipitations of 1000 to 4000 mm. Grows in the tropical dry forest and tropical humid forest life zones, in soils with good drainage, neutral and fertile.

Cordia alliodora: This species grows at altitudes up to 1900 m, requiring average annual temperatures between 18 and 25ºC and average annual precipitations between 1500 and 3000 mm. It grows in the tropical humid forest and premontane humid forest life zones. It develops well in well-drained, slightly acid soils, with presence of organic matter.

Alnus acuminata: This species grows in optimal conditions at altitudes between 2200 and 3200 m, requires average annual temperatures between 7 and 14ºC and average annual precipitations between 1000 and 2500 mm. Grows in the montane dry forest, montane humid forest and low montane very humid forest life zones, in soils acid, in the presence of organic matter.

Pinus caribaea: This species grows at altitudes up to 1500 m, requiring mean annual temperatures between 22 and 26ºC and mean annual precipitations between 600 and 3500 mm. It grows in premontane dry forest, premontane very humid forest and premontane humid forest life zones. Develops well in well drained, slightly acid, not too fertile soils.

Eucalyptus Grandis: This species grows at altitudes up to 1800 m, requiring mean annual temperatures between 15 and 32ºC and mean annual precipitations between 1000 and 3000 mm. It grows in tropical

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[9] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF). 1998. Guía para plantaciones forestales comerciales – Orinoquía. Serie de documentación No.38. Santafé de Bogotá

[10] http://herbaria.plants.ox.ac.uk/adc/downloads/capitulos_especies_y_anexos/pinus_tecunumanii.pdf

[11] CORPORACIÓN NACIONAL DE INVESTIGACIÓN Y FOMENTO FORESTAL (CONIF). 1998. Guía para plantaciones forestales comerciales – Orinoquía. Serie de documentación No.38. Santafé de Bogotá

humid forest and premontane humid forest life zones. It develops well in well-drained, slightly acid soils, in the presence of organic matter, and is very sensitive to boron deficiency.

Species selected for implementation of the assisted regeneration system

The plant material for implementation of this system will propagate sexually or asexually depending on the species and will be obtained from the forest relicts in the Chinchiná River watershed. Table 9 shows the species selected, in addition to their potential uses, and Figure 9 shows an image of some of these species. Selection will depend on edaphic and climatic conditions, and on the preference of the land owner. Distribution of the enrichment will be carried out establishing at least five different species in arrangements of up to 1100 trees per hectare.

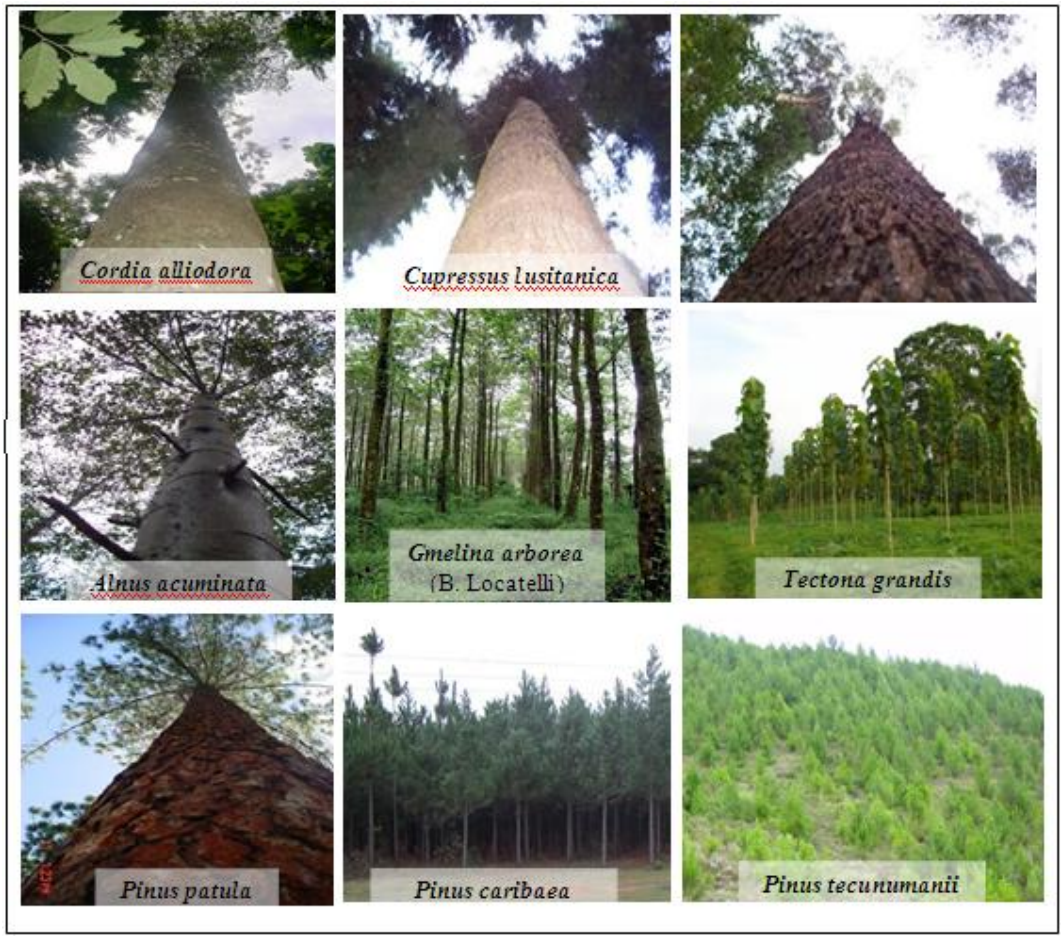

FIGURA 8. Especies consideradas para los sistemas forestales, agroforestales y silvopastoriles en el ámbito del proyecto

TABLE 9 *Preliminary list of native species of interest to be produced by the Torre IV nursery. The species marked AA are considered highly preferred and with high chances of success in the ecological restoration work.*

Family	***Scientific name***	Common Name	Priority	Approx. range	Note
Actinidaceae	*Saurauia spp.*	Dulumoco	AA	1800-3200	Attracts Fauna
Araliaceae	*Oreopanax.sp*	Mano de oso	AA	1900-3300	Attracts Fauna
Arecaceae	*Ceroxylon quindiuense*	Wax palm		1900-3000	Threatened with extinction, consumed by Fauna.
Asteraceae	*Verbesina arborea*	Camargo	AA		Rapid growth
Asteracea	*Baccharis sp*	Chilco or seep willow	AA	2500 3700	Rapid growth
Asteracea	*Montanoa quadrangularis*	Arboloco	AA	1700 2900	Rapid growth
Asteracea	*Pentacalia sp*			3000 3700	Rapid growth
Asteracea	*Diplostephium*			3000 3700	Rapid growth
Bombacaceae	*Spirotheca rhodostyla*	Ceiba.		1800-2800	Threatened with extinction.
Boraginaceae	*Cordia cf barbata and C. cilindrostachya*	Guásimo		1900-2800	Attracts Fauna
Brunelliaceae	*Brunellia camo*	Riñón; cedrillo		1900-2800	Can grow to become canopy

					trees
Buddlejaceae	*Buddleja bullata*	Gavilán	AA	2000 3200	
Caprifoliaceae	*Viburnum pichinchense*	Sáuco de monte or cabo de hacha	AA	2100-3200	Purple-black fruit; is a small pioneer tree
Cecropiaceae	*Cecropia telealba*	Yarumo blanco		1900-2600	Landscape importance
Chloranthaceae	*Hedyosmum bonplandianum*	Silbo-silbo, granizo,	AA	1800-3200	Rapid growth
Chletraceae	*Chletra reticulata*	Chiriguaco		2000-3000	Medium-slow growth
Clusiaceae	*Clusia spp.(C.multiflora*)	Chagualo		2000-3100	Consumed by Fauna;
Cunoniaceae	*Weinmannia balbisiana*	Encenillo de hoja ancha		2000-3300	Ornamental and landscape value
Elaeocarpaceae	*Vallea stipularis*	San juanito or campano	AA	2400-3700	Attracts birds
Ericaceae	*Cavendishia pubescens*	Uvito de monte	AA		Fruit is consumed by birds
Ericaceae	*Guatteria sp*	Mortiños, vallas de páramo	AA	2500 3100	Attracts birds
Euphorbiaceae	*Croton magdalenensis*	Drago	AA	1800-2750	Consumed by Fauna, particularly parrots and pigeons.
Euphorbiaceae	*Alchornea sp*	Montefrío	AA	2000-2800	Ornamental value; attracts fauna.
Euphorbiaceae	*Sapium spp. (S. utile and others)*	Mantequillo, Nadador	AA	2300-3100	Consumed by birds
Euphorbiaceae	*Hyeronima antioquensis*	Candelo	AA	2200-3000	Attracts fauna, particularly the yellow-eared parrot.
Fabaceae	*Erythrina edulis*	Chachafruto		1900-2600	Consumed by fauna, sylvopastoral value
Fagaceae	*Quercus humboltii*	Oak	AA	1800 2800	Fauna
Flacuortaceae	*Abatia parviflora*	Saca ojos	AA	2400 3100	
Gentianaceae	*Macrocarpaea macrophilla*	Tabaquillo	AA	1900-2700	Pale yellow flowers
Grossulariaceae	*Escallonia*	Chilco colorado	AA		

	myrtiloides				
Gunneracea	*Gunnnera sp*	Marsh leaf		2800 3600	Invades grass
Hippocastanaceae	*Billia columbiana*	Cariseco, granadillo		2000-2800	Fine wood of renown in the area; with ornamental value
Juglandaceae	*Juglans neotropica*	Andean walnut (Cedro negro)			
Lauraceae	*Nectandra sp.*	Piedro		2000-2700	Timber-yielding
Lauraceae	*Ocotea calophylla*	Laurel oreja burro			
Lauraceae	*Cinamon sp*	Laurel peña			
Lorantaceae	*Gaiadendron sp*	Cabuyo	AA	2700-3700	Birds, is a rooted parasite species.
Lecythidaceae	*Eschweilera antioquensis*	Olleto, olla de mono		2000-2800	Fruit is a 20 cms in diameter capsule
Mimosaceae	*Inga sp.*	Guamo de Monte		2100-2700	Attracts fauna
Magnoliaceae	*Talauma sp.*	Gallinazo blanco Molinillo, Magnolio;		2000-2600	Fine wood; endangered species.
Melastomataceae	*Tibouchina grossa*	Sietecueros	AA	2100-3200	Wood used for stakes and constructions; with ornamental value
Melastomataceae	*Miconia spp.*	Nigüitos	AA	1900-3500	Attracts fauna.
Meliaceae	*Cedrela montana*	Cedar		1800 2800	
Minosaceae	*Acacia decurrens*	Black wattle; green wattle		1900-2800	Forage production for cattle
Moraceae	*Ficus spp.*	Higuerones	AA	1900-3200	Ornamental value; fruit consumed by fauna
Myricaceae	*Myrica pubescens*	Olivo de cera	AA	2000-2800	Attracts fauna
Myrtaceae	*Myrsine sp.*	Kolea		2000-3200	
Piperaceae	*Piper spp.*	Pepper; Cordoncillo	AA	2000-3000	Attracts fauna
Piperaceae	*Peperonia sp*	Cordoncillo		2000-3000	Attracts fauna
Rubiaceae	*Lademberg ia or*	Giant quinua	AA	1900-2800	Attracts birds,

	Cinchona				rapid growth.
Rubiaceae	*Palicourea sp.*	Aguadulce	AA	1900-2800	with ornamental value
Rubiaceae	*Psychotria sp*			2000 3000	
Rubiaceae	*Guettarda chiriquensis*			2000-2700	Consumed by birds
Rutaceae	*Zanthoxylum sp.*	Prickly ash; Tachuelo or Donzel	AA	1900-3100	Consumed by birds
Sapindaceae	*Matayba sp.*	Cariseco (name in Aburrá valley)		2000-2800	With ornamental value
Saxifragaceae	*Escallonia paniculata*	Chilco colorado		2100-3200	Wood used for tool handles
Solanaceae	*Solanum sp.*	Frutillo	AA	1900-2900	Attracts birds
Solanaceae	*Sessea sp.*	Sin muerte	AA	2500 3300	Long-lasting wood
Solanaceae	*Saracha sp*		AA	3000 3700	Good adaptation and material availability
Staphyleaceae	*Turpinia cf heterophylla*	Mantequillo	AA	2100-3000	with ornamental value
Theaceae	*Freziera spp.*	Cerezo	AA	2000-3200	Ripe fruit is dark purple berry
Theaceae	*Gordonia sp*		AA	3000 3700	
Winteraceae	*Drymis granadensis*	Canelo	AA	2600 3200	
Vervenaceae	*Citharexylum subflavescens*	Cascarillo, cajeto	AA	2000-2900	Consumed by birds

Source: Universidad de Caldas Botanical Garden (1997)
*Personal communication Luis Mora, codillero and socioeconomic characterization surveys (IAVH, 2004).


Hedyosmum bonplandianum
Clusia multiflora (2)
Weinmannia balbisiana
Vallea stipularis (4)
Cavendishia ubescens (5)
Croton magdalenense (6)
Erythrina edulis (7)
Abatia parviflora (8)
Juglans neotropica (9)
Acacia decurrens
Myrica pubescens (11)
Esacallonia paniculata

FIGURE 9. Some of the species selected to implement the project's assisted regeneration system.
Sources: (1) http://www.icbgpanama.org (2, 3) http://www.tulane.edu (4) http://www.geocities.jp (5) http://www.cecalc.ula.ve (6) http://static.flickr.com (7) http://www.rebiape.org.pe (8) www.PlantSystematics.org (9) http://www.rzero.co.nz (10) http://www.seedman.com (11, 12) http://flora.huh.harvard.edu (R. C. Ulloa)

A.4.3. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

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In order for landowners to be included within the PROCUENCA-FAO project, they must voluntarily submit a letter of intent, attaching the latest purchase deed and abstract of title of their property. The first document permits a clear verification that the person showing an interest in participating in the project holds the legal title to the land and the right to use it. The second document guarantees that the land is not attached or under any property conflict.

In case the property is eligible, according to the established regulations and once the owner accepts the terms of the contractual relationship with the project, the areas, species and type of plantation to be carried out are determined by mutual agreement with PROCUENCA-FAO. Finally, the owner signs a "joint account" agreement through which he enters the project and which defines the parties' participation in the economic results of the operation.

The distribution of the rights of access to the sequestered carbon has been established as follows: 70% of the revenues from the sale of tCER will belong to the landowners participating in the project, 20% will be allocated to the establishment of a fund for biodiversity conservation and the remaining 10% will be applied to the forest capitalization fund.

A.4.4. Technology to be employed by the proposed A/R CDM project activity:

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The PROCUENCA FAO project has prepared a technical standards guide document for the establishment of forest plantations, which defines the activities and techniques to be followed during the different plantation stages:

Land preparation: Consists of the elimination of herbaceous type vegetation, present at the sites to be planted, as it might eventually compete for nutrients and light. This likewise facilitates the movement of personnel for layout, hole-making, material distribution and planting tasks. This activity is carried out transverse to the slope, using a machete or scythe, in strips approximately two meters wide or platings (*plateos*), depending on the condition of the site to be reforested. This way, the soil is not totally unprotected, thereby avoiding the erosive effects of surface runoff.

Plantation density: Is understood as the number of trees per unit of area, normally expressed in terms of the number of trees per hectare. Plantation density depends on the proposed production target for the plantation, the behavior of the selected species and the quality of the land (fertility, rain, luminosity, slope and quality of the site). The pre-defined density for commercial species is up to 1111 trees per hectare, with the exception of Cypress, which is managed with a density of 1333.

Layout: Refers to the way in which the trees will be finally arranged at the selected site**.** The plantation design follows the traditional systems, rectangular and triangular. For the establishment of agroforestry

systems, the density and distribution of the forest plantation will be subject to the biophysical requirements of the associated crop and the objective sought by the owners, with densities ranging from 150 to 600 trees per hectare.

For plantation layout, simple and practical methods may be used, which guarantee the proper distribution of the trees in the land. In general, the first lines are the most important, as they are the basis for a good layout. Before commencing layout tasks, the following items should be considered:

a. Locate timber extraction routes (by aerial cable or by animal-drawn vehicles.)
b. Number lots on each face of the land (i.e. on each side of the micro watershed)

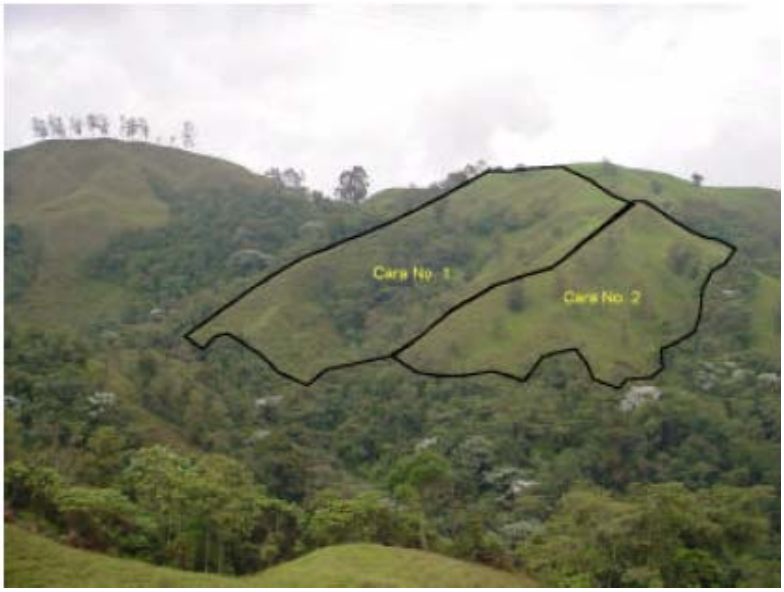

Photo 1. Division of the planting lots

c. Early on, a simple spirit level (a carpenter's spirit level or a simple home-made one will serve the purpose), a surveyor's square used in topography, or a compass, are used to locate the first lines on each slope of the micro watershed.
d. Trace the distance between plants with a previously marked piece of string.
e. Place the stakes in the position where the tree will be located.

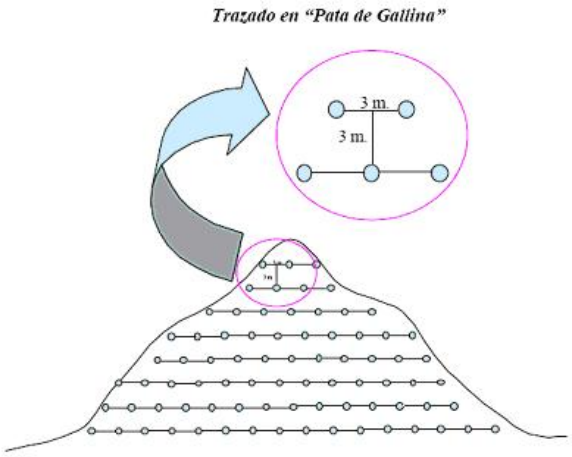

Figure 2. Type of layout for planting of species

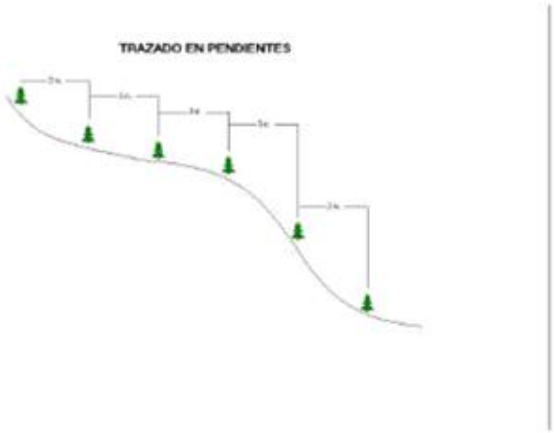

Figure 3. Type of layout in slopes

Photo 2. Form of plating at the planting site

Hole making: Consists of the opening of a hole, loosening and pricking the soil, allowing the trees to find favorable conditions for the development of their root system.
With the help of a bar, scraper or small shovel, a hole, 30 centimeters deep by 30 centimeters in diameter, is made.

Photo 3. Making of deep hole

Planting. The planting process must be carried out by trained personnel, so as to ensure the uniformity and quality of the plantation. The seedlings are placed in the earth up to 3-5 cm above the root neck, the ground is tamped to eliminate any air bags inside the whole, thus facilitating the rooting process as well as water capture at a greater depth. The procedure for planting is the following:
a) With the bag always in the ground, it is "slashed" with a machete or knife in order to remove it.

b) The seedling is picked up with both hands and the bag is then removed.

Photo 4. Planting procedure

c) The seedling is placed in the center of the hole, which is then filled with earth taken from the hole itself and uniformly pressing down on the four sides of the plant in order to eliminate any air bags.
d) The seedling is straightened up by hand, at the time of planting and two or three days later.

It is recommended not to plant in the pathways, as they also serve as a fire barrier. There should not be any planting under treetops either. Planting should be done at least 3 m from the crown projection. Places with moisture problems or subject to flooding should be avoided.

Fertilizer application: The practice of fertilization consists of giving the soil and the trees nutritional, in addition to the respective corrective elements, thereby attaining the chemical balance of the soil so that the trees will have everything they need in the right amount for an optimal development of their physiological functions and thus better productivity.

As a general rule, tropical soils have a low organic nitrogen content and soils of volcanic origin have low phosphorus availability. Consequently, according to experience and laboratory assays existing for the project area, it is recommended to supply a dose of 100 grams of dolomitic lime per seedling per site to correct acidity, plus 50 grams of NPK (10-30 10). In all, three applications of fertilizers are made per tree, two in the first year (in the third month after the planting and subsequently in the ninth month) and another in the second year with NPK and 10 grams of Boron per tree.

The fertilizer is placed in the hole, mixing it very well with the soil. The tree root should be approximately 5 centimeters above the mixture of fertilizer and soil. In hillside areas, fertilizers are placed at the top of the slope, making a crown or ditch approximately 15 cm away from the tree base and then covering it with soil.

Replanting : Is the process by which dead trees are replaced in the various reforested lots. It is done when mortality exceeds 10% of the planted surface, using forest material of identical characteristics and conditions as that initially established and with the same planting techniques, including the plating and hole making.

Maintenance cleanings: May be total or by strips, the latter being more advisable. This is done through clearing or cutting of undesirable vegetation, using tools such as machetes and small scythes. Herbicides, usually of a selective type, are also frequently used to eliminate short grasses and other grasses such as pastures.

Establishment and management of the assisted regeneration system: The PROCUENCA-FAO project follows a productive model based on native forest plant succession natural processes, is such a way as to attain sustainable production in the environmental, social and economic components. Environmentally, the model promotes biological diversity, recovers threatened native species, and reconciles production with the restoration and conservation of the habitat of numerous species. Socially, productive offer is increased, traditional knowledge regarding the use and management of forest species is recovered and there is an enrichment of the region's landscape. From the economic point of view, the offer of timber-yielding and non-timber-yielding products of the forest is increased. Competition and complementarity factors inherent to plant succession lead to the almost total elimination of management costs, while at same time ensuring a permanent production of biomass.

The characterizations made during various stages of plant succession in certain regions of Colombia show how in habitats where the original tree component has been eliminated, due to degradation of the soils through cattle raising activities or on account of natural disasters, after the proliferation of ferns, gramineae and leguminous plants of the shrub type, rapidly growing heliophyte species, such as Balso (*Ochroma piramidale*), Guásimo (*Guasuma ulmifolia*) or Yarumo (*Cecropia. sp.*) are established in medium to warm climate areas, and White Balso (*Ochroma lagopus*) and Arboloco (*Montanoa quadrangularis*) in moderate to cold climates, all these being tree species of medium or low height, with wide or extended leaves and very light wood, adapted to compete for light, save water and rapidly gain height.

This first generation of heliophytic species is followed by a second slightly more diverse series of species, somewhat taller, with straighter shoots, of rapid and intermediate growth, with a high capacity to invade the aerial stratum in a horizontal manner. Most of these species have intermediate-density woods, among which the Carbonero (*Calliandra sp*), Pink cedar (*Cedrella odorata*), Common cedar (*Cedrella montana*), Yarumo (*Cecropia peltata*), Guayacanes (*Tabebuia roseae and T. chrysanta*), Oak (*Quercus humboldtii*), and Andean walnut (Cedro negro) (*Juglans neotropica*), among others, stand out. Although these species do not demand much shade, a not too dense shading during the early periods promotes their development in the seedling, sapling and young tree stages, stimulating the elongation of the internodes and not promoting low ramification. When this second successional stage attains its maximum development, there is a displacement of the first species of the succession, a phenomenon associated with the incapacity of the species to compete and with their high light requirements, even in the adult stage.

A third stage, later and less uniform in its development, although more diverse in terms of the number of species that comprise it, occurs when the species of the second successional stage attain their maximum development. These are long-life and slow-growth species, of dense crowns, which later form the upper and outstanding canopy in climax forests, and have greater shade and moisture requirements throughout their development. These species are the most vulnerable to the impact caused by human activities. The most representative species of this group in the project area are laureaceae and lecitidaceae (*Nectandra spp., Ocotea spp., Rhodfostemonodaphne spp., Lecytis spp., Couropita spp*., among others)

Colonizing or accompanying species

These forest species are the first to leave the management program, through selective thinning. They may be used as wood for chipboards, racks, wooden crates, among others. The proposed plantation density of these will be 833 trees per hectare, at a distance of 3 x 4 meters, and thinning will be done in years 7, 12, 15 and 18. Selected species: aliso or Andean alder (*Alnus acuminata*), urapán or Chinese ash (*Fraxinus chinensis*), patula pine (*Pinus patula*).

Intermediate species

The woods of this type of species are characterized by their good acceptance in the market for furniture-making and as decorative wood. The management plan proposes the selective extraction of these species starting in year 15 of the plantation and their use will be for sawmilling. A plantation density of 417 trees per hectare, at a distance of 6 x 4 meters, is proposed, with selective felling in years 15, 18, 25, 30 and 35.

Selected species: common cedar *(Cedrella montana),* oak *(Quercus humboldtii),* Andean walnut or black cedar *(Juglans neotropica)*.

Fine species

With the planting of this type of species the PROCUENCA-FAO project seeks to contribute to the conservation of this genetic resource. This type of plantation might become, in the future, a germoplasm bank and seed source to develop greater knowledge of the species, promotion and establishment of similar plantations. No uses are anticipated for these species. A plantation density of 208 trees per hectare, at a distance of 12 X 4 meters, is proposed.
Selected species: Colombian pine (*Prumnopitis rospiggliosii*), romerón pine (*Podocarpus oleifolius*), laurel (*Nectandra sp*), comino crespo (*Aniba perutilis*).

A.4.5. Approach for addressing non-permanence:

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According to paragraph 38 and section K of the modes and procedures for afforestation and reforestation projects, tCERs were selected for addressing non-permanence

A.4.6. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>
4425027 tons of CO_2e (four million, four hundred twenty-five thousand twenty-seven tons of CO2e), during the first twenty-year accreditation period.

Summary of results obtained in Sections C.5., 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)**
1	0	12793.8	3160,27	9633.525
2	0	27392.69	3231,66	24161.03
3	0	32618.3	3213,81	29404.48
4	0	45717.15	3228,14	42489.01
5	0	60365.84	3237,11	57128.73
6	0	103682.4	3314,94	100367.5
7	0	158860	3334,77	155525.3
8	0	188544.1	3354,60	185189.5
9	0	258529.5	3374,43	255155.1
10	0	340157.1	3334,77	336822.4
11	0	390881.6	3203,95	387677.7
12	0	434833.4	3136,48	431696.9
13	0	363528.8	3136,48	360392.4
14	0	366592.7	3136,48	363456.2
15	0	334611.7	3136,48	331475.3
16	0	321447.4	812,74	320634.7
17	0	311964.6	812,74	311151.9
18	0	220849.2	812,74	220036.5
19	0	306264.5	812,74	305451.7
20	0	197990.4	812,74	197177.7
Total (tonnes of CO_2 e)	0	4477625	52598,07	4425027

A.4.7. Public funding of the proposed A/R CDM project activity:

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Following is a description of the supporting financing sources for the Procuenca project:

Project Financing Sources:

Co-investment:
Infimanizales
Owners

Project Sources of Income

CIF
Wood sales:
CER sales

The project will be financed by a co-investment between Infimanizales and the owners participating in the forest project. Another possible source of project financing is the CIF (Forest Incentive Certificate), an incentive offered by the National Government in recognition of the benefits of reforestation, which is paid to the reforester in cash, based on the reimbursement of a percentage on the cost scale for the establishment and management of the plantation during the first five years and which is updated each year by the National Government. Nevertheless, the CIF is an uncertain source because it depends on the budget availability of the National Government. To date, it has only been attained for 40% of the owners involved.

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:

>>
June 1, 2002 is the starting date of the project activity. This is the date that the planting program began.

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

>>
100 years.

B.3 Choice of crediting period and related information:

>>
The project will use renewable crediting periods.

B.3.1. Renewable crediting period, if selected:

>>
20 years with two renewal periods for a total of 60 years.

B.3.2. Fixed crediting period, if selected:

>>
N/A

SECTION C. Application of an approved baseline and monitoring methodology

C.1. Assessment of the eligibility of land:

>>

The essential criterion considered in the analysis to determine eligible areas was the time period that the soil had remained without a wooded cover. For the first compliance period, reforestation activities will be limited to those occurring in those lands which did not meet the definition of forest between December 31, 1989 and the project initiation date.

The work of CRAMSA & SODEIC[12] (1988), which includes a description of plant covers by altitude levels, was used. These covers were compared against the present cover, using cartography prepared by CORPOCALDAS, based on the Land and Environmental Management Plan for the Chinchiná River Watershed. To that end, the areas under each cover were calculated by altitude levels. As a result, as shown in Table 10 and detailed in Figure 4, it was determined that the potential area to carry out the CDM project spans a total of 57,721 hectares, identified as eligible according to the feasibility study conducted (Black *et al*. 2004), according to the definition of forest adopted by Colombia[13] and distributed in five categories and divided by life zone.

According to the map provided by PROCUENCA officials, in a scale of 1:25,000, for the Chinchiná river watershed, its plant covers are classified into 33 use categories (Table 10). In order to determine the potential area for the establishment of forests, these were regrouped into larger categories, classified as eligible and non-eligible (Table 11). In the case of the area covered by constructions, 739.3 ha in the urban zone of Manizales (low montane humid forest life zone), where the PROCUENCA project plans to establish plantations for the recovery of hillside areas, were included as eligible. Therefore, areas dedicated to perennial agricultural crops, grasslands, uncultivated lands, naked soils and the 739.3 ha covered by constructions are considered eligible.

The category classified as forests included agroforestry with coffee or shade coffee. Land covers classified as miscellaneous temporary agriculture were not considered eligible, as there would be a conflict in their use in changing the cover of lands intended for agriculture to forest systems. In addition, the area corresponding to the Río Blanco reserve was classified as non-eligible, as it would be difficult to demonstrate additionality in an area where the recovery of non-wooded lands would quite feasibly be assured due to their special handling nature.

[12] Corporación Autónoma Regional para la Defensa de las Ciudades de Manizales, Salamina, Aranzazu (CRAMSA) & Ingenieros Consultores e Interventores Ltda (SODEIC). 1988a. Study of the Chinchiná River subwatershed. Flora and fauna. CRAMSA, Manizales, Colombia. 132 p.

[13] The definition of forest for Colombia is determined as: minimum tree crown cover 30%, minimum area of one hectare and minimum value of 5 m in tree height, which values are in line with the regulations established by the UNFCCC. Available in: http://cdm.unfccc.int/DNA/ARDNA.html?CID=49

TABLE 10 *Area of use and plant covers of the Chinchiná River watershed.*

Use and plant cover	Total (ha)
Agricultural in greenhouse	3.90
Agricultural miscellaneous	568.70
Agricultural perennial or semi-perennial cacao	21.25
Agricultural perennial or semi-perennial coffee	21898.75
Agricultural perennial or semi-perennial technologically modernized coffee	147.61
Agricultural perennial or semi-perennial technologically modernized sugar cane	195.11
Agricultural perennial or semi-perennial fruit trees	399.60
Agricultural perennial or semi-perennial plantain	0.58
Agricultural temporary	368.33
Agricultural perennial or semi-perennial traditional sugar cane	11.43
Agroforestry coffee with shade	4718.21
Natural forests giant bamboo (guadua)	1660.79
Natural forests latifoliated	583.69
Natural forests high scrubland	24704.91
Natural forests low scrubland	1597.42
Planted forests conifers	1605.21
Planted forests latifoliated	1090.62
Planted forests reforestation	558.08
Constructions rural disperse	18.49
Constructions rural grouped	337.98
Constructions urban industrial	305.84
Constructions urban recreational	70.28
Constructions urban residential	1765.21
Bodies of water natural free surfaces	66.77
Bodies of water snow-covered free surfaces	1468.44
Grass paramos shrub lands	757.96
Grass paramos herbaceous	5636.23
Grasslands bushy	2930.03
Grasslands shrubs	35830.08
Uncultivated lands exposed rock fragments	3098.00
Uncultivated lands exposed rock massive	69.62
Uncultivated lands naked soil erosion	34.67
Uncultivated lands naked soil riverbanks-beaches	87.25
(empty)[14]	64.24
Total	**112675.25**

In the montane ground life zones (bp-M and bmh-M), only those areas classified as grasslands were included as eligible. Uncultivated lands in naked soil and paramo grasses were excluded due to possible environmental and ecological restrictions existing in these areas, which are

[14]Areas identified as "empty" had no associated use and plant cover in the map provided by the PROCUENCA project. They represent a very small area with respect to the total.

constituted for the most part by prairies covered by groups of frailejones (*Espeletia sp.*) (Holdridge 1967, Espinal 1991), which did not allow the establishment of wooded vegetation. Neither were areas within the pluvial sub-Andean paramo (pp-SA) life zone included, as there vegetation becomes scarce, mainly dominated by grassy scrublands, with isolated trees and shrubs and some plants in the form of rosettes and cushions growing among the frailejones (Espinal 1991). This denotes a high level of frailty, importance and threat in these ecosystems and low C capture capacity in this life zone. In addition, this type of vegetation does not meet the definitions of forest established by the country. The watershed includes 8,273 ha of the Los Nevados Natural National Park, mostly located in the pp-SA life zone. For the same reasons mentioned for the Rio Blanco reserve, the area corresponding to the Park was considered non-eligible.

TABLE 11. *Eligible and non-eligible areas for a CDM forestry project in the Chinchiná River watershed.*

Eligibility	Major use categories	Total (ha)	Total (%)
Eligible areas	Agricultural perennial	22,674.32	20.12
	Grasslands	34,979.41	31.04
	Uncultivated lands naked soil	67.47	0.06
	Non-buildable urban hillsides	739.30	0.66
	Total eligible area	**57,721.21**	**51.23**
Non-eligible areas	Agricultural temporary	940.93	0.84
	Forests	36,518.91	32.41
	Constructions	1,758.49	1.56
	Bodies of water	1,535.21	1.36
	Paramo flora	6,394.19	5.67
	Paramo grasslands	3,780.70	3.36
	Uncultivated lands naked soil	54.45	0.05
	Uncultivated lands exposed rock	3,167.61	2.81
	(empty)	64.24	0.06
	Total non-eligible area	**54,954.04**	**48.77**
	Total area of watershed	**112,675.25**	**100**

The surface to be reforested estimated for the pilot phase will be 15,000 ha. The lands will be gradually added to the pilot project to the extent that the landowners are incorporated into the PROCUENCA-FAO Project.

TABLE 12. *Classification of eligible areas, according to their potential use for the CDM, in the different life zones of the Chinchiná River watershed.*

Category	Life zones	Uses of the land (baseline)	Project activities	Eligible area ha	Eligible area (%)
I	bh-T, bh-PM	Coffee, Cattle raising	Reforestation (walnut, eucalyptus), agroforestry (walnut + coffee), sylvopastoral (walnut + cattle dual purpose), melina, tecunumani, teak.	26,179	45.36
II	bmh-PM	Coffee	Reforestation (walnut, pine tecunumani, eucalyptus), agroforestry (walnut + coffee), sylvopastoral (walnut + cattle dual purpose)	7,855	13.61
III	bh-MB, bmh-MB	Cattle raising	Reforestation (patula, cypress, alder) sylvopastoral (dairy cattle + patula)	9,000	15.59
IV	bmh-M	Cattle raising	Assisted natural regeneration (biological corridor)	4,524	7.84
V	bmh-M, bp-M	Cattle raising	Assisted natural regeneration	10,160	17.60
			Total eligible	**57,721**	**100.00**

CORPORACIÓN AUTONOMA REGIONAL DE CALDAS. 2006. Restauración ecológica y reforestación en zonas de importancia hídrica en la cuenca del río Chinchiná, Caldas. Proyecto Forestal para la Cuenca del río Chinchiná – PROCUENCA-FAO.

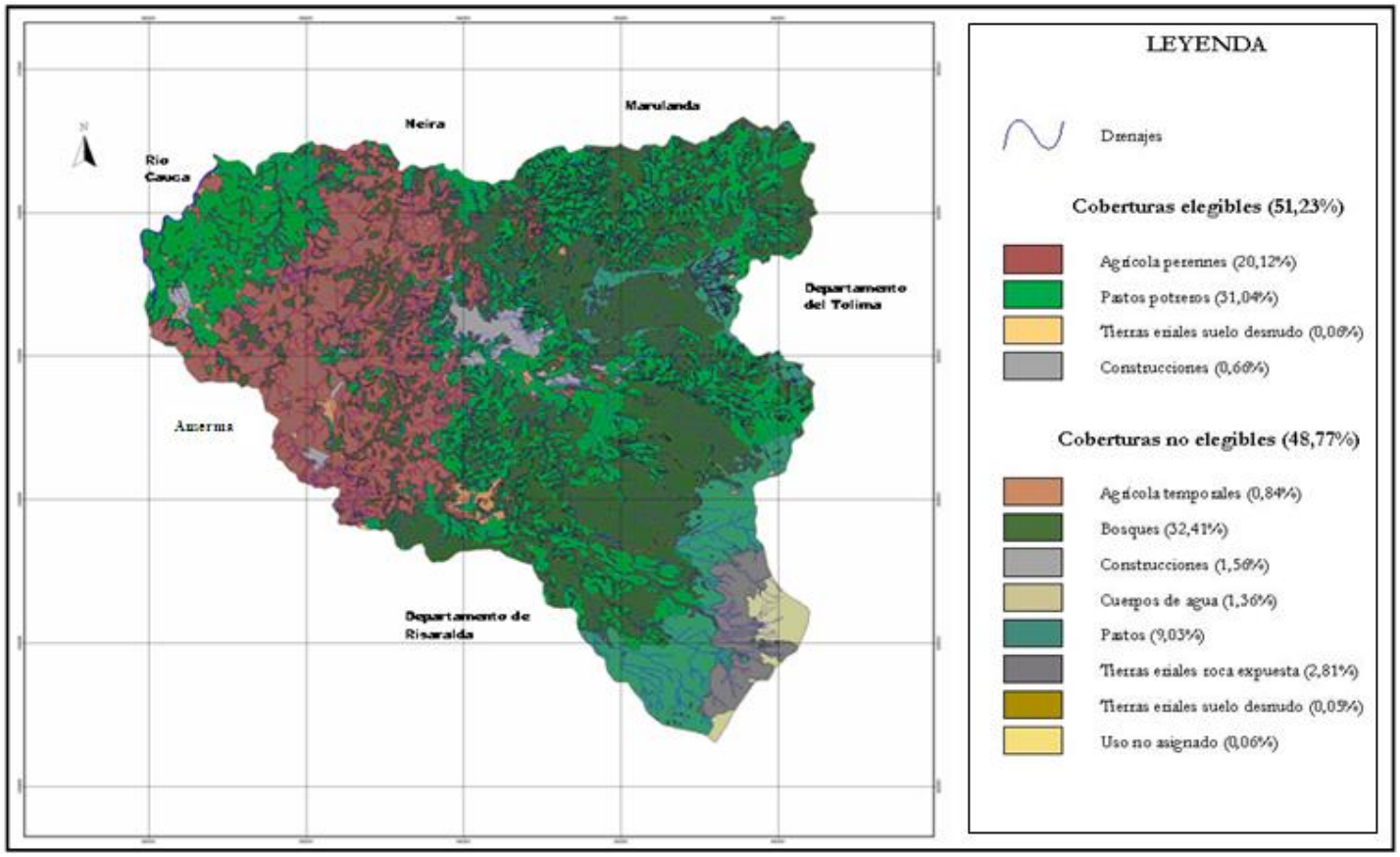

FIGURE 4. Areas identified as eligible and non-eligible for the CDM project under afforestation and reforestation systems within the Chinchiná River watershed.

C.2. Title and reference of the approved baseline and monitoring methodology applied to the proposed A/R CDM project activity:

>>

Approved afforestation and reforestation baseline methodology AR-AM0004 "Reforestation or afforestation of land currently under agricultural use"[15]

C.3. 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:

>>

Applicability

This activity is applicable to the conditions of the Procuenca project according to the established criteria:

- Afforestation or reforestation of degraded lands, which are subject to additional degradation or remain in a constant low carbon content state, through assisted natural regeneration, the planting of trees or control of activities preceding project implementation such as pasturage or firewood gathering activities (including coal production at the site)

- Project activity may lead to a change in the alternatives available before its implementation outside the area of influence, e.g. displacement of agricultural activities, pasturage and/or firewood gathering, including charcoal production.

The methodology is applicable to the conditions of the Procuenca project according to the following criteria:

- The lands that are to be afforested or reforested are degraded and will continue to degrade or will continue to have low carbon contents.
- Site preparation tasks do not cause a long-term net decrease in soil carbon contents; neither are gas emissions other than CO_2 in the soil increased.
- It is expected that organic carbon contents in the soil, detritus or dead wood will decrease substantially due to erosion of the soil and human activities, when compared to the project implementation scenario.
- Irrigation by flooding is not permitted.
- Drainages or disturbances in the soil are insignificant and for this reason no gases other than CO_2 will be emitted.

[15] Available in : http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html

- The number of nitrogen fixer species used by the project is not significant. Therefore, greenhouse gas emissions due to denitrification are insignificant for the quantification of greenhouse gas removals by sinks.

- The project activity is implemented in lands where no other afforestation and/or reforestation activities are planned (there are no afforestation and/or reforestation activities in the baseline).

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

>>

See above.

C.5. Identification of the baseline scenario:

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

>>

Although seed sources are available in the lands included within the project, the constant pressure of the farmers prevents the reestablishment of the forest covers at these sites. Cattle raising activity, together with animal browsing (feeding on leaves or shoots of trees or shrubs) causes compacting of the soils which prevents the establishment of pioneer species which might initiate a succession process in these forests.

The steps are described in the document"*Tool for the demonstration of additionality in A/R CDM project activities*"[16], issued by the CDM executive board at the United Nations and which shall be hereinafter referred to as the "additionality tool". Only the barrier analysis argument was used for this project (step 3).

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

>>

See section C.6, below.

C.6. Assessment and demonstration of additionality:

>>

Land eligibility

Annex 16 of EB-22 was applied for this procedure: "Procedures to define the eligibility of lands for afforestation and reforestation project activities"

This procedure requires a demonstration that the lands are not covered by forest at the start of the project, so that an afforestation or reforestation project activity can be implemented.

(a) Demonstrate that the land is not a forest at the start of the project, providing information to prove that:

[16] Available at: http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html

i. The land is belowr the national definition of forest (crown cover, tree height and minimum land area) for forest definitions under decisions 11/CP.7 and 19/CP.9, as communicated by the respective Designated National Authority.

The lands that are being and will be planted as part of the A/R CDM project are currently under agricultural use or in pasturage. In neither of these cases is it possible for natural regeneration of the lands to occur in order to attain the wooded cover, due to the current human activities. Thus, the lands included within the project activity meet the characteristics for lands that are to be afforested or reforested, according to decision 11/CP.7

ii. The lands are not currently being harvested or depleted by human activities and are not covered by seedlings or plantations which can attain, by natural means, the definition of forest as determined by the Designated National Authority

The lands considered eligible do not include areas which at the start of the project had covers meeting the conditions of a forest. The lands have experienced degradation processes which prevent the natural regeneration of the forest towards advanced successional stages inducing covers that meet the definition of forest established by the country.

(b) Demonstrate that the project activity is afforestation or reforestation:

i. For the reforestation project activities, demonstrate that as of December 31, 1989, the land was below the definition of forest of the Designated National Authority (Crown cover, tree height and minimum area), as communicated by the DNA under decision 11/CP.7

The eligible covers were verified based on aerial photographs taken between 1989 and 1990. These flights were made by the IGAC[17]. Consequently, the activity in the process of implementation for project execution has been classified as reforestation.

Assessment of domestic and/or regional policies

The project is in line with the domestic legal regulations related to the forest sector, set out in Law 99 of 1993, the National Renewable Natural Resources and Environmental Protection Code (Decree 2811 of 1974), and the General Forest Act (Law 1021 of 2006)[18]. These laws govern the development of timber-yielding and non-timber-yielding resources of the forest, under the principle of sustainability, giving priority to protection of the biodiversity, conservation of the associated environmental services, and benefits to the community in the areas developed.

The PROCUENCA-FAO project follows the local guidelines established in the Land Management Plans of the municipalities comprising the Watershed of the Chinchiná River (Manizales, Chinchiná, Palestina, Villamaría and Neira). The forest and agroforestry plantations are compatible with the potential uses established for the proposed project boundary. Most of the lands correspond to boundarys suitable for forests which were incorporated into agricultural and livestock activities and to an inadequate management which has led them to commence severe degradation processes.

Assessment of alternative uses of the land

[17] Instituto Geográfico Agustín Codazzi

[18] The complete texts of these laws are available at: http://www.minambiente.gov.co

This methodology proposes three steps to determine the most plausible baseline scenario:

Step 1: Identify and make a list of land use alternatives

The following possible uses of the land were identified in the project boundary, according to national and regional policies and interviews conducted with interested parties and inhabitants of the region:

1. Status Quo: The lands will continue to be used for unshaded coffee production, extensive stockbreeding and marginal agricultural uses, including subsistence agricultural production.

2. Permanent abandonment of marginal lands: The project lands are abandoned by the farmers and the succession process can then begin.

Step 2: Demonstrate that under the plausible scenarios identified in Step 1, the most plausible scenario is that the areas forming part of the project will remain under the current or a similar usage system.

Interviews conducted with individuals interested in the project show a tendency not to change over to possible alternative uses of the land. Credit institutions perceive investment risks in reforestation projects for commercial purposes due to market problems and the long return on investment period. The difficulty to find reliable germoplasm sources and the scarce research in this field in our country make reforestation activities for commercial purposes uncertain.

Coffee-growing is a very representative activity of the region and has well-defined marketing channels. Market risks make individuals conservative and cause them to prefer to continue engaging in a productive activity whose financial success is not assured, due to fluctuations in the international market, rather than making incursions into other productive possibilities that are perceived as uncertain.

Field research and interviews with interested parties have demonstrated that the only realistic and credible alternative for project participants is to continue with the current marginal agricultural practices.

Step 3: Demonstrate that the regeneration of the forest would not occur in the absence of the project activities:

Although seed sources are available in the lands included within the project, the constant pressure of the farmers prevents the reestablishment of the forest covers at these sites. Cattle raising activity, together with animal browsing (feeding on leaves or shoots of trees or shrubs) causes compacting of the soils which prevents the establishment of pioneer species which might initiate a succession process in these forests.

The steps are described in the document"*Tool for the demonstration of additionality in A/R CDM project activities*"[19], issued by the CDM executive board at the United Nations and which shall be hereinafter referred to as the "additionality tool". Only the barrier analysis argument was used for this project (step 3).

Step 0. Preliminary filter based on the starting date of the A/R CDM project activity

The PROCUENCA-FAO Forest Project for the Chinchiná River watershed was formulated during the years 2000 and 2001 based on the "Environmental Management Plan of the Chinchiná River watershed",

[19] Available at: http://cdm.unfccc.int/methodologies/ARmethodologies/approved_ar.html

considering the Clean Development Mechanism as a co-financing source and with the support of the department's local environmental authority, CORPOCALDAS and the participation of the Instituto de Financiamiento, Promoción y Desarrollo de Manizales, Infimanizales, as the project promoter and developer entity.

The cooperation agreement was signed in June 2001 between INFIMANIZALES and the United Nations Food and Agriculture Organization – FAO, establishing the CDM as a co-financing source for this project (see document FAO Project UTF/Col/025/Col, June 21, 2001)

The PROCUENCA-FAO project conducted a feasibility study to apply the CDM Marrakech Accords and the COP9 decisions in the areas of interest of the project (Black *et al* 2003). Based on the results of the CDM pre-feasibility and the emergence of approved methodologies, it became feasible to formulate the CDM project. Since 2001, the Ministry of the Environment, Housing and Territorial Development, the NDACDM for Colombia, included the project in the country's CDM portfolio and has been accompanying its application process to the CDM.

Step 1. Identification of alternatives to the project activity under the CDM, according to the current laws and regulations

1. Status Quo: The lands will continue to be used for unshaded coffee production, extensive stockbreeding and marginal agricultural uses, including subsistence agricultural production.

2. Permanent abandonment of marginal lands: The project lands are abandoned by the farmers and the succession process can then begin.

Financial Analyses

- Cash flow for wood with and without CERs, per ha.
- Project ROI for Wood with and without CERs
- Financial comparison of the most probable land use alternatives, Cattle raising and Coffee, including wood with and without CERs.

Partial results of the financial analyses of the activities conducted in the project area and the forest proposal, through analyses of the net present values of the investment for each activity, starting from the cash flows. For this analysis, the most relevant activities in the area of the Chinchiná river watershed, such as beef and dairy cattle raising and coffee agricultural activity were used as reference, and compared against a walnut forest proposal, given that this species is the one that generates the highest internal rate of return (IRR), with respect to the other forest species proposed by the project.

From the results of the financial analysis it can be demonstrated that forest activities present a lower income behavior (Figure 20) with respect to the coffee and beef and dairy cattle raising proposal, under three discount rates (3.8, 4, 5, 7 and 10%) (Figure 21).

The foregoing denotes additionality from the A/R activities proposed in the project, through the financial analysis tool, as considered by the methodology.

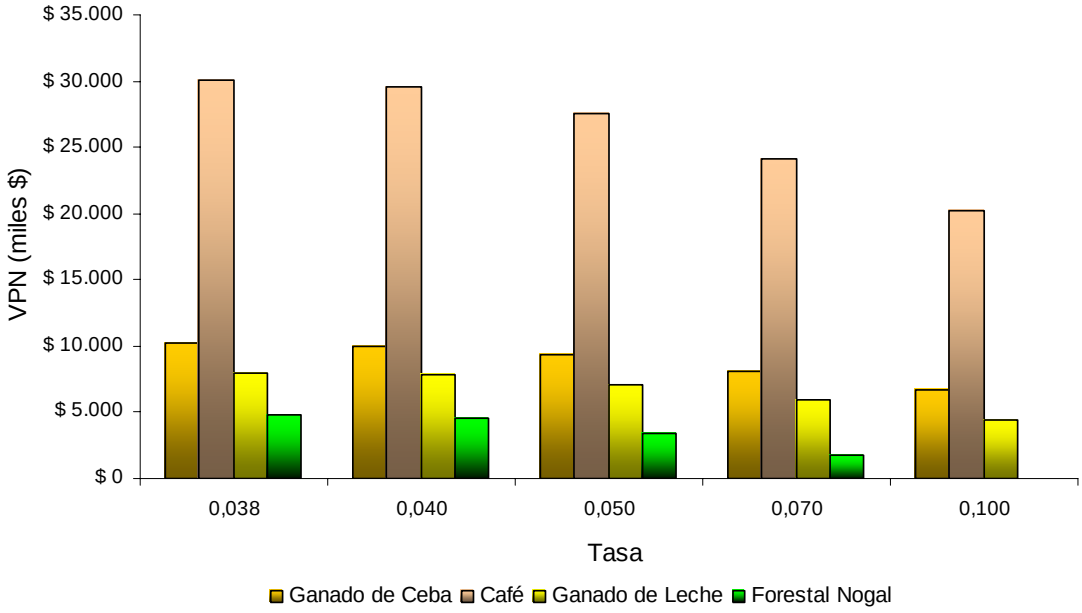

FIGURE 21. Behavior of annual net present value (NPV) for beef and dairy cattle raising activities, coffee plantations and the forest proposal with walnut trees, under different rates (3.8, 4, 5, 7 and 10%). The walnut species was selected because it showed the highest IRR in the cash flow.

Step 3. Analysis of Potential Barriers

This analysis was carried out in order to discard those barriers which for various reasons should not be included in the PDD and focus our efforts on those considered more relevant. To this end, matrixes were constructed for each project in which the optional barriers potentially existing in each of the projects are determined and justified. Subsequently, for each of the barriers identified, their application to other alternatives in the zone is analyzed and there is an assessment of whether the CDM could remove them.

The barriers perceived in the PROCUENCA project appear to be few and basically relate to investment and social conditions, essentially due to demographic pressure on the land. The latter is considered the greatest barrier for the project and there is a high potential to demonstrate it. The other barriers are more general and are not specific to the project but to the general situation of the country. The evidence that can be obtained for these will serve equally for both projects.

Sub-step 3a. Identify barriers which might prevent the implementation of the type of project activity proposed

i) Investment barriers

Although there are funds in Colombia allocated to this type of activities, such as the Forest Incentive Certificate (Certificado de Incentivo Forestal) (CIF), the policies related to this incentive are still confusing and the delivery of the incentive is highly uncertain. There is inconsistency between the budget initially assigned to the incentive and the amount of money which must be invested in the projects that applied for it and are under execution.

There are no bank credits for reforestation. Banking institutions perceive the investment risk for this type of projects as very high, due to market limitations and the long return on investment period. There are multilateral banking credits, but their processing is quite complex and, furthermore, they are intended mainly for Regional Autonomous Corporations, the entities in charge of managing environmental resources and policies in the various regions of Colombia.

iii) Technological barriers

There are limitations to obtain reliable germoplasm sources for native species and some of the commercial species of the project. Research in forest genetics is scarce in our country and, in addition, there is little technology transfer to the communities.

iv) Barriers related to local tradition

Coffee-growing is a deeply-rooted activity among the inhabitants of the region and the markets for this activity are well defined. The same is true for ranching and dairy farming. These activities currently have strong institutional support, through federations such as Fedecafe and the Stockbreeders Committees, which are well organized entities from the technological, financial and institutional points of view.

vi) Barriers due to social conditions

The area is undergoing a rapid urban expansion process and, therefore, the pressure to develop these lands makes their price increase and hampers the implementation of other activities such as reforestation. This situation is even more accentuated in the medium and low areas of the Chinchiná River watershed, although there is also pressure in the high areas, but not as generalized yet.

One of the strengths of the project is its potential to educate individuals from the region and train them in the successful development of forestry activities. Without the PROCUENCA-FAO project, there would be no community organizations related to forest activity, while for the performance of traditional alternative activities there is sufficient qualified personnel in the region.

vii) Barriers related to possession of the land, ownership, inheritance and property rights.

The PROCUENCA-FAO project is clear with respect to the form of participation of individuals or entities interested in the project, at the level of demonstrating the legal possession of the land, the ownership rights of the resources and services obtained, and therefore there are no barriers perceived in this respect.

Step 4. Impact of the CDM registration

The approval and registration of the proposed A/R CDM activity will permit a reduction of the economic and financial obstacles that prevent the project's implementation, such as the absence of bank credits for reforestation projects in Colombia.. It will also allow the strengthening of community organizations to work in the forest in the area of influence, through training and overcoming the technological barriers, serving as a precedent to consider other alternative uses of the land in the region and in other areas of the country with high potential for the implementation of similar projects.

The resources received from the sale of tCERs will, furthermore, allow the local inhabitants to reduce their fear of investing in the project's activity, by guaranteeing a revenue from the sale of the emmission reduction certificates. Thus the project will become more independent from the constant fluctuations in

the market price of wood. The revenues from CER sales depend exclusively on attaining the growth targets of the forest species, while the revenues from wood depend on the growth targets and in addition on the existence of a viable market in the future. Hence, it is guaranteed that the project will not fail from the financial point of view.

Thus, without the registration of the project in the MDL, the investment in reforestation and the financial, social and environmental benefits resulting from its implementation would not be possible.

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

>>

ID number[20]	Data variable	Data unit	Value applied	Comment

Year	Annual estimation of baseline net anthropogenic GHG removals by sinks in tonnes of CO_2 e
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
10	0
11	0
12	0
13	0
14	0
15	0
16	0
17	0
18	0
19	0
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	0

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

period of estimated baseline net GHG removals by sinks (tonnes of CO2 e)	

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

>>

Andean Center for Economics in the Environment
www.andeancenter.com
Cra. 3 No. 11-55 Int. 213
Bogotá, Colombia
Thomas Black Arbeláez
Email: thomas.black.a@gmail.com

Centro de Investigación en Ecosistemas y Cambio Global Carbono y Bosques (C&B)
www.carbonoybosques.org
Medellín, Colombia
Calle 51 No.72-07 Int. 708
Wilson Lara
Email: wilsonlara@carbonoybosques.org

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:

>>

TABLE 13 *Estimates of net GHG removals by sinks, in the ex-ante phase of the project.*

Years	DCplb	GHGe
1	12837.10	43.30
2	27453.28	60.59
3	32687.61	69.32
4	45790.26	73.11
5	60444.27	78.43
6	103851.75	169.34
7	159038.42	178.38
8	188731.55	187.43
9	258716.91	187.43
10	340335.52	178.38
11	391032.98	151.38
12	434833.39	0.00
13	363528.85	0.00
14	366592.67	0.00

15	334611.74	0.00
16	321447.44	0.00
17	311964.62	0.00
18	220849.20	0.00
19	306264.45	0.00
20	197990.43	0.00

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

>>

TABLE 14 *Ex-ante estimates of leakage produced by the project.*

Years	LKvehicle	LKconversion	LKfuelwood	LKfencing
1	3160.27	0.00	0.00	0.00
2	3231.66	0.00	0.00	0.00
3	3213.81	0.00	0.00	0.00
4	3228.14	0.00	0.00	0.00
5	3237.11	0.00	0.00	0.00
6	3314.94	0.00	0.00	0.00
7	3334.77	0.00	0.00	0.00
8	3354.60	0.00	0.00	0.00
9	3374.43	0.00	0.00	0.00
10	3334.77	0.00	0.00	0.00
11	3203.95	0.00	0.00	0.00
12	3136.48	0.00	0.00	0.00
13	3136.48	0.00	0.00	0.00
14	3136.48	0.00	0.00	0.00
15	3136.48	0.00	0.00	0.00
16	812.74	0.00	0.00	0.00
17	812.74	0.00	0.00	0.00
18	812.74	0.00	0.00	0.00
19	812.74	0.00	0.00	0.00
20	812.74	0.00	0.00	0.00

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

E.1.1. Monitoring of the project boundary:

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Monitoring the boundary of the proposed A/R CDM project activity

The factors to be verified for the development of this section as determined by the methodology are:

- Review of all project boundary to assess possible reforestation activities presently under way.
- Geographical survey of the areas comprising the project, making use of geographical tools such as satellite images, maps or aerial photographs, and conducting field verification with GPS.
- Calculation of the eligible areas differentiated by strata or substrata.
- Periodic verification that the project limits correspond to the limits enunciated in section A.
- Should additional areas be added on to the areas initially defined in the project and not considered at the time (proposed in section A), these would be subject to verification of their eligibility as lands suitable for the proposed A/R project, within the CDM model. To this end, it will also be necessary to establish their respective baseline net GHG removal. However, these areas will not be considered part of the A/R activities proposed in the initial project. It should be pointed out that any change occurring in the limits of the project area must be reported and the affected areas will be subject to validation during the project's execution.
- There will be periodic verifications of the project area limits, during the accreditation period. If the limits present changes within this period on account of deforestation, these areas will be located and determined. The modified limits will be reported to the DOE for their subsequent verification, the deforested lands will be excluded from the project and the CERs issued for these areas will be deducted. Similarly, the areas where planting fails, or the use of the land changes, must be documented.

ID number[21]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[22]	Recording frequency	Number of data points / Other measure of number of collected data	Comment

E.1.2. Monitoring of forest establishment:

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The factors to be verified for the development of this section as determined by the methodology are:

- Review of all project boundary to assess possible reforestation activities presently under way.
- Geographical survey of the areas comprising the project, making use of geographical tools such as satellite images, maps or aerial photographs, and conducting field verification with GPS.
- Calculation of the eligible areas differentiated by strata or substrata.
- Periodic verification that the project limits correspond to the limits enunciated in section A.
- Should additional areas be added on to the areas initially defined in the project and not considered at the time (proposed in section A), these would be subject to verification of their eligibility as lands suitable for the proposed A/R project, within the CDM model. To this end, it will also be necessary to establish their respective baseline net GHG removal. However, these areas will not be considered part of the A/R activities proposed in the initial project. It should be pointed out that any change occurring in the limits of the project area must be reported and the affected areas will be subject to validation during the project's execution.

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

[22] Please provide full reference to data source.

- There will be periodic verifications of the project area limits, during the accreditation period. If the limits present changes within this period on account of deforestation, these areas will be located and determined. The modified limits will be reported to the DOE for their subsequent verification, the deforested lands will be excluded from the project and the CERs issued for these areas will be deducted. Similarly, the areas where planting fails, or the use of the land changes, must be documented.

ID number[23]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[24]	Recording frequency	Number of data points / Other measure of number of collected data	Comment

E.1.3. Monitoring of forest management:

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In order to guarantee the quality of the planting and confirm that the forestry activities described in section A are well implemented, procedures would be set up that lead to the gathering of all information on the establishment activities carried out until the first monitoring, such as:

- **Clearings:** Type of clearing, density, places, species and biomass extracted.
- **Crops:** Location of crops, area, species and biomass extracted.
- **Fertilization:** Species, location, amount and type of fertilizer applied, etc.
- Verification and confirmation that the areas harvested will be replanted or reseeded by direct planting, immediately after being used.

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

[24] Please provide full reference to data source.

- Verification and certification that the lands harvested present good conditions for natural regeneration, if allocated to this purpose.

Among others. All these activities must include the respective date of execution.

ID number[25]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[26]	Recording frequency	Number of sample plots at which the data will be monitored / Other measure of number of collected data	Comment

E.2. Sampling design and stratification:

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Stratification:

Stratification of the areas will correspond to the guidelines established by the methodology, and consists of a first stratification based on the existing natural conditions or factors such as physical and chemical conditions of the soil, topography, climate, hydrology, land use history, type of existing vegetation, in addition to factors such as degree of anthropic pressure on the soil, which is determined in the reference scenario (Ch. B). Other final factors that will be considered for the stratification will be the differences in the estimated carbon capture capacity for each productive system or tree stand model.

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

[26] Please provide full reference to data source.

The unification of indicated ex-ante stratification criteria allows us to enter an initial stratification based on the proposed productive systems, given that these depend on the topographic and edaphic conditions of the project boundary.

After the first monitoring of the plots of land, re-stratifications may be carried out according to: 1) the results of biomass accumulation, 2) planting dates and 3) forestry treatments carried out and/or productivity attained by the various forest systems present in the project. The information required for the stratification process will be determined by the forest inventories, evidences of vegetation changes through aerial photographs or with information of another nature, always trying to present the lowest possible number of strata that will facilitate the total evaluation of the project scope. As determined by the methodology, strata that are considered as presenting similar conditions of a diverse nature in terms of biomass accumulation, forestry activities, etc., reflected in the results of the first monitoring, may be unified in order to reduce the number of strata.

Structuring of the sampling

The establishment of permanent sampling plots is considered, their number depending on the number of strata present within the project boundaries in accordance with cost – effectiveness criteria. The monitoring will assess the evolution of the biomass in those tree stands or covers comprising the project and which have been subjected to various forestry activities (e.g. preparation of the soils, fertilization, clearing, harvesting, enrichment, etc). All plots of land will be duly numbered, georeferenced and located in a map of covers present within the project boundaries (see attached sampling protocol).

Determination of sample size

The number of plots will be determined by the variation in the species, number of strata identified, accuracy and monitoring interval; this under a proper cost-effectiveness concept. The sample size (n) is estimated with fixed accuracy levels, assuming there are no cost differences between the existing strata and substrata, as described in the approved methodology and starting from assessments made in tree stands with similar characteristics or information in existing literature. Therefore for l strata, the number of plots of land is given by:

$$n = \frac{\left(\sum_{h=1}^{l} N_h \cdot s_i\right)^2}{\frac{N^2 \cdot E^2}{t^2}\left(\frac{N^2 \cdot E}{z_{\alpha/2}}\right)^2 + \left(\sum_{h=1}^{l} N_h \cdot {s_i}^2\right)} \qquad (1)$$

Where
N_h number of sampling units for stratum *h*
l strata defined in the project scenario
s_i standard deviation for stratum *i*
N total number of sample units (all strata)
E permitted error (± 5% of mean)
$z_{\alpha/2}$ value of statistical z for a confidence level (95%), this value is assumed as $z = 2$, given that the size of the sample is unknown.

The standard deviation (*s*) will be taken from measurements made in similar tree stands to those proposed, in areas located near those of the project. In those cases where this is not possible, standard deviations reported in local or international scientific literature, for similar systems and species, would be used. The sample size will exceed 10 % of the value estimated by the equation; thus, we have a prudential additional number of plots to counteract any contingencies which may cause losses of sampling units over time. Similaly, and following the first monitoring, it is possible that the sample size will be modified, according to the results obtained from said monitoring analysis. Therefore, a new examination of the sample size (*n*) may be carried out after the first monitoring. When it is identified that the establishment costs of a plot of land are variable, the new plot size will be alternatively established with equation 2.

$$n = \left(\frac{t}{E}\right)^2 \left[\sum_{h=1}^{L} W_h \cdot s_h \cdot \sqrt{C_h}\right] \cdot \left[\sum_{h=1}^{L} W_h \cdot s_h \Big/ \sqrt{C_h}\right] \qquad (2)$$

$$n_h = n \cdot \frac{W_h \cdot s_h / \sqrt{C}}{\sum_{h=1}^{L} W_h \cdot s_h / \sqrt{C_h}} \qquad (3)$$

Where:
L total number of strata
T value of statistical t for a specified confidence level (95%); this value was assumed as t = 2, when the sample size is unknown.
E permitted error (± 10% of mean)
s_h standard deviation for stratum h
n number of sampling units

n_h number of sampling units for stratum h, their value is proportional to $W_h \cdot S_h / \sqrt{C_h}$

W_h N_h / N

N total number of sampling units (all strata), $N = \sum N_h$

N_h number of sampling units for stratum h, results from dividing the area of stratum h by the area determined for each plot.

C_h cost of selecting a plot from stratum h

Size of the plots or sampling units.

The size of the plots of land for monitoring will be determined by the type of forest system to be assessed and the planting density. It is recommended to establish 100 m^2 plots in those tree stands with a high planting density and up to 1000 m^2 for more open tree stands. In the Procuenca project, nested rectangular plots of land with an area of 500 m^2 will be established in all forest systems. Within them, all trees with a diameter equal to or greater than 10 cm would be measured. Within these plots, subplots of 25 m^2 each will likewise be established, in which all trees with a diameter of less than 10 cm and with a minimum stem height of 1.3 m will be measured. In case it should become necessary to change the size of the sampling units, the size of the plots of land may fluctuate between 250 and 1000 m^2. This size interval is considered cost-effective according to the proposed A/R models. The size variation is determined by factors such as: stratum, species, planting system or even by variations in the A/R productive models under CDM.

Location of plots of land in the field.

The distribution of the sampling units will follow a stratified random pattern. The allocations will be made using the "*Random Point generator* " tool of *ArcView* software, in order to avoid the subjective location of the plots (center of the plots, reference points of the plot or movement of the center of the plot to a more "convenient" position). Following the randomness principle is considered a good practice by GPG-LULUCF. For their location and georeferencing in the field, a GPS system will be used, thereby permitting their easy access, location and monitoring over time. The sampling plots of land will be identified with alphanumeric code series and the information regarding their geographical position (GPS geographic coordinates), the location of the sample unit, as well as the strata and substrata, will be recorded and archived.

Monitoring frequency.

Time intervals for monitorings depend largely on the variation of carbon contents in the sinks. Nevertheless, in order to decrease their implementation costs, a monitoring frequency is established in accordance with the years of verification, thereby assuming a five-year monitoring frequency. In general, the years of

monitoring are related to the periods of accreditation and tCER issuance (see Annex 4), considering that a monitoring must coincide with the first commitment period, which is defined for the year 2012. The first plantations of the PROCUENCA project were established during the year 2002. It is expected that the first monitoring will be carried out at the end of 2007. The next monitorings will be made at the end of the years 2012, 2017 and 2022 (Annex 4).

Measurement and estimation of changes in carbon stock over time.

Only the biomass increase in tree vegetation (belowground and aboveground) is considered, thus assuming a conservative position with respect to increases in carbon capture, given that herbaceous, shrub and grass vegetation is not counted, as this component will continue to contribute little to the accumulated biomass, thus being consistent with the assumption proposed in the referenced scenario (subsection B of this document), where the change in the carbon content is assumed as zero for this type of vegetation. Therefore, only the individual growth of each tree in the sampling plots will be monitored. Said value shall be estimated as in terms of shaft increase for each monitoring period. The carbon content changes in other components of the aboveground biomass (branches and leaves) and belowground biomass (roots) of the trees in each plot of land will be estimated through the expansion factor method or through the alometric equations method, said procedure being considered a good practice according to the IPCC[27].

[27] *The Intergovernmental Panel on Climate Change* (IPCC) 2003. IPCC Good Practice Guidance for LULUCF.

Monitoring of GHG emissions produced by emitting sources, as a result of the implementation of proposed A/R under CDM activity.

The possible emissions generated by the A/R under CDM activities of the proposed project are monitored with the same frequency as the biomass and within the same time intervals, enabling the establishment of an exact accounting of the net anthropogenic removals derived from the project for the same periods. The elimination of the entire plant component is not anticipated for the establishment of the plantation, nor will it be subject to burning. Therefore, only nitrous oxide emissions are considered, as a consequence of fertilization with nitrogen and the burning of fossil fuel as a result of vehicle movements or from the use of machinery during the project's execution. Nevertheless, all forestry activities will be monitored allowing for changes in the initial establishment proposals. The emissions generated will be monitored, assessed and estimated with the information obtained from the forest management activities. An adequate emission factor in CO_2-e would be applied to the results of these emissions, to be subsequently deducted from the net removals.

E.3. Monitoring of the baseline net GHG removals by sinks :

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It is deemed that the net changes in carbon contents present in the sinks considered are equal to zero in the scenario of baseline net GHG removals, due to the fact that the lands included within the project boundaries are areas dedicated to pasturage and to the establishment of temporary crops, assuming, therefore, that they are areas devoid of forest cover (under the concept of forest considered for the Colombian national territory). In addition, the history of land use indicates that the baseline net GHG removals will remain constant over time (zero) with the use actually made of the lands. Therefore, the monitoring of the baseline net GHG removals by sinks will not be necessary, at least during the first accreditation period.

E.3.1. Monitoring of the baseline net GHG removals by sinks (before start of the project), if required:

>>

N/A

ID number[28]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[29]	Recording frequency	Number of sample plots at which the data will be monitored	Comment

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

[29] Please provide full reference to data source.

E.3.2. Monitoring of the *ex post* baseline net GHG removals by sinks (after start of the project), if required:

>>
N/A

ID number[30]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[31]	Recording frequency	Number of sample plots at which the data will be monitored	Comment

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

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

>>

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

[31] Please provide full reference to data source.

ID number[32]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[33]	Recording frequency	Number of sample plots at which the data will be monitored	Comment
4.1.1.01	*Stratum ID*	*Alpha numeric*	*m, e*	*Before start of the project*	*100%*	*Each stratum is established through a combination of criteria such as species, type of soil, climate, existing vegetation and topography.*
4.1.1.02	*Sampling plot ID*	*Alpha numeric*		*Before start of project*		*Each plot is identified with a unique code.*
4.1.1.03	*Plot location*		*m*	*5 years*		*After the start of the project, the plots will be located in the field with GPS, at the time of the monitoring.*
4.1.1.04	*Confidence level*	*%*	*e*	*Before start of project*		*Allows maintaining quality control of the measurement and controlling accuracy of the monitoring*
4.1.1.05	*Precision level*	*%*	*e*	*Before start of project*		*In order to maintain quality control of the measurement and control accuracy of the monitoring*
4.1.1.06	*Tree species*			*5 years*		*Those established in the CDM project under proposed A/R.*
4.1.1.07	*Age of plantation*	*year*	*m*	*5 years*		*Counted as of planting date*
4.1.1.08	*Number of trees by species*	*Numeric*	*m*	*5 years*		*Counted in the sampling plot*
4.1.1.09	*Diameter at*	*cm*	*m*	*5 years*		*Measured during each monitoring period,*

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

[33] Please provide full reference to data source.

	breast height (DBH)					*following the sampling method. The DAP is established at a height of 1.3m.*
4.1.1.10	*Mean DBH*	*cm*	*c*	*5 years*		*The mean diameter is obtained with the information of 4.1.1.08 and 4.1.1.09.*
4.1.1.11	*Tree height*	*m*	*m*	*5 years*		*Total length of main branch of measured tree.*
4.1.1.12	*Mean tree*	*m*	*c*	*5 years*		*The mean diameter is obtained with the information of 4.1.1.08 and 4.1.1.11.*
4.1.1.13	*Wood density*	*$td.m.m^{-3}$*	*m,e*	*5 years*		*Intrinsic to each species. The established national values or those measured in the project can be followed.*
4.1.1.14	*Biomass expansion factor (BEF)*	*dimensionless*	*e*	*5 years*		*Intrinsic to each species*
4.1.1.15	*Carbon fraction*	*$tC(td.m^{-1})$*	*m ,e*	*5 years*		*Value by default established by IPCC*
4.1.1.16	*Root - shoot ratio*	*dimensionless*	*e*	*5 years*		*Specific for the species, literature curve or default value based on practices guide in "LULUCF" for each species.*
4.1.1.17	*Carbon stock change in belowground biomass of plot*	*$tCha^{-1}$*	*c*	*5 years*		*Calculated from 4.1.1.09 and 4.1.1.11.*
4.1.1.18	*Carbon stock change in aboveground biomass of plot*	*$tCha^{-1}$*	*c*	*5 years*		*Calculated from 4.1.1.11 4.1.1.17, making use of expansion factors or functions for this component.*
4.1.1.19	*Average carbon*	*$tCha^{-1}$*	*c*	*5 years*		*Through 4.1.1.18*

	belowground biomass by unit of area, species and stratum					
4.1.1.20	*Average carbon content present in aboveground biomass by unit of area, species and stratum*	*$tCha^{-1}$*	*c*	*5 years*		
4.1.1.21	*Area of stratum and substratum*	*ha*	*m*	*5 years*		*Actual area of each stratum and substratum*
4.1.1.22	*Carbon content present in aboveground biomass of each species by stratum*	*tC*	*c*	*5 years*		*Based on information of the monitorings via 4.1.1.08 to 4.1.1.14, through equation 7.*
4.1.1.23	*Carbon content present in belowground biomass of each species by stratum*	*tC*	*c*	*5 years*		*Based on information of the monitorings via 4.1.1.16.*
4.1.1.24	*Change in belowgroun*	*$t\ year^{-1}$*	*c*	*5 years*		*Differences in estimations made from inventory information for each monitoring*

	d biomass contents for each species in each stratum					*period*
4.1.1.25	*Total carbon stock change CO2 - e.*	*t CO2-eq year^{-1}*	*c*	*5 years*		*Corresponds to the sum total of changes in all carbon contents by sinks, for each stratum, substratum and by species.*

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:

>>

ID number[34]	**Data variable**	**Data unit**	**Measured (m), calculated (c) estimated (e) or default (d)**[35]	**Recording frequency**	**Number of sample plots at which the data will be monitored**	**Comment**
4.1.2.1	*Amount of synthetic fertilizçer N applied per unit area.*	*Kg N ha^{-1}yr^{-1}*	*m*	*annual*	*100%*	*According to species and management of tree stand.*

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

[35] Please provide full reference to data source.

4.1.2.2	*Amount of organic fertilizer N, applied per unit area*	*Kg N ha^{-1} yr^{-1}*	*m*	*annual*	*100%*	*According to species and management of tree stand.*
4.1.2.3	*Area of land with N applied*	*$ha^{-1}yr^{-1}$*	*m*	*annual*	*100%*	*According to species and management of tree stand.*
4.1.2.4	*Amount of synthetic fertilizer N applied.*	*t N $ha^{-1}yr^{-1}$*	*c*	*annual*	*100%*	*According to demands of each species and for each stratum. Obtained through the monitoring of A/R activities.*
4.1.2.5	*Amount of organic fertilizer N applied.*	*t N ha^{-1} yr^{-1}*	*c*	*annual*	*100%*	*According to demands of each species and for each stratum. Is obtained through the monitoring of A/R activities, using equation 16 via 4.1.2.2 and 4.1.2.3*
4.1.2.6	*Fraction that volatilizes as NH_3 and NO_x for synthetic fertilizer*	*Dimensionaless*	*d*	*Before the monitoring*	*100%*	*Value estimated by the IPCC (0.1) is assumed by default*
4.1.2.7	*Fraction that volatilizes as NH_3 and NO_x for organic fertilizer*	*Dimensionaless*	*d*	*Before the monitoring*	*100%*	*Value estimated by the IPCC (0.2) is assumed by default*
4.1.2.8	*Emission factor fron N input*	*Dimensionaless*	*d*	*Before the monitoring*	*100%*	*Value estimated by the IPCC (1.25%) is assumed by default*

4.1.2.9	*Direct N_2O of N input*	*Dimensionaless*	*c*	*annual*	*100%*	*Calculated from information of sections 4.1.2.4 to 4.1.2.8, through equation 17*

E.5. Leakage:

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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:

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Leakage represents an increase in GHG emissions by emitting sources in areas located outside the project boundary, as a result of the implementation of A/R activities under CDM. This leakage must be measurable and quantifiable. The Procuenca project could promote the displacement of agricultural and pasturage activities carried on in the areas where tree planting is anticipated to take place. Nevertheless, leakage only occurs to the extent that wooded ecosystems are altered or wherever it is necessary to eliminate the plant cover, to prepare new sites outside the project boundary. The main source of leakage in this project will be the GHG emissions related to the displacement of grazing animals.

It should be mentioned that the project only anticipates the temporal displacement of pasturage activities, given that the A/R proposal includes sylvopastoral systems, allowing intensive pasturage activities over short time intervals, gradually bringing the displaced animals back to the sylvopastoral systems. Therefore, the leakage sources due to displacement of pasturage activities could be of little significance.

The agricultural activities carried on in certain project boundary will not necessarily be displaced, as there will be a change in the working activities of the farmers and, in addition, these activities will be incorporated into the agroforestry models, in order to be efficient in the use of the soil. Therefore, it is considered that leakeage due to displacement of agricultural activities are not significant.

The other leakage, considered more relevant, are associated with the burning of fossil fuels, due to vehicle movement outside the project boundaries, necessary for the transport of personnel related to the A/R activities, the technical team, administrative personnel and consultancy and monitoring groups of the CDM project. On the other hand, the necessary vehicle movement for the supply of inputs, raw materials, equipment and marketing of harvested products (wood, fruit, cattle, etc) is considered. CO_2 emissions may be estimated using the *bottoms-up* approach, as described in the IPCC-GPG (2000).

ID number[36]	Data variable	Data unit	Measured (m), calculated (c) estimated (e) or default (d)[37]	Recording frequency	Number of data points	Comment
5.1.01	*Hectares deforested due to displacement of activities*	*ha*	*m*	*Years 1, 5*	*100%*	*Only monitored if there is a deforestation of the wooded cover for implementation of the activity.*
5.1.02	*Average carbon stock of mature forest (t CO_{2-e})*	*t CO_{2-e}/ha*	*e*	*once*	*100%*	*The values reported must correspond to wooded covers of similar ecosystems to those intervened.. The biomass values found may be multiplied by 1.83 in order to take them to t CO_{2-e}*
5.1.03	*Leakage due to deforestation*	*t CO_{2-e}*	*c*	*Years 1, 5*	*100%*	*Estimated with information from 5.1.01, 5.1.02 and 5.1.03*
5.1.04	*Number of each vehicles type used*	*numeric*	*c*	*annually*	*100%*	*Monitoring of the movements of each vehicle*
5.1.05	*Emission factor for road transportation*	*Kg $CO_{2-e}l^{-1}$*	*e*	*annually*	*100%*	*Values estimated at local or national level are prioritized*
5.1.06	*Kilometers travelled by vehicles*	*km*	*m*	*annually*	*100%*	*Monitoring of kilometers of movement estimated for each type of vehicle*
5.1.07	*Fuel consumption*	*liters*	*e*	*5 years*	*100%*	*Monitoring of kilometers of movement estimated for each type of vehicle, in*

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

[37] Please provide full reference to data source.

	per kilometer traveled, by each type of vehicle					*addition to quantity and type of fuel consumed*
5.1.08	*Fuel consumption for road transportation*	*liters*	*c*	*annually*	*100%*	*Calculated with information from 5.1.04, 5.1.06 and 5.1.07 through equation 23*
5.1.09	*Leakage due to vehicle use for transportation*	*Kg $CO_{2\text{-}e}year^{-1}$*	*c*	*annually*	*100%*	*Calculated with information from 5.1.05, 5.1.87 through equation 22*

E.5.2. Please specify the procedures for the periodic review of implementation of activities and measures to minimize leakage:

>>

The way the project has been proposed, the leakages that can be generated by the project's implementation are of two types: from the burning of fossil fuels and from the displacement of pasturage activities. However, the latter, as indicated above, is not expected to occur due to the change in the production system that is to be implemented, going from extensive cattle raising to intensive modernized cattle raising, in addition to gradually incorporating the population currently involved in stock breeding activity into forestry activity. This way, the project seeks to eliminate possible leakage from enteric fermentation or conversion of wooded areas into pasturelands. On the other hand, the use of vehicles for the transport of equipment, supplies, harvest products and personnel must be efficient, given that the costs related to their use is a determining factor in the cash flow, with an impact on the decrease of emissions. In addition, technological development will be applied by incorporating more efficient vehicles in terms of diesel fuel consumption and kilometers traveled, and trying to make use of gas as fuel in those vehicles that allow it.

E.6. Quality control (QC) and quality assurance (QA) procedures undertaken for data monitored:

Data ***(Indicate table and ID number e.g. 3.-1.; 3.2.)***	Uncertainty level of data (High/Medium/Low)	**Explain QA/QC procedures planned for these data, or why such procedures are not necessary.**

4.1.1.03 Plots Location	*Low*	*The use of GPS will ensure a random verification of the monitoring plots for changes in carbon contents in the project.*
4.1.1.01 Stratum ID	*Medium*	*Is determined by the species and forestry activities.*
4.1.1.06 Tree species	*Low*	*Random verification in the project boundary, ensuring that the types of tree species planted are well estimated.*
4.1.1.07 Plantation age	*Low*	*Random verification in the project boundary that the plantation age is correctly determined.*
4.1.1.08 Number of trees	*Low*	*Random verification of the plots of land*
4.1.1.09 Diameter at chest heightt (DAH)	*Low*	*Random verification of the plots of land. Several plots of land are selected and various diameters are measured, enabling their comparison against the records and finding possible measurement errors. The remeasurement of a portion of the individuals will be promoted after completing the measurement of each plot of land.*
4.1.1.11 Tree height	*Low*	*Random verification of the plots*
4.1.1.13 Wood density	*Low*	*The density values of the species planted will be estimated and compared against those initially established in the project and, if such were the case, said values will be corrected.*
4.1.1.14 Biomass expansion factor	*Low*	*Values established by default by the IPCC which may be verified*
4.1.1.15 Carbon fraction present in the biomass.	*Low*	*Value established by default by the IPCC which may be verified*

4.1.1.16 Root - shoot biomass ratio	*Low*	*Value established by default by the IPCC which may be verified*
4.1.2.9 Direct N_2O emissions due to incorporated N	*Medium*	*The values established by the IPCC, which are established by default and can change due to the update of the published reports.*
5.1.04 Number of vehicles of each type	*Low*	*The trips made will be reported and will be verifiable in the project.*
5.1.07 Fuel consumption per km.	*Low*	*Consumption values may be less than those estimated due to technological changes or modernization of vehicles.*
5.1.06 Kilometers traveled by each vehicle	*Low*	*The trips made will be reported and will be verifiable in the project.*
5.1.01 Deforested hectares due to displacement of activities	*Low*	*It is highly feasible that there will be no displacement of agricultural and cattle raising activities outside the project boundaries*

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

>>

The project entitled "Development of an Environmental Services Payment Scheme through the CDM for Water, Soil and Biodiversity Conservation and Climate Change Mitigation in the Chinchiná River Watershed, PROCUENCA-FAO" is an environmental, productive and social alternative for the area of influence. It is an initiative promoted by the departmental environmental authority, CORPOCALDAS and the Instituto de Financiamiento, Promoción y Desarrollo de Manizales, (INFIMANIZALES), considering the Clean Development Mechanism as a co-financing source, with the additional participation of the PROCUENCA-FAO institution. The latter is responsible for managing and executing the proposed project's A/R activities and, in addition, for

coordinating the project participants. Therefore, this entity will be in charge of facilitating the technical, scientific and other means that will allow the development of the proposed A/R project under the CDM quantification and monitoring process.

The FAO will be in charge of cooperation in specific programs, general technical assistance and fiduciary administration of resources, based on its worldwide experience.

On the other hand, an international or domestic institution, duly authorized to such end, will be in charge of conducting the verification or audit process and subsequent approval of the results generated by the monitorings, through checks and taking of random information at the monitoring points.

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

>>

Andean Center for Economics in the Environment CAEMA:

- Thomas Black Arbelaez

Carbon and Forests Research Center C&B:

- Wilson Lara Henao
- Andrés Sierra Buitrago
- Cesar Bustamante

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:

>>

Historically, the Chinchiná River watershed has experienced deterioration processes of the natural forests due to many years of timber and fuelwood extraction activities, either as raw material sources for certain industries such as mining or for domestic consumption. Something to be highlighted is the absence of management of the protective forest in steep slope areas, to ensure a balance between use and conservation of this resource. The decrease in the wooded cover has forced the rural communities that depend on this element as a source of energy to move farther away each time and to use forest resources which are not the most appropriate to attend to this demand.

Coffee-growing activity has generated important environmental impacts which cause a decrease in the water offer of the ecosystem, such as the elimination of the tree covers associated with the crop, pollution of the waters with agrochemical products and additional contaminations of the water sources, due to poor management of the waste products from this activity, such as coffee pulp and the waters resulting from the treatment of coffee beans at the coffee processing plants.

As to the cattle production systems, the criterion of free pastures with no tree presence has prevailed, following the guidelines of the green revolution. In fact, the clearing and burning system has been constantly used in the paramos and subparamos of Los Nevados natural national park, favoring erosion and soil degradation processes. These factors demonstrate the scarce sustainability of the cattle production scheme, with the strongest impacts being in high places, where the ecosystems are more fragile and vulnerable to disruptions. In addition, there is an encroachment of bodies of water by cattle, including river and stream sources, wetlands and watercourses, contaminating the sources with fecal coliforms (Corpocaldas, 2002).

According to the Forest Zoning plan proposed by CONIF in the year 2000, nearly 60% of the territory has forest potential. As a result of this, given that the use of the soil does not match its potential, the loss of wooded cover has led to deterioration of the environmental offer, modification of the water cycle, high sedimentation levels in the waters, erosive processes and loss of habitat for the flora and fauna. These factors are evidenced due to a non-sustainable development model which endangers the availability of the watershed's natural resources.

From the participative diagnosis of the Territorial Environmental Management Plan of the Chinchiná River watershed (1999), we can extract the following priority issues originating in the traditional uses of the soil, in order of importance:

- Pollution of surface water sources
- Absence of Environmental Education, in the areas described in the matrix
- Inappropriate management of Water Resources
- Frailty of micro-watersheds that feed the municipal and rural water systems
- Pressure on the forest
- Inappropriate management of production modes
- Inappropriate management of solid wastes
- Extinction of existing flora

- Deficit in waste water management in the rural area

With the implementation of the PROCUENCA-FAO A/R activity under the CDM the following environmental benefits will be obtained:

- Regulation of the water cycle
- Prevention of erosion
- Improvement of soils
- Reduction of pressure on the natural forests.
- Carbon capture
- Formation and consolidation of biological conservation corridors
- Increase of biodiversity

Risks

There are general risks for forest projects and specifically for the Procuenca project. Among these are:

- forest fires: The Project has been establishing forest brigades to respond to and mitigate possible forest fires in project boundary. The high precipitation and its excellent distribution minimizes this risk.
- pests and forest diseases: The project maintains a constant field monitoring together with the owners. In order to attend to possible occurrences of pests and diseases, there is a vegetation health committee in the region led by the Colombian Agriculture and Livestock Institute, ICA, an entity of the national order responsible for these matters.
- Impacts on biodiversity: certain concerns have been expressed regarding the possible effect of the Procuenca forest models on biodiversity. In order to measure and document the changes in biodiversity that occur in changing the use of the soil from pastures and coffee to the Procuenca forest models, a biodiversity indicator monitoring program, designed by Conservation International and Fundación Proaves de Colombia, was incorporated.

In the event that the monitoring program indicates that the project activity causes a drop in the biodiversity indicators when compared to the baseline case, the project will take corrective action. In the event that the program shows an increase in the biodiversity indicators, which is what the Procuenca-CI-Proaves technical team expects, this will permit the offer of tCERs from the project with the certainty that, in addition to mitigating climate change, the project is also improving the habitat conditions and increasing the valuable biodiversity in this Hotspot of the Andes.

BIODIVERSITY MODEL AND INDICATORS TO MEASURE BIODIVERSITY INCREASE - FOREST PROJECT FOR THE CHINCHINÁ RIVER WATERSHED (PROCUENCA)

Several studies have focused on describing biodiversity in landscapes transformed by man (Farigh 2003). Nevertheless, there is a need to start proposing new forms of landscape arrangements where both productive systems and biodiversity can function together. For this reason, conservation efforts in highly transformed areas must take into account the elements of the existing landscape, such as secondary forests, agroecosystems, natural resource utilization systems, creation of new reserve areas, establishment of biological corridors, hedges, private and community lands, and to that end it is essential to know the biodiversity in order to establish effective regional conservation strategies (Brown & Kappelle 2001).

A forest project known as PROCUENCA-FAO is currently in progress in the Department of Caldas, specifically in the watershed of the Chinchiná River, aimed at establishing forest plantations, agroforestry and sylvopastoral systems in areas dedicated to extensive cattle raising and perennial crops, for the most part unshaded coffee, in addition to the creation and conservation of biological corridors that will permit the connectivity of natural forest fragments in the high zone, starting from assisted ecological restoration in degraded areas. One of the most used conservation tools at a worldwide level to measure the condition of ecosystems are "Bioindicators", which include those organisms whose presence or absence, abundance or scarcity, can be used for this purpose (Jiménez 1981).

This type of forest and agroforestry systems play an important role in the conservation of wild animals by providing shelter, resting sites, nesting and food (Espinal, S. 1991). This way they become productive systems beneficial to wildlife and at the same time allow for carbon fixation in the course of the growth of forest plantations, creating new carbon sinks. Thus they contribute to the conservation of biodiversity and the sustainable use of the natural resources, in compliance with the requirements of the Kyoto Protocol (Herrera et al 2003).

Most biodiversity conservation actions and efforts are focused on protected areas. However, outside of these, there are increasing productive systems, which create pressure on these natural biodiversity refuges, leaving them, in some cases, practically isolated. Therefore, a more global approach to conservation is necessary, which includes the surrounding agricultural landscape, without losing sight of the needs of specific groups. From here, the development of the "BIODIVERSITY MODEL AND INDICATORS TO MEASURE BIODIVERSITY INCREASE - FOREST PROJECT FOR THE CHINCHINÁ RIVER WATERSHED (PROCUENCA)". The purpose of this study is to define and implement a monitoring model that will permit an evaluation of the increase in biological diversity in the Chinchiná River watershed forest systems, based on the use of biological indicators. At the end of the project, we will have: 1) a document with the characterization of the diversity in each of the representative stages of the productive systems implemented by Procuenca, and 2) a self-sustainable diversity monitoring model, which meets the standards and the agreement on biological diversity adjusted to a carbon capture forest project. In order to accomplish this, we must evaluate the diversity of the different productive packages compared by type of plantation, age and in relation to places without agroecosystems such as pastures and unshaded coffee plantations. From this preliminary information we will select the optimal variables and biological indicators to measure the increase in biodiversity together with its importance and a statistical and methodological model will be designed starting from basic, simple, repeatable and reliable biodiversity monitoring techniques.

This progress report shows the preliminary results, obtained over a period of three months after the start of the study, which partly reflect the current biodiversity status of the area of influence of the PROCUENCA-FAO forest project in the Chinchiná River watershed, particularly the first component which determines fauna diversity (Mammals, Birds, Amphibians and Reptiles) in the different biotypes encompassed by the Procuenca Forest Project for the watershed of the Chinchiná River".

METHODOLOGY

Study Area: The area of this study is located in the municipalities of Manizales, Neira, Palestina, Chinchiná and Villamaría belonging to the Department of Caldas. For sampling design purposes and following the parameters implemented by the PROCUENCA-FAO Forest Project, three main zones (High, Medium and Low) were identified, locating within each of these sampling points for the productive packages belonging to PROCUENCA (Patula pine, Walnut, Walnut-Coffee). The other landscape units present, referred to herein as baseline, constituted mainly by Pastures and unshaded Coffee and finally natural forests, are treated as a control or reference ecosystem (Table 15).

TABLE 15. *Distribution of sampling sites by zones for biodiversity recognition*

Study Zones	Sites x Zone	Habitat Structures	Coordinates	altitude
High Zone	La Floresta	Natural Forest	05º10'18"N 75º26'53"W	2200-2300
		Pastures	05º10'03"N 75º26'50"W	
	Aguas Frías	Adult Pine	05º10'26"N 75º28'31"W	2000-2100
		Young Pine	05º10'01"N 75º28'33"W	
Medium Zone	La Libertad	Natural Forest	05º07'45"N 75º33'38"W	1550-1700
		Coffee-Walnut	05º07'54"N 75º33'41"W	
		Coffee	05º07'48"N 75º33'10"W	
	El Colibrí	Pastures	05º06'31"N 75º33'07"W	1450-1500
Low Zone	La Argelia	Natural Forest	05º03'33"N 75º40'21"W	1100
		Young Walnut	05º03'29"N 75º40'35"W	
	Cuernavaca	Adult Walnut	05º08'49"N 75º43'47"W	960-1000
		Pastures	05º08'41"N 75º43'28"W	

Field Methods: Given their high sensitivity to modifications in their habitat, and considering that their diversity reflects to a good extent that of other taxa existing in a biological community, Birds, small land and flying Mammals, Amphibians and Reptiles were selected as indicator groups for this project.

To obtain the information related to mammals, different capture techniques were used: Creels, Tomahawk Traps and Pitfall Traps for small land mammals, and fog nets for flying mammals. In the case of birds, captures were made with fog nets and through direct observations, using fixed point censuses in the different matrixes studied. Finally, for amphibians and reptiles, the visual encounter survey (VES) method was used, through previously established transects 200 m long and 2 m wide (Heyer et-al 1994). In addition, pitfall traps were used, which were in operation during the sampling days, by study area, following a standardized methodological protocol. Finally, the diversity values by sites have been estimated using the Shannon-Weaver index.

Monitoring Period: The sampling period began in July 2006, and the indicators have been measured since then and to date. The project will permanently maintain the biodiversity monitoring program during

the CDM accreditation period. At the end of each period, the project will present the results of the CO2 fixed by its activity and the changes in the associated biodiversity.

RESULTS AS OF THE PDD SUBMISSION DATE

To date, a total of 43 Mammal species, 185 Bird species, 16 Reptile species and 16 Amphibian species have been reported for the studied sites. The control or reference ecosystem is that which in general terms has the greatest biodiversity values. This is obviously due to the fact that it offers well defined strata, with greater spatial heterogeneity, microhabitat diversity, supply of food in the form of fruit and insects, in addition to optimal humidity and temperature conditions (Murcia, 1997). However, through an analysis of the diversity of the zones by productive and baseline packages, the following results have been found:

High Zone:

The highest diversity values found in this zone for mammals, birds, amphibians and reptiles have occurred in the Adult Pine plantations, which in some cases, as in that of birds and amphibians, show a high similarity with Natural Forests, indicating that these are much more favorable to diversity than the pasture matrixes, due, among other things, to high natural regeneration in the medium and low strata of said system. The high diversity values shown by pastures in the bird group, originate mainly in the fact that this habitat matrix is strongly interrupted by small relicts of micro watershed protective forests which offer possibilities to this group, which does not mean that these are, as such, convenient or offer resources for birds. (Table 16)

TABLE 16 *Diversity values for orders studied in the High Zone*

Order	Habitat Structures			
Orders (Bioindicators)	Productive and baseline systems			Control System
	Adult Pine	Young Pine	Pastures	Natural Forest
Mammals	1.949	1.028	1,243	3,057
Birds	7,336	5,508	6.664	8,285
Amphibians and Reptiles	1,551	1,221	0,97	1,834

Medium Zone:

In this zone, for groups of mammals, amphibians and reptiles, the greatest biodiversity values have been found in the Walnut-Coffee productive package which, owing to the configuration and structure of its habitat, offers shelter, food and reproduction possibilities to these groups of species, above those of the baseline. In the case of birds, no significant differences were observed between the Walnut-Coffee and unshaded Coffee productive systems. The greatest diversity in this group was found in the Pasture matrix, probably due to the presence of different associated landscape structures (natural forests), which permit the movement of numerous species through them (Naranjo, 1992). Finally the zero diversity value for amphibians and reptiles in unshaded coffee may be due to the high level of intervention and the management system used in these habitat matrixes. (Table 17)

TABLE 17. *Diversity values for orders studied in the Medium Zone*

Order Orders (Bioindicators)	Habitat Structures Productive and baseline systems			Control System
	Coffee-Walnut	Coffee	Pastures	Natural Forest
Mammals	1.314	1.116	0.4551	1.949
Birds	7.705	7.985	9.187	8.829
Amphibians and Reptiles	0.6931	0	0.3179	1.274

Low Zone

The diversity of mammals in the low zone has shown similar values in the three habitats studied, being slightly higher in the Adult Walnut forest matrix than in the other systems. As to Birds, the highest diversity values have been found in the Young and Adult Walnut plantations, due to the fact that these not only offer a number of resources to this group, but also function as natural corridors between other surrounding landscape matrixes. Finally, the greatest diversity in amphibians and reptiles has been obtained in the Pasture matrix, above the forest packages, possibly as a result of the high homogeneity found in the lower strata of the latter. (Table 19)

TABLE 19 *Diversity values for orders studied in the Low Zone*

Order Orders (Bioindicators)	Habitat Structures Productive and baseline systems			Control System
	Adult Walnut	Young Walnut	Pastures	Natural Forest
Mammals	1.43	1.028	1.082	2.652
Birds	8.987	9.247	6.694	9.707
Amphibians and Reptiles	0	0	1.564	1.787

PRELIMINARY CONSIDERATIONS

- Among the forest associations, the one closest to an optimum diversity model proved to be that of low density Pine, given that proper forest management enables the presence of certain plant species (natural regeneration) within them, generating the presence of mammals, birds and amphibians belonging to natural ecosystems. Among the forest plantations evaluated, those of patula Pine present the highest diversity value in herpetofauna due to their vegetation structure, formed by well-defined strata, providing greater spatial heterogeneousness, diversity of microhabitats, optimal humidity and temperature conditions. The mammal diversity values found in the watershed of the Chinchiná River show us that forest associations provide the proper conditions for the presence of certain mammals, particularly of the Chiropteran Order, which were found due to the presence of places used as shelters and to the use of these forests systems as corridors between forest patches. The diversity of small rodents in forest associations shows a poor representativeness in relation to the forest, quite possibly due to the vulnerability of the latter to predators in these forest cultivation areas which do not offer an adequate vegetation structure where these can take refuge.

- The diversity values of each study zone are highly influenced by the presence of individuals of the Chiropteran Order, considering that due to their morphological characteristics and wide food spectrum they are able to travel long distances. The sylvopastoral and modernized coffee associations do not permit a significant increase in rodent diversity, due to the fact that there is little or no evidence of natural regeneration. For this reason, the chances of food resources for the rodent species present in the surrounding forests are reduced.

- In the high and low zones, the natural forest presents a greater diversity of birds, given that, as in other studies, it was found that the mature forest canopy is structurally more heterogeneous when compared to plantations where this stratum is dominated by a single species. In the low zone, this is perhaps due to their disposition and connection with the other habitats present in the zone. (Hayes & Samad 1998, Mitra & Sheldon 1993, Murcia 1997).

- The highest bird diversity values in the Medium Zone were found in the pasture. This is probably due to the fact that this place is surrounded by different landscape structures such as coffee and plantain single-crop farming, forest remainders and strips, allowing for the presence of a large variety of bird species (Naranjo, 1992).

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:

>>

Domestic legislation and regulations do not consider that reforestation projects cause negative environmental effects. Therefore, no environmental impact studies are required.
No significant negative impacts are expected

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

>>
NA

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

>>
The project expects to improve the living conditions of the local communities, restoring the soils and biodiversity through social and environmental sustainability criteria, promoting the implementation of productive projects and systems, from which products and services can be obtained that benefit both the local communities and the populations outside the direct area of influence of the project; in accordance with the foregoing, the project is aimed at forming a great water reservoir to guarantee the supply of this resource to the region's inhabitants, generating alternative production, conservation, research, ecotourism and employment activities, through the implementation of more efficient land use systems than the current production models.

In terms of profitability for the owners, the revenues from the activities considered additional in this study, would come, on the one hand, from the CDM and, on the other hand, from the conventional products, inherent to each of them: wood for different uses, in the case of pure plantations, coffee and wood for agroforestry systems and beef and wood in sylvopastoral systems

As part of the improvement of the quality of life the project expects to contribute with the reduction of unemployment, generating conditions for the improvement of housing, health, education, self-sufficiency in food production, drinking water and energy coming from renewable sources through the incorporation of a forest component in the property planning made by the owners, changing the vision of a deforesting culture, where the national resources present in the properties are used in a non-rational manner

Given the social conditions that have historically characterized the region, the project will attract resources to invigorate the local economy, stimulating the creation of stable and well remunerated employment for those families who enter the project as owners or as labor for the establishment of the forest unit. In addition to job creation, the local communities would be accompanied in the training and education processes that will ensure the maintenance of plantations and the sustainability of the project.

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:

>>
It is expected that impacts on the communities will be positive, mainly through the increase in employment opportunities during the project execution phase, through environmental education processes and strengthening of the community organization, beyond the duration of the implementation of the forest cycle.

The expected impacts are:

Economic.

- At the regional economy level, the project will have an impact on the GDP, adding new resources to the economic flow from the production and marketing of primary and transformed forest products and the sale of tCERs resulting from CO2e capture.
- At the family level, new revenues will be generated from the implementation of forest systems in the properties of producers involved in the project and their participation in the sale of tCERs.
- Forestry activities related to ecological restoration and establishment of biological corridors generate ecotourism activities which contribute new and greater income at the family and regional economy levels.
- The project will have a positive impact on jobs and economic revenues during the time it is in progress, generating work for the economically active population of the local communities in activities such as land preparation, gathering, layout and hole making, seedling propagation, planting and maintenance, forest protection and utilization.
- Stabilization of the local economy, which in rural areas presents fluctuation percentages on account of the constant change in the prices of agricultural products, particularly coffee, which depends to a great extent on the supply in the international market.

Social.

- Generation of short and long-term employment, at the rate of 1800 equivalent jobs per year for each 4000 ha established.
- Strengthening and support to community organizations for self-management and participation in projects generated by reforestation activities.
- Establishment of associative organizations related to the forest sector and restoration of the biodiversity.

Cultural.

- Continuous training processes which increase knowledge and transfer of forest technology to the rural communities in the area of influence of the project.
- Environmental education processes among the child and youth population in schools of the rural area, to prepare the generational takeover for sustainable forest development.

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:

>>

The main socioeconomic impacts at this stage are positive; in fact, no negative impacts have been identified to date.

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

>>

NA

SECTION H. Stakeholders' comments:

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

>>

From the start of the project, its objectives and activities have been made known through different media. This includes monthly meetings and farm by farm visits, illustrative promotional tours, personalized presentations, publication of a bimonthly bulletin with a total circulation of more than 300,000 copies, publication on the Internet of the web page, www.procuenca.com, weekly radio programs, press releases, television and radio interviews, Training Forums on CDM, institutional videos, brochures and technical handbooks, open meetings at the Municipal Council, among other things.

2. SOCIAL CONSULTATION

The selection and invitation process for the social consultation included a varied and wide range of public and private institutions, trade associations, NGOs, universities, research centers, property owners and media, including nearly 500 invitations.

145 individuals representing the entities and persons summoned attended the consultation event. During the event, a description of the project and its current status in terms of execution, the progress of the biodiversity monitoring program at the forest plantations and the worldwide trends in the international carbon market as well as the application process to the CDM were presented. The forum was likewise opened to interventions and comments of the parties involved with respect to the project. The PROCUENCA – FAO team responded to all concerns and questions posed by the Stakeholders. At the end, the Stakeholders completed a survey regarding their perceptions of the project impacts. In short, the stakeholders expressed their full support, as shown in the following tables.

ATTENDANCE AT SOCIAL CONSULTATION FORUM

TYPE OF ENTITY	NUMBER OF ATTENDEES
Land owners	57
Forest nurseries	33
Public institutions	12
Educational institutions	12
NGOs	20
Environmental authority	3
Private individuals	8
Other	
Total	145

OF THE FORGOING ATTENDEES, 106 ANSWERED THE SURVEY:

TYPE OF ENTITY	NUMBER OF ATTENDEES
Land owners	57
Forest nurseries	7
Public institutions	11
Educational institutions	7
NGOs	9
Environmental authority	2
Private individuals	3
Other	10
Total	106

H.2. Summary of the comments received:

>>

Following is the tabulation of the answers to the questions included in the survey:

1. Compared to the normal conditions of the location in absence of the project, with the project presented today, do you think the environment and community of this location will be affected POSITIVELY, NEGATIVELY or will there be NO CHANGE:

	POSITIVE	NEGATIVE	NO CHANGE	NO REPLY	Total
Quantity	89	7	1	9	106
Percentage %	83.96	6.60	0.94	8.49	100

2. How important do you consider the project components for the well-being of the community and the environment (mark with an X).

Project Components	Importance to the community				
	High	Medium	Low	No answer	Total
Economic	81	18	0	7	106
Social	76	15	0	15	106
Environmental	86	5	0	15	106

Also included were questions that allowed for an open answer regarding the Stakeholders' perceptions of the project, properly documented. The great majority expressed strong support to the project.

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

>>
The only concern related to possible effects on biodiversity in the forest packages of the project. In order to determine the actual impact on biodiversity from the land use change to the forestry packages, the project has implemented a monitoring program of the changes in biodiversity in the reforestation areas (see description below). This program was designed and implemented by Conservation International and the PROAVES Foundation.

Annex 1

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

Organization:	Instituto de Fomento, Promoción y Desarrollo de Manizales (INFIMANIZALES)
Street/P.O. Box:	Carrera 21, No 29-29 p.4
Building:	
City:	Manizales
State/Region:	Caldas
Postfix/ZIP:	
Country:	Colombia
Telephone:	57-6 884 8484 x 411
FAX:	57-6 884 3333
E-Mail:	gerencia@infimanizales.com
URL:	www.infimanizles.com
Represented by:	Alvaro Velez Gomez
Title:	Gerente General
Salutation:	Dr.
Last Name:	Gomez
Middle Name:	Velez
First Name:	Alvaro
Department:	Gerencia General
Mobile:	
Direct FAX:	57-6 884 3333
Direct Tel:	57-6 884 848 x 411
Personal E-Mail:	gerencia@infimanizales.com

Organization:	Asociación de Productores Forestales (AGROFORESTAL)
Street/P.O. Box:	K. 3, Via el Magdalena, Expoferias
Building:	Expoferias
City:	Manizales
State/Region:	Caldas
Postfix/ZIP:	
Country:	Colombia
Telephone:	576 874 4150 ext 114
FAX:	576 874 4150 ext 105
E-Mail:	angelamatilde@gmail.com
URL:	www.procuenca.com
Represented by:	Angela Matile Arango de Valencia
Title:	Directora Ejecutiva
Salutation:	Dra.
Last Name:	Arango de Valencia
Middle Name:	Matilde
First Name:	Angela
Department:	Gerencia

Mobile:	
Direct FAX:	
Direct Tel:	Cel 310 825 6084
Personal E-Mail:	

Annex 2

INFORMATION REGARDING PUBLIC FUNDING

This project does not use funding derived from official international development assistance.

ANNEX 3

BASELINE INFORMATION

1. Historical changes in covers and uses of the land

Coffee (Coffea arabica) plantations have been established at altitudes between 1000 and 2000 meters, resulting in high deforestation rates. In fact, seven of the ten countries with the highest deforestation rates in the planet are found in northern Latin America (Perfecto et al. 2005)[38]. One of the reasons for this phenomenon is the increase in population density on the slopes of the Andes mountains in Colombia.
There is a positive relationship in the project area between population density increase and landscape transformation (Etter & Wyngaarden 2000)[39]. Although it only covers 40% of the country's surface area, the Colombian Andean Region holds 70% of the population (IAvH 2003)[40]. The main productive activity on the slopes of the Andes mountains between 1000 and 2000 meters has been extensive cattle ranching, since the drop in the international prices of coffee, which was until then one of the most important productive activities in the country. This translates into high deforestation rates and deterioration of the ecosystems during the last decades.

It has been estimated that by the year 1998, 69% of the Andean forests, corresponding to approximately 180,600 km^2, had been cleared (Etter et al. 2006)[41]. Land management for extensive cattle ranching represents 70% of the total deforested Andean forests. The ratio between lands dedicated to stockbreeding and the Colombian population increased continuously throughout the 20th century, reaching 0.97 ha/person. Despite this large area, the long-term impacts of the extensive cattle production system on biodiversity and ecosystem processes in Colombia are still unknown. The coffee production system was also one of the factors with the greatest influence on deforestation of the ecosystems in the Colombian and Andean zone, due to the introduction of unshaded varieties, which meant large deforested zones and practically non-existent shade in the large coffee plantation areas. A large portion of lands that are adequate for pasturage is found less than 10 km away from the main land communication routes, which reinforces the aforementioned link between population density and the probability of future changes in plant covers in the project zone. This has been demonstrated by an ecosystem vulnerability modeling study carried out in 2006, which indicated that the highest probability of transformation of the remaining ecosystems in Colombia is found in the Andes and the Caribbean area (Etter *et al.* 2006).

An assessment of the Andean region forest fragmentation has identified the Oak (*Quercus spp.*) forest as the most threatened (Fernández & Sork 2007; Armenteras & Villareal 2003)[42]. These forests are

[38] Perfecto, Ivette. John Vandermeer, Alex Mas, Loreta Soto. 2005. Biodiversity, yield, and shade coffee certification. Ecological Economics. 54: 435-446

[39] Etter, Andrés and Willem van Wyngaarden. 2000. Patterns of Landscape Transformation in Colombia, with Emphasis in the Andean Region. Ambio. 29(7): 432-439

[40] IAvH. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. 2004. Conservación y uso sostenible de la biodiversidad de los Andes Colombianos. Informe Anual 2003. 107 p.

[41] Etter, Andrés., Clive McAlpine, Kerrie Wilson, Stuart Phinn, Hugh Possingham. 2006. Regional patterns of agricultural land use and deforestation in Colombia. Agriculture, Ecosystems and Environment 114: 369–386

[42] Fernández-M, Juan F., Victoria L. Sork. 2007. Genetic Variation in Fragmented Forest Stands of the Andean Oak Quercus humboldtii Bonpl. (Fagaceae). Biotrópica. 39(1): 72-78

recognized for their great value in terms of the environmental services they provide, such as regulation of the water cycle and conservation of the soil, which aspects are precisely among those covered by the objectives sought by PROCUENCA.

2. Site classification and quality evaluation

The description of the evaluation to determine the eligibility of lands is described in subsection C.1.

2.1 Classification of the project zone according to characteristics of the soils

Described in subsection A.4.1.5

3. Stratification

Will be established according to the selected methodology guidelines, based on the existing natural conditions, such as physical and chemical conditions of the soil, topography, climate, hydrology, land use history, type of existing vegetation. It will initially be established according to the differences in estimated carbon capture capacity for each productive system or tree stand model (Table I).

After the first monitoring there could be re-stratifications based on the biomass accumulation results obtained, the planting dates and the forestry treatments carried out or the productivity attained by the different forest systems. As described in the methodology, the objective is for those strata considered to have similar conditions, according to the results of the first monitoring, to be combined in order to reduce the number of strata, which would facilitate the total project evaluation.

TABLE I *Stratification of the PROCUENCA project*

Strata	Area established as of December 2006	Area predicted for the year 2012
1. Silvo-pasturage *Pinus patula*	1199.74	2873.1775
2. Silvo-pasturage *Pinus tecunumanii*	134.59	1149.271
3. Silvo-pasturage *Eucalyiptus grandis*	75.95	150.968348
4. Silvo-pasturage *Alnus acuminata*	292.09	229.8542
5. Agroforestry *Cordia alliodora*	745.41	1149.271
6. Agroforestry *Pinus tecunumanii*	11.99	1494.0523
7. Pure plantation *Pinus patula*	279.60	344.7813
8. Pure plantation *Pinus tecunumanii*	0.00	229.8542
9. Pure plantation *Cupresus lusitánica*	248.28	229.8542
10. Pure plantation *Eucalyiptus grandis*	42.00	229.8542
11. Pure plantation *Cordia alliodora*	37.92	229.8542

D. Armenteras, F. Gast, H. Villareal. 2003. Andean forest fragmentation and the representativeness of protected natural areas in the eastern Andes, Colombia. Biological Conservation 113: 245–256

12. Pure plantation *Alnus acuminata*	86.65	270.078685
13. Pure plantation *Pinus caribea*	0.00	229.8542
14. Pure plantation *Tectona grandis*	19.00	229.8542
15. Pure plantation *Gmelina arborea*	0.00	229.8542
16. Mixed Forests	334.07	2222.27627
Total area	**3507.29**	**11492.71**

4. Estimation of the baseline net GHG removals by sinks

According to the procedure proposed by the methodology, the baseline is determined *ex-ante* and remains fixed during the specified accreditation period. Therefore, it does not require monitoring.

Annex 4

MONITORING PLAN

1. Monitoring of baseline removals

Changes in the baseline carbon stock do not require monitoring after the project establishment, given that the accepted approximation of baseline 22(a) assumes the continuation of the carbon contents within the project limits at the time of its validation.

2. Monitoring of the total A/R CDM project activity behavior.

a) Monitoring of the current project limits

The project limits shall be determined on the project map as the plantations are established. Each productive nucleus will be measured using a GPS during field work (planting, clearings, etc.). The results of these measurements will be entered in a database and stored in electronic format and on paper.

b) Monitoring of the forest establishment to ensure the quality of the plantation in order to confirm that the management practices described in subsection A are carried out as indicated.

The plantation quality and survival indexes will be monitored by the entity in charge of providing technical advice for the implementation of this project, PROCUENCA. Soil preparation activities will also be monitored, so as to verify that the designed plan is carried out.

c) Forest management monitoring

Clearings, fertilizations and cleanups will be monitored by the entity assigned for such purpose, so as to guarantee the application of correct practices. Thus, assurance is obtained that unsustainable forest use practices are avoided and correct growth of the plantations is monitored, according to the established standards.

3. Monitoring of current net removals by sinks and data acquisition

a) Stratification

An initial stratification in the project area according to the forest species involved and an additional stratum for the assisted regeneration system (*Pinus patula, Pinus tecunumanii, Eucalyiptus grandis, Alnus acuminata, Cordia alliodora, Cupresus lusitanica, Tectona grandis, Pinus caribea, Gmelina arborea, Mixed Forests*) is proposed. The monitoring proposal will make use of permanent sampling plots to evaluate changes in the carbon contents present in the aerial and underground biomass within the project scope. The sample size for each stratum will be established in a cost-effective manner, complying with an accuracy level equal to ± 5% of the mean and with a 95% confidence level (the details of the initial stratification are shown in section E.2.). After the first monitoring, the stratification could be reassessed, according to the changes detected in the project limits, reforested areas, actual years of establishment and/or variations in carbon contents by strata and substrata, which may be grouped together or associated by similar carbon contents, by their change dynamics or by their spatial variation.

b) Sample size determination:

Is described in detail in subsection C.3

Total sample number

$$n = \frac{\left(\sum_{i=1}^{m_{PS}} N_i \cdot st_i\right)^2}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right) + \left(\sum_{i=1}^{m_{PS}} N_i \cdot (st_i)^2\right)}$$

Sample number by stratum

$$n_i = \frac{\sum_{h=1}^{m_{PS}} N_i \cdot st_i}{\left(N \cdot \frac{E}{z_{\alpha/2}}\right)^2 + \left(\sum_{i=1}^{m_{PS}} N_i \cdot (st_i)^2\right)} \cdot N_i \cdot st_i$$

n total number of sample units, in the projects area
n_i number of sample units for stratum i
st_i standard deviation for stratum i
E permitted error ($\pm$ 10% of mean)
N total number of sample units (all strata), $N = \frac{A}{AP}$
A total project area
AP plot area
N_i total number of sample units in stratum i, $N_i = \frac{A_i}{AP}$
$z_{\alpha/2}$ value of statistical z , for $\alpha = 0.05$ (indicating a 95% confidence level)

Sampling of *Pinus patula, Pinus tecunumanii, Eucalyiptus grandis, Alnus acuminata, Cordia alliodora, Cupresus lusitánica, Tectona grandis, Pinus caribea, Gmelina arborea, Mixed forest plantations.*

The size of the plots for sampling during successive monitoring times will be 400 m^2, for all systems. Nevertheless, said area may be subjected to an evaluation of its effectiveness for each proposed system, in order to remain within the error and reliability established for the project. The plot area may range between 100 and 1000 m^2; therefore, their size will depend on planting density, forestry practices and tree survival.

Type of plots

Based on planting design characteristics in commercial forest plantations, a rectangular pattern will be followed for the establishment of monitoring plots; therefore, these plots will be square, 20 meters on each side (see Figure A.1)

Random location of the plots in the field

After the stratification, courses and distances are randomly assigned in the sampling area, using the ArcView software "*Random Point Generator*" tool, which is considered a good practice in GPG-LULUCF. A GPS system will be used for their location and georeferencing in the field, thereby permitting their easy access, location and monitoring over time. Easily distinguishable points are located on the land, which shall be considered the entry location to the plot. Starting from this point and with the course and distance of each sampling site, the center point of the plot is then located. To this end, marks are left along the way at intervals that will allow an easy entry at later times. Once the center-point of the plot is located, a stake, duly marked with paint and reflective tape is placed in it; this tape shows information regarding the species, age, plot number and sampling date.

Plot survey.

After determining the point where each of the plots will be established, vertex 1 of the plot is located, and the following vertices will subsequently be located in a clockwise direction or along the center of each of the corridors or spaces present between the rows of trees. This will provide the effective hypothetical occupation area of each individual. The measuring and marking of the trees will likewise be done in a clockwise direction, covering 2 rows in zigzag down to the end opposite that where we started (Figure A.1). Trees located on the outside of each vertex are marked with the number of the respective vertex to which they correspond; this ensures that each of these will be included in subsequent monitorings.

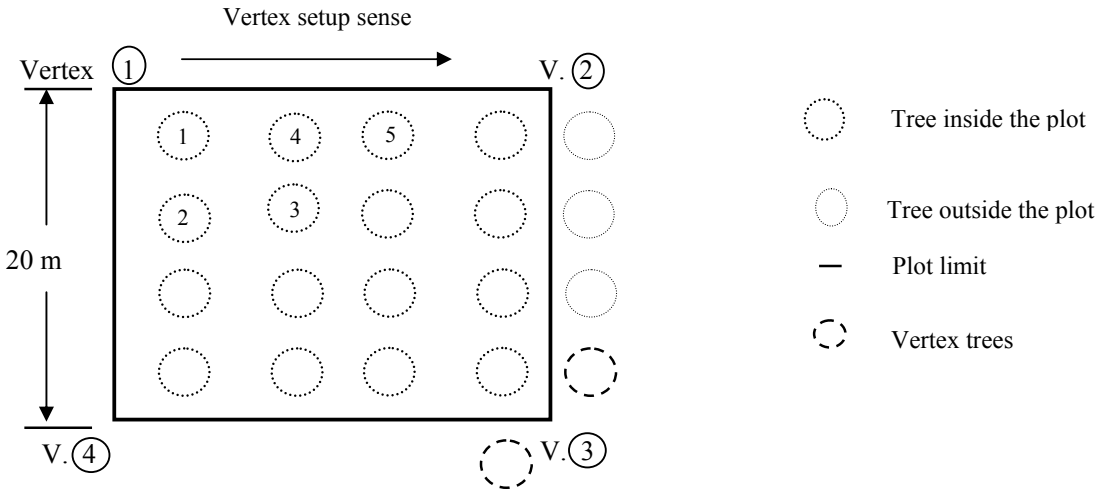

FIGURE A.1. Survey of the monitoring plots. Length of each side 20 meters, for an area of 400 m^2.

The plots will be closed using a compass and tape measure, allowing for adjustments and closure errors, precisely estimating the area of each plot. The plots will be marked using paint that is highly weather-resistant and in highly-contrasting color with the surrounding vegetation (may be yellow). The numbering will be located above the chest height diameter (DAP) line; when the numbering exceeds two digits it will be placed vertically (Figure A.2).

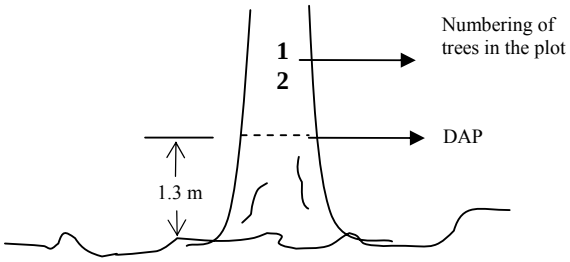

FIGURE A.2. Marking of trees within each plot. The diameter line must be marked at chest height (DAP), at a height of 1.3 m and with its respective number, enabling the establishment of diameter increases between monitorings.

Information obtained in the monitoring process.

The following information is obtained from each plot:

- Physiographical conditions of the surrounding land, including topography, drainage and rocky outcrops.
- Slope of the area comprising the plot and surrounding area. When measuring the land, slope corrections must be considered using the horizontal distance correction table.
- The following factors, shown in Table 2, are used to extrapolate plot data at the hectare level.

TABLE 2. *Conversion factors of plot to hectare (ha)*

Area of plot (m²)	Conversion factor to ha
1000	10
500	20
400	25
250	40
200	50
100	100

25	400

Measurement of required variables

The following variables are logged in the form designed for such purpose.

- **Diameter.** The diameter at chest height (DAP) must be measured at a distance of 1.3 m from the base of the tree using a tree caliper, gage, tape measure or diametric tape. When a tape measure is used, the resulting value corresponds to the perimeter at chest height (PAP). Figure A.3 shows the guidelines to be followed in measuring the DAP, depending on the different situations that may occur.

- **Height.** Height is measured with a hypsometer. This piece of equipment is calibrated for horizontal distances of 15, 20, 30 and 40 m from the tree base and the measurement distance depends on the total tree height. The larger the angle between the horizontal line of the ground surface and the visual line to the crown of the individual tree, a greater measurement error may be incurred. Therefore, the ideal minimum height measurement distance, corresponds to the approximate projection of the height of the individual tree above the surface of the land (Figure A.4). In order to maintain height measurement consistency between monitorings, it will be necessary to place a paint mark, in order to take the height measurements on the same side of the tree in each monitoring.

  Tree heights in all systems will be measured every three individuals, that is, after being numbered, the selected trees to be measured will be 1, 4, 7, 10, etc.

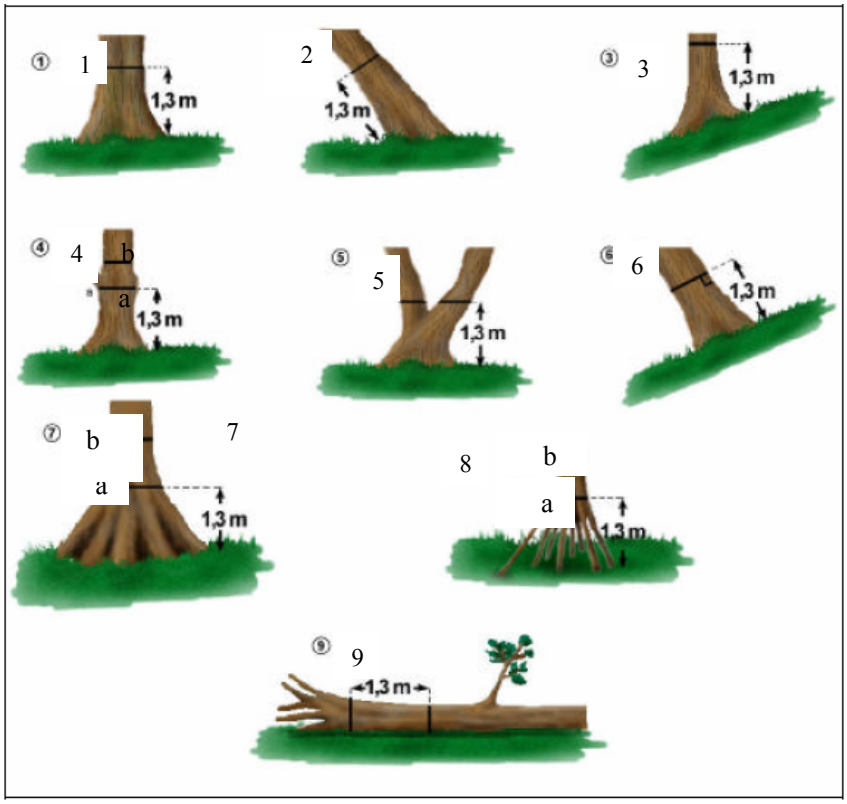

FIGURE A.3. Correct diameter measurement. In situations 4, 7 and 8 the tape or tree caliper is moved to position b in order to measure diameter. Taken from Schlegel *et al*. 2001[43]

[43] SCHLEGEL, B.; GAYOSO, J. AND GUERRA, J. 2001. Medición de la capacidad de captura de carbono en bosques de Chile y promoción en el mercado mundial. Manual de procedimientos para inventarios de carbono en ecosistemas forestales. Universidad Austral de Chile. Valdivia, Chile. 17p.

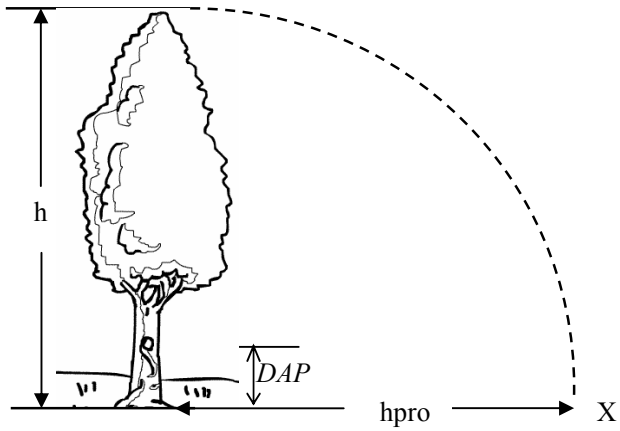

FIGURE A.3. Optimal distance for height measurement, where X is the ideal position corresponding to the total height projection of the tree on the ground surface, *DAP*; diameter at chest height (1.30m from the ground).

Two readings are taken with the hypsometer, a lower one directed at the tree at DAP height and a higher one directed at the terminal part of the crown. It should be noted that total height is determined using the lower reading, the higher reading plus the 1.30 m of the DAP. Said readings are recorded in the plot form. Once a tree is measured, it is marked with aerosol paint at the measurement point (DAP), with a strip covering ¼ of the tree perimeter and its respective number. This avoids a double measurement or not measuring a tree. This numbering and markings are placed in such a way that they can be seen from the center of the plot. The numbering is located on the DAP marks, and when it exceeds two digits, it is placed vertically with the first number on top.

Individual characteristics of the tree

In order to establish certain phytosanitary and growth conditions of the individual, the following codes are used which allow a definition of these states in the field:

N: Normal
A: Damage in the apex
B: Several shafts or bifurcations (above the PAP)
C: Fallen
E: Sick
H: Ant attack
M: Standing dead
Q: Broken
T: Crooked

- **Sociological position.** Is determined by the development level of the individual with respect to its height and for which the following categories are considered:

Dominant (D). Tree whose crown surpasses the upper strata of the canopy. It is important to assess height with respect to diameter in these individuals, due to the direct relationship between these two characteristics.

Co-dominant (C). Tree that is in the upper stratum and presents a well-developed crown, without surpassing the other individuals. Is characterized by continuous competition for the sun, given that its crown converges with that of other individuals of the same stratum.

Suppressed (S). Is found below the average canopy of the other trees, without receiving light energy directly. Suppressed trees are described as intolerant species which possibly, in the event of a liberation or thinning of certain surrounding individuals, will not yield a positive response.

In addition to the foregoing observations, the condition of the plantation (when such is the case) with respect to weeds or undergrowth must be taken into account. This enables establishing the degree of intervention as to plantation maintenance and assessing the possible effect on their development.

Monitoring frequency

The first monitoring will be made in 2007, coinciding with the first commitment period; after this there will be monitorings every five years (2012, 2017, etc.) until the first 20 years of project accreditation are covered. On the other hand, the development of CDM projects under the Kyoto protocol after the year 2012 is uncertain; decisions made in due course could alter the sequence and activities of the monitorings.

Measurement and estimation of changes in carbon stock over time

Shall be made by obtaining volume models of the forest species comprising the project. Consequently, measurements of diameter at chest height (DAP) and total height of the individuals shall be made in each of the plots established for monitoring of the species. The biomass ratio between shaft and root, wood density or other variables may be obtained from the existing literature, for similar biophysical conditions to those of the project scope. In order to proceed with the dendrometric variable measurements a minimum DAP measurement range shall be established, which shall be 5 cm. In addition, an adequate expansion factor will be fixed to determine total biomass values, starting from the volume obtained for each project species, which shall be taken to values per hectare, taking into account planting density.

Monitoring of GHG emissions by sources as a result of the A/R projects activity

The method applied to measure and estimate changes in carbon stock over time within the project area takes into account possible decreases resulting from forestry or human activities (forage gathering). All emissions resulting from transportation activities will be counted as leaks.

Monitoring of Leaks

Described in subsection C.5

Emissions resulting from transportation activities

Described in subsection E.5.1

Quantity of Kilometers traveled, number of vehicles and fuel consumption of the vehicles by type shall be monitored through reports of the project participants or professional services rendered. This data will be compared against other similar data to ensure their consistency.

Quality and control

Described in subsection E.6.

Data maintenance and filing

The data shall be taken and stored in electronic format and on paper, and a copy thereof will be delivered to each project participant. All electronic data and reports will be stored in CDs, a copy of which will be made to be kept in several places. These files include:

- Copy of all original field measurements and spread sheets
- Estimates of changes in carbon stock and gases other than CO_2 and relevant spreadsheets
- Data taken with GPS
- Copies of measurements and monitoring reports

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