Programmatic Project for the Payment for Environmental Services

Mitigation of Greenhouse Gas Emissions through Avoided Deforestation of Tropical Rainforests on Privately-owned Lands in High Conservation Value Areas of Costa Rica

Central Volcanic Range Conservation Area, Costa Rica (Project Design Document prepared for Pax Natura by FUNDECOR[1])

March, 2009

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20 March 2009

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Project summary

Project title	Programmatic project for the payment for environmental services to mitigate greenhouse gas emissions through avoided deforestation of privately owned tropical rainforests in high conservation value areas in the Central Volcanic Range of Costa Rica
Sponsoring organizations	National Biodiversity Institute (INBio) National Forestry Financing Fund (FONAFIFO) Foundation for the Development of the Central Volcanic Range (FUNDECOR)
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Total cost	US$10,000,000.00 (ten million United States dollars)
In situ avoided deforestation	3,816 hectares (three thousand eight hundred sixteen hectares)
Ex situ avoided deforestation	1,563 hectares (one thousand five hundred sixty-three hectares)
CO_2 offset	1,614,887 Mg CO_2 (one million six hundred fourteen thousand eight hundred eighty-seven tons)
Type	Gold Offset Carbon
Year of project launch	2009
Project duration	10 years

1. General description of the project area

1.1. Project location and basic physical parameters

This programmatic project will recruit a total of **12,000 hectares** of privately owned forest (involving some 100 farm owners) that do not necessarily form a single forest block. The geographical distribution of these 12,000 hectares will be determined by the location of the farms of owners who voluntarily join the program. Recruitment will take place in a total area of **30,000 hectares** of privately owned forest lands, in an area of interest of **39,522 hectares** inside the Central Volcanic Range Conservation Area (ACCVC), specifically in the Central Volcanic Range Forest Reserve (RFCVC), in Cartago and Limón provinces (Figure 8). No national parks or biological reserves are included in these 39,522 hectares, although the area does border on several national parks (to the west with Braulio Carrillo National Park and to the south with Irazú and Turrialba National Parks). It is also important to note that the Guácimo and Pococí aquifers are inside the project area of interest.

Climate

Precipitation

Given the topography of the RFCVC, precipitation is orographic, which makes it common for forest cover at the higher elevations to be cloud forest.

There are no dry months in the project area, as it rains throughout the year. This has been indicated by Lozilla et al (2006) in Table 1 and Figure 1. The precipitation regime in the mountainous sector consists of seven very rainy months (May-November) and five less rainy months (December-April).

Lozilla et al (2006) also indicate that the Chindama meteorological station best describes the climatic conditions of the project area. Data from 1993 to 2005 are presented as monthly averages in the following table.

Table 1: Annual average precipitation in the Pax Natura project area, ACCVC, Costa Rica.

Jan.	*Feb*	*Mar*	*Apr*	*May*	*Jun*	*Jul*	*Aug*	*Sep*	*Oct*	*Nov*	*Dec*	*Total*
585.0	359.6	316.2	362.7	693.7	658.9	597.6	676.0	1569.5	558.8	785.9	628.8	6792

Source: National Meteorological Institute, Chindama Station.

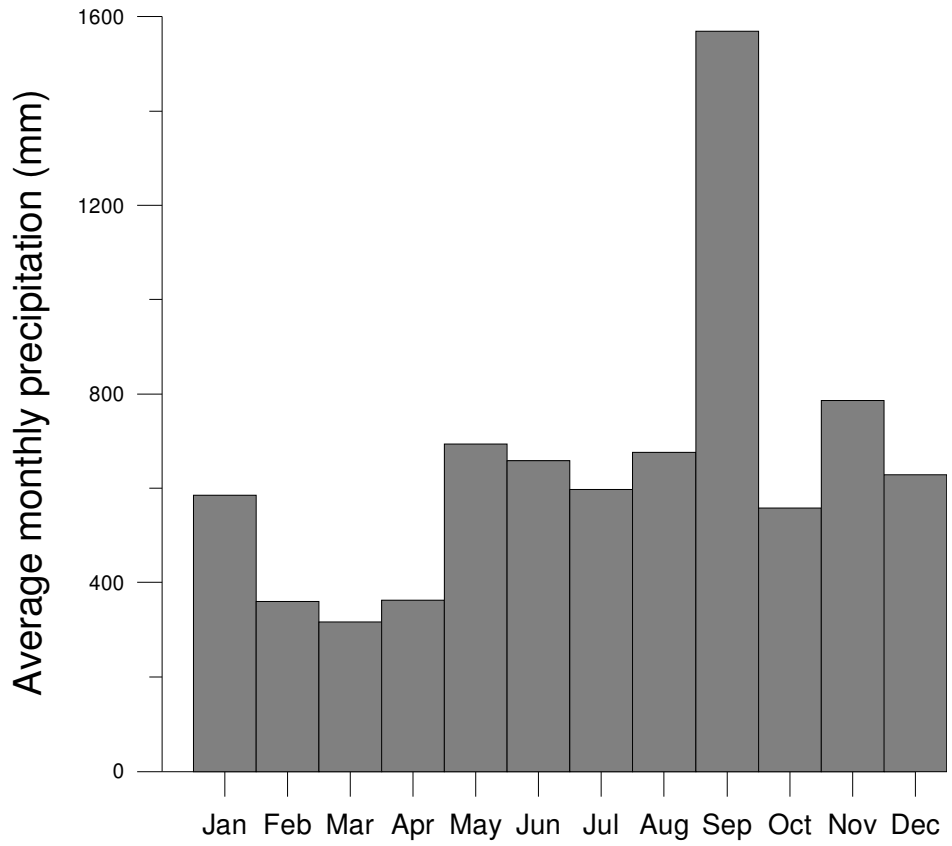

Figure 1: Average monthly precipitation distribution, Chindama Station.
Source: Table 1, prepared by the authors.

Temperature
The annual averages for maximum, medium, and minimum daily temperatures are 30.3°C, 25.3°C, and 20.3°C, respectively. Temperatures are lower in the less rainy (drier) months due to increased winds, related to the lack of cloud cover during the day and lower temperatures at night. The lowest minimum daily temperatures occur in January and February (averaging 19.5°C and 19.9°C, respectively), while the highest maximum daily temperatures occur in May and September (averaging 31.4°C and 30.9°C, respectively).

The annual average variation in the highest and lowest temperatures is a mere 2.4°C, representing a small month-to-month variation throughout the year.

Sunshine
The closest meteorological station that reports sunshine data is the Río Frió station (100 meters above sea level). From this data, considered representative for the intermediate sector of alluvial fans, the highest values of effective sunshine hours occur between the months of November and March, with an average 4.7 hours/day; the highest average sunshine occurs in January and February (5.1 hours/day). In the rainy months the average is 3.8 hours per day; July reports the lowest average, at 3.1 hours/day.

Relative humidity
The annual distribution of relative humidity is very similar to the annual distribution of precipitation, directly related to the lower or greater availability of moisture on evaporation surfaces. The highest values occur in July and August (88%); the lowest in April (79%).

Wind
Although no meteorological stations near the project area keep wind records, the climate statistics of the Poás Volcano station can be used as a reference. There, the annual average wind speed is 1.6 kilometers per hour. The highest daily average wind speeds occur in December, January and February, and average 2.3 km/hr. In general, the winds in the area are characterized as light, according to the Beaufort[1] scale, and do not often cause damages.

Evapotranspiration
According to Lozilla et al (2006), in the intermediate sector of alluvial fans, the monthly average evapotranspiration potential (ETP) was determined in millimeters using the Hargreaves method for Costa Rica, since more sophisticated methods require climatic parameters not available for the area.

The Hargreaves method is based on a formula that uses monthly averages of temperature (°C), relative humidity (%), and extraterrestrial radiation for the latitude of the area.

For calculating the aquifer recharge potential of the three sectors of Pococí and Guácimo cantons (mountainous, alluvial fans, alluvial plains), average relative humidity and average temperature values obtained from the Río Frío station were used to calculate ETP, yielding an annual ETP of 1674.4 mm. The highest ETP values occur in March and April, when they reach 157.5 mm and 152.9 mm, respectively.

Interception
Given the continuity of precipitation throughout most of the year, the percentage of interception by vegetation and depressions is considered negligible since foliage remains moist and the interception process ends within a very short period of time.

Geology and soils

The geology in the project area has its origins in volcanic manifestations occurring primarily in the Quaternary period; although there are some well-identified volcanoes, it is possible that its origin was influenced by fissure eruptions. According to Lozilla (2006) and Cordero (2005), the geology of the area is characterized by a sequence of lava and pyroclasts, associated with lava formations, ignimbrites, and lahars from the Irazú and Turrialba volcanic centers. It is composed almost entirely of andesites and basaltic andesites; in addition, layers of lava with highly fractured zones are common.

According to Cordero (2005), in the Guácimo and Pococí aquifer zone, the landforms of the higher and intermediate elevations originated in the volcanic activity of Turrialba and Irazú volcanoes during the Quaternary period. At the higher elevations, the unit is characterized by a volcanic edifice that descends uniformly toward terrain characterized by alluvial fans and debris cones sharply dissected by the action of surface water at intermediate elevations, then toward alluvial materials of moderate relief and slightly rolling terrain at the lower level.

The large water surpluses produced at higher elevations, even under dense forest cover, caused extensive incision of the original volcanic terrain made up of layers of lava, mud flows, lahars and ash deposits. That facilitated modeling with

a slope break line that divides the base of the fluvial debris cones, with areas produced by alluvial accumulation in a resulting flat-to-rolling topography.

The spatial environment of the project area and its morphological configuration has slopes with 30% to 60% inclines in the recharge area at the headwaters of the Jiménez, Roca, Perla and other rivers that descend from the mountains to form a radial drainage system in the intermediate and low sections. At the base of the fans and near the cities of Guápiles, Guácimo and Jiménez in the distribution area, the morphology is flat-to-rolling slopes with 5% to 15% inclines that lead to the low units where natural drainage systems meander along a concave-to-flat terrain with 1% to 5% slopes.

In general, the hydrodynamic characteristics produce areas with excess water, which is channeled toward natural beds, thus reducing its erosive capacity.

In the upper reaches of the recharge area of the hydrological systems, residual soils have developed through a process of intense pedogenesis. Surface formations supported the development of andisols (due to the presence of amorphous materials in their typical profile) with excellent moisture-retaining capacity, to entisols in early development due to their limited development, especially in areas with very steep slopes.

In the formations of alluvial terraces and plains of the most important rivers, soils are characterized by light- and medium-textured inceptisols, ranging from sandy clay, sandy-silty clay to loamy-sandy or loamy-clay, which are suitable for agriculture but susceptible to erosion.

Hydrology

The surface of the project area is made up of volcanic soils with high infiltration capacity in their natural state, meaning that they fulfill a very important function in regulating surface runoff and recharging the aquifers that originate there.

According to Lozilla et al (2006), the highly permeable layer of fractured lava, combined with the conditions of heavy precipitation, produced aquifers with very high potential in those layers. For their part, the lava formations behave as a low permeability aquitard at the base of the aquifers, allowing for the vertical transfer of water between them.

A study prepared for FONAFIFO by Fallas (2006) shows the project area to be one of the areas with the greatest potential for infiltration, with an annual average output capacity ranging from 2,195 mm to 2,796 mm.

A study on groundwater vulnerability to contamination (using the DRASTIC model and Geographic Information Systems) conducted by the GIS of the National University reported that one of the areas characterized as very

vulnerable is in the northwestern section of the Central Volcanic Range, in the Guápiles-Guácimo and Siquirres aquifers.

1.2. Vegetation in the project area: types and condition

A FUNDECOR analysis of the Landsat satellite image of the area (2005) determined that the project area comprises **30,018 hectares** of non-cloud forest, excluding forests inside national parks and biological reserves. A proportional distribution of clouds by land-use category determined that total forest cover in the project area may be as much as **34,200 hectares.**

The forest area without cloud cover is distributed among six Life Zones, according to Holdridge's classification (1971). The following table shows the number of hectares in each ecosystem, excluding national parks and biological reserves.

Table 2: Forest area (hectares) by life zone for the Pax Natura project. ACCVC, Costa Rica.

Life Zone	Forest (ha)
Tropical wet forest, Premontane transition (bmh-P)	9,037
Premontane rainforest (bp-P)	12,632
Lower montane rainforest (bp-MB)	6,494
Montane rainforest (bp-M)	735
Tropical wet forest (bmh-T)	964
Wet forest, basal belt transition (bmh-B)	156
Total	30,018

Source: Land-use map based on Landsat image (2005), prepared by FUNDECOR-GIS Laboratory.

1.3. Carbon pools in the project area

According to the Intergovernmental Panel on Climate Change (IPCC, 2006), the carbon pools in forest lands are biomass, dead wood, and organic matter in the soil. To estimate the carbon pool in the project area, only above-ground biomass made up of all the above-ground live woody vegetation, including stems, branches, cortex, fruits and foliage, and excluding herbaceous biomass, was considered. Dead wood, litter, and soil-stored carbon were not considered in calculating the biomass of the soil.

Dead organic matter: Because the project area is not affected by management practices or disturbances that significantly change the forest's mortality and recruitment patterns, it has been assumed that the pool comprising dead wood and litter are in equilibrium, and that the change in the pool of dead organic matter is zero.

Figure 2 shows the regional and temporal variability of above-ground biomass observed in FUNDECOR's network of permanent plots, established both in forests under polycyclic management and under protection arrangements in the

Tortuguero and Central Volcanic Range Conservation Areas. As can be seen, in the period 1989-2007 the impact of natural disturbances and of FUNDECOR's forest management system on forest mortality and recruitment produced, for the most part, variations in above-ground biomass amounting to less than 10%.

Soil carbon: Considering the linear model of Powers et al (2004) for elevations higher than 120 m, it is estimated that the average carbon pool, to a depth of 30 cm, for the project area under forest cover is **104.8 Mg*ha^{-1}.** This model was developed for a 140,000 hectare area in the Sarapiquí region, which is less than 20 kilometers from the project area. Also, using a linear model developed by the same authors, it is estimated that the percentage change in the carbon pool resulting from forest conversion to pasture is **26.11%.**

The foregoing implies that the carbon pool in the project area would be reduced by **27.36 Mg*ha^{-1}** with a change in land use from forest to pasture. Considering that pasture lands report a carbon pool of **16 Mg*ha^{-1}** (IPCC, 2006), it was assumed for the purposes of this project that the balance between carbon released through a change in land use and carbon present in the resulting pasture will be zero.

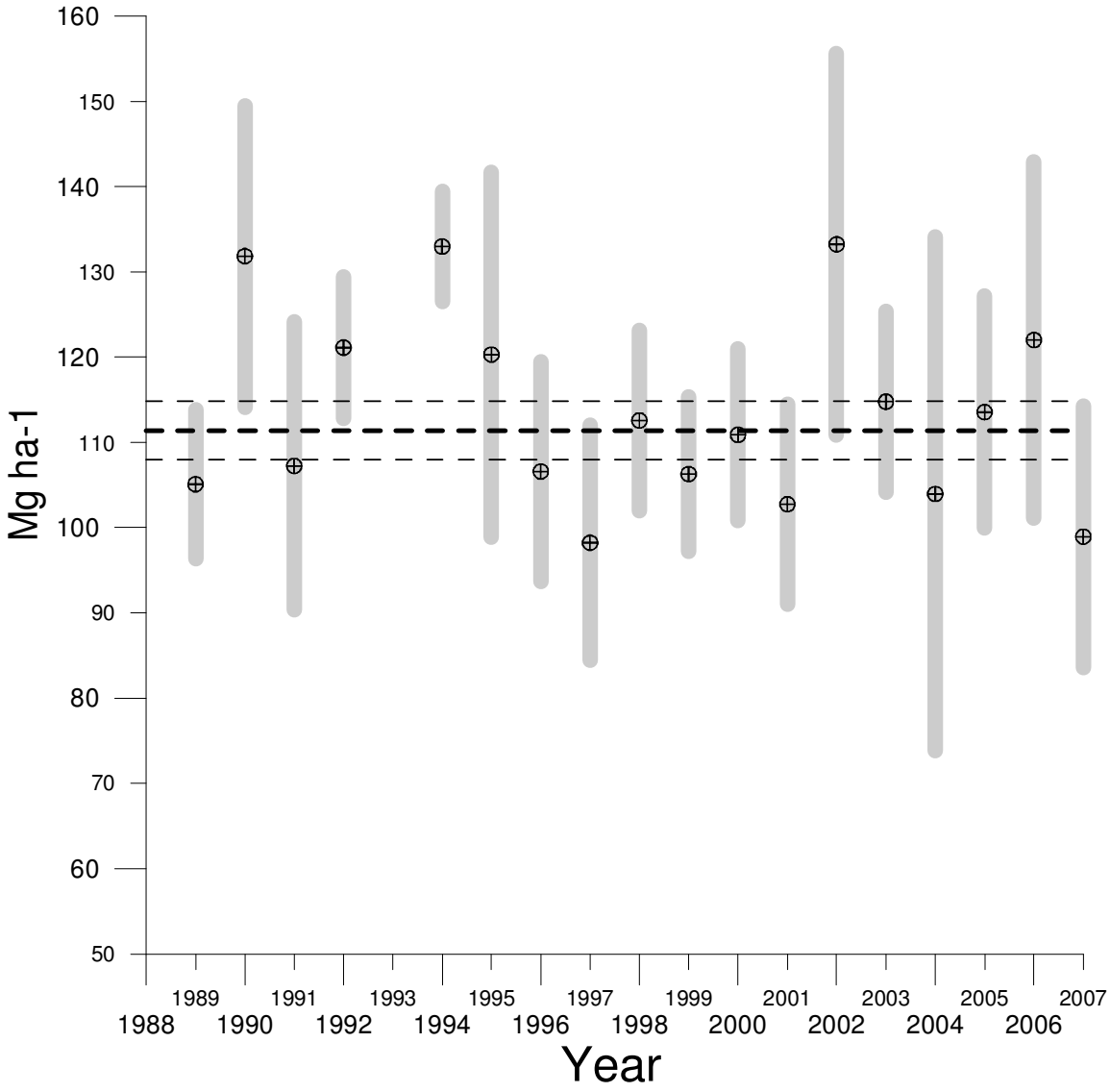

Figure 2: Regional and temporal variability of above-ground biomass observed in FUNDECOR's network of permanent forest plots under management and protection systems in the Tortuguero and Central Volcanic Range Conservation Areas. Source: FUNDECOR Network of Permanent Plots. Prepared by the authors.

Above-ground biomass: According to Holdridge (1971), the forests in the project area occupy five different life zones (see Figure 11); the above-ground biomass for each life zone was estimated by Helmer and Brown (2000) and is presented in Table 3.

Average biomass corrected for the forests in the project area

Taking into account the proportion of original forests in the project area, the above-ground biomass reported by Helmer and Brown (2000) was corrected for each life zone of Costa Rican forests.

To this end, it was established that all forests appearing on the land-use maps of 1986 (CATIE, 1986) that are still present in the land-use maps of 2005 (FUNDECOR, 2007) would be regarded as ***original forest*** and consequently be attributed 100% of the biomass reported by Helmer and Brown. The rationale is that these forests have had 30 years or more to recover from any type of human intervention, which ensures total occupation of the sites in all life zones.

The remaining forests did not appear in the 1986 land-use maps and are therefore considered degraded. Although secondary forests in the northern lowlands of Costa Rica that are five years of age and older report biomass values greater than 40 $Mg*ha^{-1}$ (Sesnie, 2006), for the purposes of the present project their biomass was taken to be zero (0 $Mg*ha^{-1}$).

In this way, the proportion of original forest was calculated for each life zone, and the area of forest present in 1986 and still present in 2005 was divided by the total forest area in that life zone found in the 2005 land-use map (FUNDECOR, 2007).

The information in Table 4 was used to estimate the average amount of carbon per hectare for the forests in the project area. This is a weighted average of the forest area without cloud cover, observed in 2005, by life zone.

A weighted average is used for each life zone instead of the average because the project is programmatic and therefore the specific location of the forest blocks that will make up the 12,000 hectares of forest to be recruited is still unknown.

Therefore, all estimates for the present project were made with the weighted average of carbon, estimated at **115 $Mg*ha^{-1}$**.

Table 3: Above-ground biomass and carbon per hectare for the different life zones in the Pax Natura project area. ACCVC, Costa Rica.

	Life Zone	Number of sites	Above-ground biomass ($Mg\ has^{-1}$)	Carbon ($Mg\ has^{-1}$)
Bmh	Lowland wet	8	365	160.60
Bmh-p	Premontane wet	4	306	134.64
Bp-P	Premontane rain	2	318	139.92
Bp-MB	Lower montane rain	3	324	142.56
Bp-M	Montane rain	1	309	135.96

Source: Helmer and Brown (2000)

Table 4: Average biomass corrected for forests in the Pax Natura project area. ACCVC, Costa Rica.

Life zone	Non-cloud forest 2005 (hectares)	Proportion original forest (forest 86)	Carbon Mg*ha^{-1}		Weighted average of carbon Mg*ha^{-1}
			In original forest	In forest with corrected biomass	
Bmh-T (Prem)	9,037	76%	161	122	37
Bp-P	12,632	83%	140	116	49
Bp-MB	6,494	76%	143	109	24
Bp-M	735	87%	136	118	3
Bmh-T	964	60%	161	97	3
Bmh-P (Basal)	156	40%	135	53	0
Total	30,018				115

Source: Prepared by authors based on land-use maps from Landsat images, 1986, 1992, 2000 and 2005 (CATIE, 1986; CATIE, 1994; CATIE, 2000; FUNDECOR, 2007).

1.4. Community information

The project area includes farms and isolated properties isolated from community centers, with the exception of some very small hamlets. In general, the area is made up of small to medium-sized properties on which owners have constructed their homes and whose closest neighbors are at a distance of hundreds of meters or kilometers.

The two closest large centers of population outside the project area are Guácimo and Pococí, which belong to the cantons of the same name in Limón Province. Since the aquifers that supply these two communities are inside the project area, analysis of the social impact of the project will be focus on water quality, as it is directly related to forest mass and would be seriously affected by degradation or disappearance of same.

Table 5 contains socioeconomic indicators for these communities which, when compared with the national social development indicator of 46.9 (Ministry of Health, 2007), rank average.

Table 5: Socioeconomic indicators of Guácimo and Pococí cantons, Limón Province, for the year 2006.

Canton	Social development index	Extension (km^2)	Population	Population density	Births	Birth rate x 1000 inhabitants	Infant deaths	Infant mortality rate x 1000 live births	Deaths
Pococí	43.8	2,403	131,697	54.8	86.50	19.0	2.93	16.84	13.18
Guacimo	47.8	576	43,109	74.8	103.02	20.3	2.25	33.80	2.25

Source: Ministry of Health (2007).

Current land use and tenure in the project area

Land ownership in the project area is largely in the hands of small owners who, through the process described later in this document, will be recruited and brought into the project.

Because this is a programmatic project, the location of the forest blocks that will comprise the 12,000 hectares to be recruited are still not known. Nonetheless, the distribution of at least 6,610 hectares of forest among 56 owners can be observed in the map in Figure 8. These land owners have already signed agreements for forest technical assistance with FUNDECOR, and given their commitment to conservation through those agreements, will very likely join the Pax Natura project.

Table 6 shows land use in the project area based on a satellite image from the Landsat 7 sensor (2005), classified by FUNDECOR's Geographic Information Systems Laboratory. It is important to note that more than 76.8% of the project area is under forest cover. Most is primary forest (74.8%); the remaining 2% is secondary growth or reforested.

1.5. Biodiversity

The project area covers 28% of the 141,000 hectares making up the Central Volcanic Range Conservation Area (ACCVC). This territory is under different types of management categories, including national parks, forest reserves, and private property.

Most of the biological diversity of this Conservation Area is found in its protected wildlife areas. According to the National Biodiversity Institute (INBio), the topography, temperature, and precipitation of the ACCVC, as well as its location in the national territory, make it one of the country's most important regions in terms of endemism, mainly for the group of land vertebrates whose endemism represents 80.7% of the endemic species in the country, especially at the highest elevations of the mountain ranges. It is also rich in herpetofauna (28 species), mainly salamanders. In addition, the ACCVC is considered one of the regions of the country with the greatest endemism in terms of avian fauna.

Some of the endemic species are: humming-bird (*Elvira cupreiceps*), toad (*Bufo holdridge*), oak (*Quercus tonduzii*), in the high elevations of Poás and Barva volcanos; and a species from the gymnosperm group, *Prumnopitys standleyii*. Also the white cypress (*Podocarpus macrostachyus*) and a species of butterfly (*Automeris kopturae*). The map below shows the endemism centers identified in Costa Rica: green indicates the Central Volcanic Range.

Table 6: Land use in the Pax Natura project area. ACCVC, Costa Rica.

Category	Area (ha)	%
Primary forest	29,553	74.8%
Manipulated forest	504	1.3%
Crops and pasture	2,934	7.4%
Wooded pasture	277	0.7%
Brush	7	0.0%
Bare soil	105	0.3%
Bodies of water	9	0.0%
Reforestation/recovery	308	0.8%
Clouds/No data	4,843	12.3%
Urban	982	2.5%
TOTAL	39,522	100.0%

Source: Land-use map of the ACCVC based on Landsat image 2005 (FUNDECOR, 2007).

There are some places in the Conservation Area that are marked by high biological diversity. For example, 6,000 species of plants (50% of all species expected for the entire country) have been identified in Braulio Carrillo National Park (47,582.56 hectares), as have 515 species of resident and migratory birds, equivalent to 60.5% of the total birds identified in Costa Rica.

In the northern sector (La Selva Protected Area) 2,000 plant species have been recorded, of which 400 are trees, as well as 400 species of birds, 116 species of mammals, 123 species of amphibians and reptiles, 43 species of fresh water fish, and 1,600 species of insects.

According to the National Biodiversity Institute, more than 50 plant species are endemic to the ACCVC. Following is more specific information on some of the species of flora and fauna found in the ACCVC.

Flora: Species in the cloud forest include: oak (*Quercus costarricensis*), balsam tree (*Clusia odorata*), white cypress (*Podocarpus oleifolius*), tongue fern (*Elaphoglossum lingua*), myrtle (*Vaccinium sp.*), papayillo (*Didymopanax pittieri*), ciprecillo (*Escallonia mylloides*), wild apple (*Ardisia sp.*), candelillo (*Magnolia poasana*), white oak (*Quercus sp*), epiphytes and other plants.

Vegetation at the highest elevations (Irazú Volcano) is characteristic of subalpine rain paramo, with species including myrtle (*Vaccinium sp.*) and tropical live oak (*Quercus oleoides*). There are patches of primary vegetation of montane rain forest, with species including black oak (*Quercus sp.*), jaúl (*Alnus acuminata*), salvia (*Baddleia nitida*), matagente (*Oreopanax xalapensis*), lorito (*Weinmannia*

pinnata), escalonia (*Escalonia poasana*), candelillo (*Magnolia poasana*), cow's tongue fern (*Miconia sp.*) and poor man's umbrella (*Gunnera insignis*).

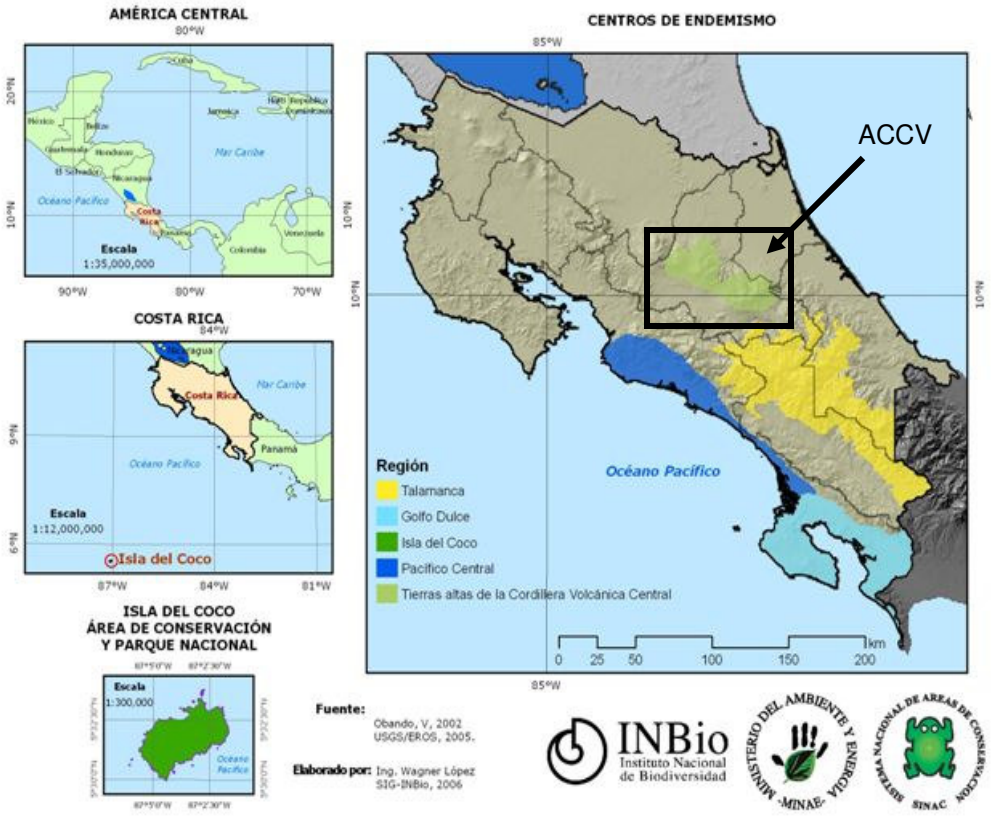

Figure 3: Centers of endemism identified in Costa Rica. Source: National Biodiversity Institute

In the tropical wet forest, species including manú (*Caryocar costarricensis*), mahogany (*Swietenia macrophylla*), oak (*Quercus costaricensis*), caobilla (*Guarea rhopalacarpa*), and gavilán (*Pentaclethra macroloba*) are relatively abundant. Also present are botarrama (*Vochysia ferruginea*), Ceiba (*Ceiba pentandra*), yos (*Sapium pittieri*), lorito (*Weinmannia pinnata*), and ojoche (*Brosimun costaricanum*). Other species, however, are in danger of extinction, including nazareno (*Peltogyne purpurea*), gourd tree (*Crescentia alata*), walking stilt palm (*Iriartea deltoid*) and súrtuba (*Geonoma binervia*).

Fauna: In the ACCVC, fauna is represented by approximately 150,000 species of insects, 550 species of birds, 150 species of mammals, and more than 100 species of amphibians and reptiles. The most characteristic species of birds found there are: mountain robin (*Turdus plebeyus*), quetzal (*Pharomachrus mocinno*), flame-throated warbler (*Pacula gutturalis)*, black guan (*Chamaepetes unicolor*), emerald toucanet (*Aulacorynchus prasinus*) and several species of humming birds (*Trochilidae*); king vulture (*Sarcoramphus papa*), three-wattled bellbird (*Procnias tricarunculata*), black-faced solitaire (*Myadestes melanops*),

volcano junco (*Junco vulcani*), acorn woodpecker (*Melanerpres formicivorus*), clay-breasted robin (*Turdus grayi*), toucans (*Ramphastos sulfuratus* and *swainsonii*), montezuma oropendola (*Psrocolius montezuma*), trogons (*Trogon sp.*), woodpeckers (*Melanerpes sp.*), squirrel cuckoo (*Piaya cayana*), ornate hawk-eagle (*Spizaetus ornatus*), and green macaw (*Ara ambigua*), among others.

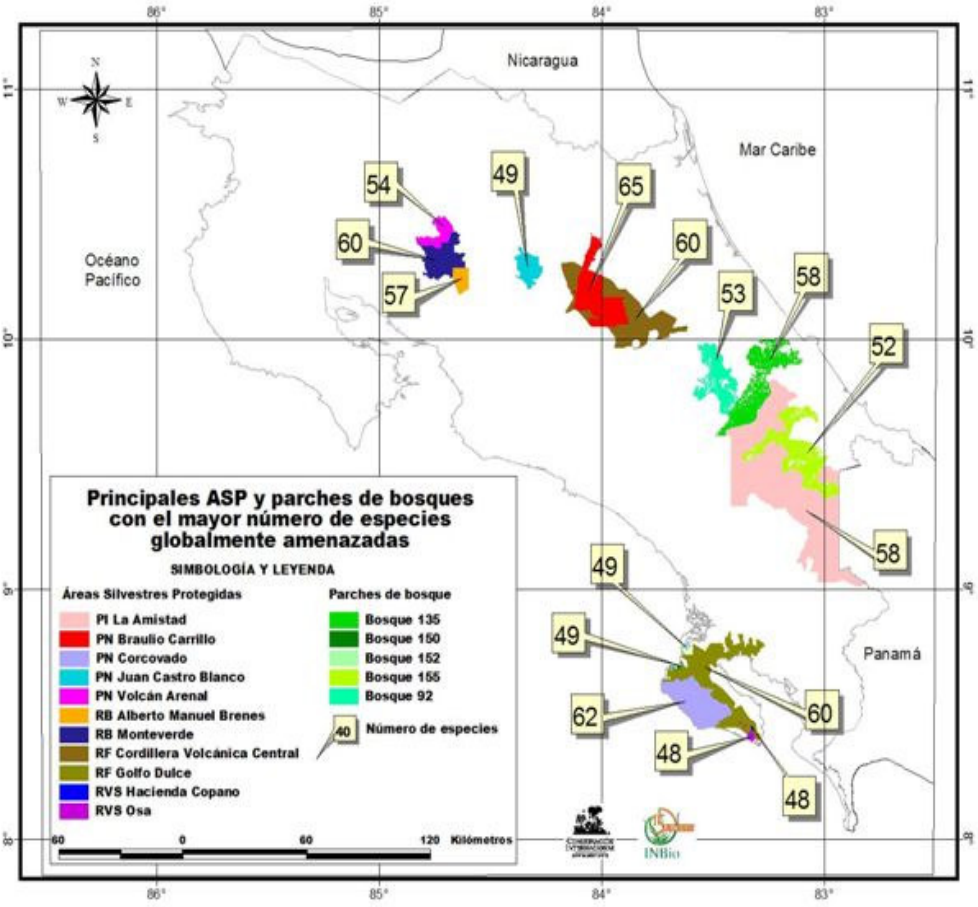

Figure 4: Protected wildlife areas identified in Costa Rica with the greatest number of globally threatened flora species. Source: INBIO (2006)

Mammal species include: white-faced capuchin (*Cebus capuchinus*), Central American spider monkey (*Ateles geoffroyi*) and howler monkey (*Alouatta palliata*); Baird's tapir (*Tapirus bairdii*), puma (*Puma concolor*), jaguar (*Panthera onca*), white-lipped peccary (*Tayassu peccary*), northern Tamandua anteater (*Tamandua Mexicana*), red brocket deer (*Mazama americana*), tapeti/forest rabbit (*Sylvilagus brasiliensis*), coyote (*Canis latrans*), nine-banded armadillo (*Dasypus novemcinctus*), prehensile-tailed porcupine (*Coendou mexicanus*), long-tailed weasel (*Mustela frenata*), ocelot (*Leo pardus*), red-tailed squirrel (*Sciurus granatensis*), two species of sloth (*Choloepus hoffmanni* and *Bradypus griseus*), tayra (*Eira barbara*), kinkajou (*Potos flavus*), squirrels (*Sciurus sp.*), white-nosed coati (*Nasua narica*), paca (*Agouti paca*), and others.

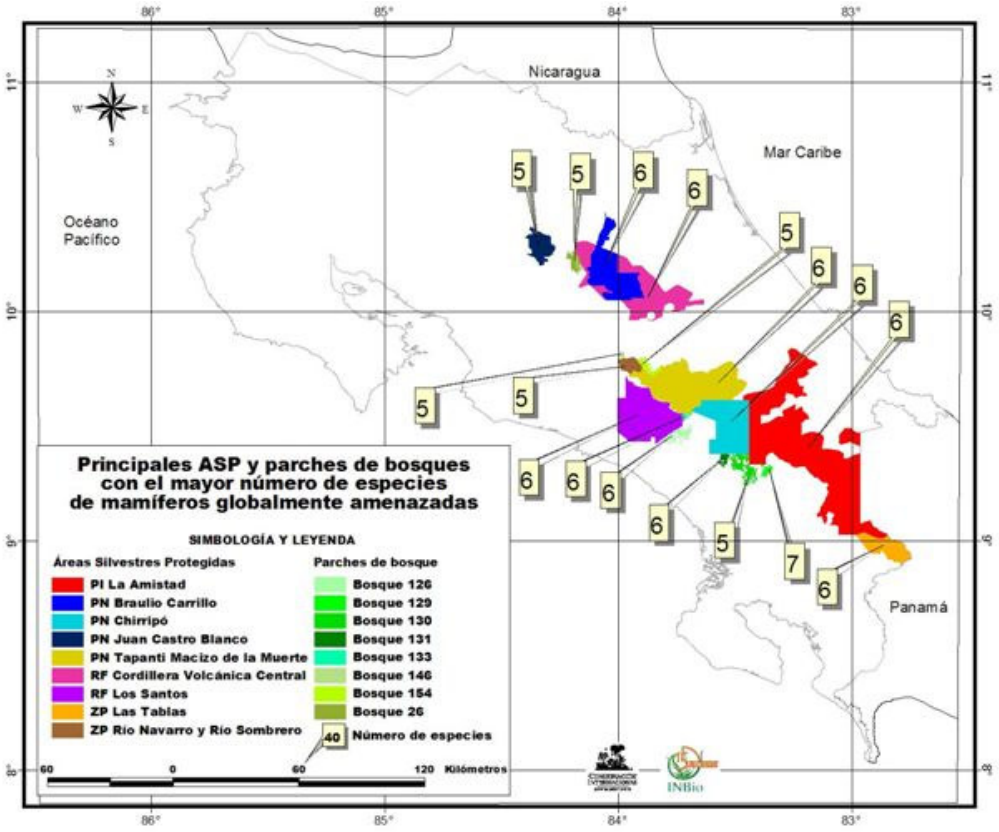

Figure 5. Protected wildlife areas identified in Costa Rica with the greatest number of globally threatened mammal species. **Source: INBio.**

Conservation gaps in the ACCVC

The GRUAS II Project identified the "gaps" in Costa Rica's conservation system by pinpointing the types of vegetation, fresh water ecological systems (volume II), marine ecological systems (volume III), and species not adequately represented in the present network of protected areas (SINAC, 2007).

Under this project, forest patches were identified that will help fill the conservation gaps, based on patch size (area > 1000 hectares); presence of special species; presence of endemic species; land-use capacity VII and VIII; aquifer recharge areas, and overlapping of previously prioritized fresh water ecological systems in microbasins.

As can be seen in Figure 5, the Pax Natura project area includes forest patches that meet 100% of the aforementioned criteria.

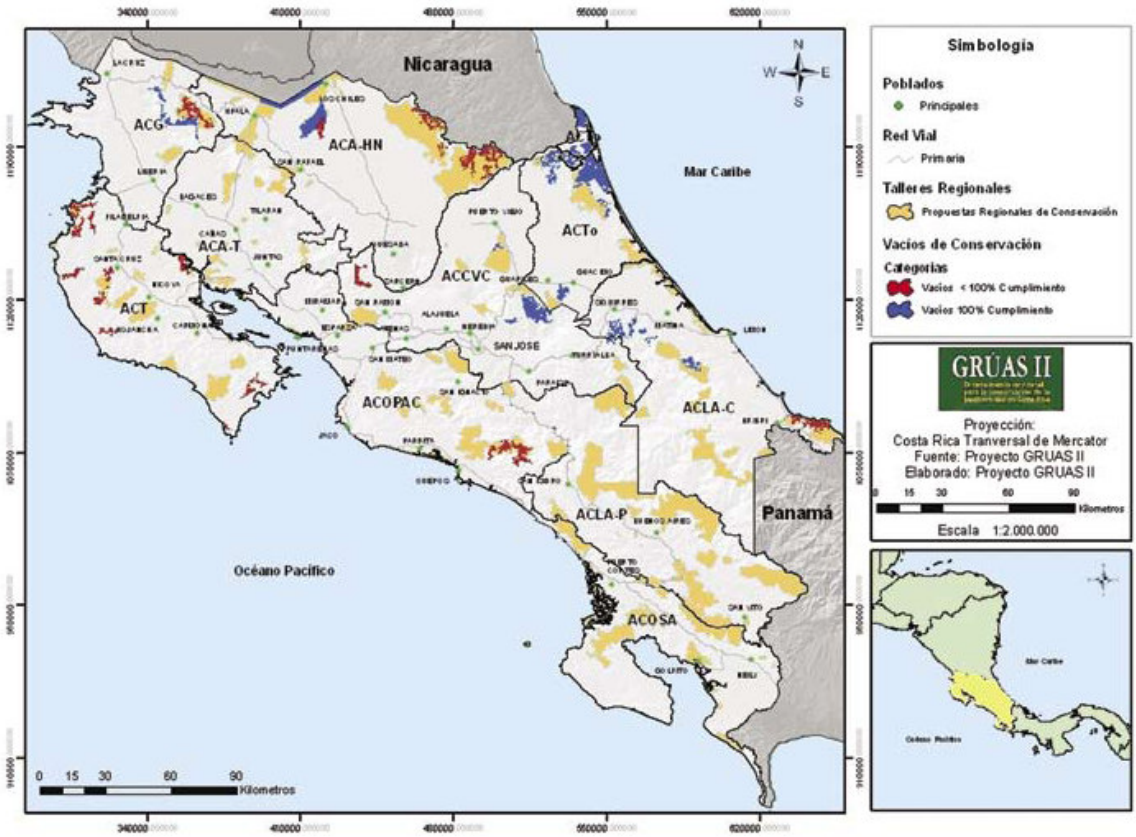

Figure 6: Fragments of natural cover > 1000 hectares making up the proposed conservation gaps to be filled in order to reach 100% and < 100% of the target and regional conservation proposals from consultation workshops (SINAC, 2007)

2. Definition of the baseline

2.1. Obstacles to project implementation

The main obstacle to project implementation is financial. According to the analytical model cited by Walker (2004) and used by Tattenbach et al (2006) to model deforestation in the ACCVC, an area's deforestation is determined by its rent. This is defined as the rent from alternative use of forest lands (alternative rent) minus rent from forest lands. In the absence of policies to improve the rent of forest lands, forests will be eliminated in favor of other activities. Therefore, the following are considered obstacles to project implementation:

- **Access to funds for avoided deforestation projects:** Limited funds are available for avoided deforestation projects. FONAFIFO does not have the Project Design Documents needed to market carbon rights generated under the PES program in the limited voluntary market. The Clean Development Mechanism (CDM) excludes Reduced Emissions from Deforestation and Degradation (REDD) projects, at least until 2012. Nor is there any guarantee that REDD projects will be eligible for CDM after 2012.
- **Increased rent for alternative uses of forest land:** An increase in alternative rent spurred by a greater demand for land to produce biofuels will shrink the scope and/or competitiveness of the PES program.

2.2. Relevant laws and policies considered in the baseline

Binding legislation considered for the baseline

- **Land-use change prohibited:** Although land-use change is prohibited in Costa Rica under the 1996 Forest Law, this law has not been fully enforced due to a lack of financial and technological resources, among other things. The principal program of the National System of Conservation Areas (SINAC) to control illegal felling was closed down. Its purpose had been to discourage conversion of forests to wooded pastures, and it was highly successful in dealing with the irregular felling of trees in pastures that had been converted from forest, using global positioning systems and satellite images. To date, however, SINAC has still not issued effective directives to prevent changes in land use, such as, for example, through the mandatory use of global positioning signal receivers and the year 2000 cover image. Finally, it is no coincidence that the prohibition on land-use change is found in the same law that recognizes the environmental services provided by forests, and that authorizes payment for environmental services (PES) to those who conserve their forests. That law also authorizes FONAFIFO to secure financing from the international sale of carbon credits. The ban on land-use changes was the outcome of a political agreement to compensate with PES those prohibited from changing land use, which led the State to develop the environmental services markets.

National programs and policies not taken into account in the baseline

- **Approval of the World Bank loan "Scaling up and Mainstreaming Payment for Environmental Services in Costa Rica."** Negotiations for this loan began in 2006, at the same time that the contract between Pax Natura and FONAFIFO was signed, and was finally approved in early 2009 by the Legislative Assembly. It was negotiated with the World Bank for the purpose of providing the FONAFIFO-administered PES program with the resources needed to recruit 288,000 hectares nationwide to produce environmental services. That recruitment level is similar to FONAFIFO's PES program of 2005 (280,000 hectares of forest), which is scheduled to conclude in February 2012. The effect of execution of this loan on the baseline was not taken into account. With regard to the construction of the baseline, the CDM allows policies or measures to be excluded if their implementation will discourage the creation of laws and policies that directly or indirectly pursue the same objectives as the project.[2]

2.3. Most likely land-use change scenario, without the project

Taking into account the obstacles to implementation, the relevant binding legislation considered, as well as national Type E- or E+ policies (in accordance with CDM regulations) not considered, the most likely change in land use scenario as of 2009 will be determined by a lack of financing for the payment for environmental services.

With regard to the projected change in land use obtained with the econometric model developed by Tattenbach et al (2006) (Table 7), in the absence of the Pax Natura project, the area of interest will lose **9,750 hectares** in the ten years comprising the 2009-2019 period. This represents an **annual 3.9%** gross deforestation rate for that period. Since the econometric model was designed to estimate gross deforestation in four-year periods, forest cover loss was projected for two four-year periods plus one two-year period.

2.4. Most likely land-use change scenario, with the project

The projected change in land use with the project is presented in Table 8, and was also obtained with the econometric model developed for the ACCVC by Tattenbach et al (2006). In this projection, expected gross deforestation with the project, in the 2009-2019 period, is estimated at **4,371 hectares**, or an **annual 1.6%** gross deforestation rate**.**

2.5. Change in carbon pools, without the project

According to the most likely land-use change scenario in the absence of the Pax Natura project (Table 7), it is estimated that at least **1,125,000 Mg*ha^{-1}** of carbon

[2] COP, decision 17/CP.7, 11 November 2001; and CDM, EB 22, Annex 3, paragraphs 7(a) and 7(b).

will be emitted due to deforestation during the 2009-2019 period, from the above-ground biomass of the 9,750 deforested hectares.

As Pax Natura is an avoided deforestation project, it is not expected that pools of greenhouse gases other than carbon will be influenced by the absence of the project.

2.6. Effect of the "without-the-project" scenario on water resources and local communities

Given the effect of plant cover on water quality and the regularity of the rainfall regime, expected deforestation in the "without-the-project" scenario would have an impact on infiltration capacity, and on the quality and regularity of drinking water for the main water supply of the communities of Guácimo and Pococí, which have a population of 38,466 and 114,017, respectively (INEC, 2006). This is because the Guácimo and Pococí aquifers are inside the project area.

Lozilla et al (2006) indicate that the total annual recharge potential calculated for all recharge sectors of Pococí canton is **3.2 billion cubic meters**, and that the area that contributes most to this (52**%** of the total) is inside the project area.

Infiltration tests cited by the same authors and performed in Cubujuquí (less than 5 km from the project area) show a positive relation between primary forest and infiltration capacity, compared to other uses. In these tests, the average infiltration of pastures was 12.4 $mm*hr^{-1}$ (0.3 $m*d^{-1}$), while average infiltration capacity under forest cover (primary and secondary forests) was 836.3 $mm*hr^{-1}$ (20 $m*d^{-1}$); this means that the infiltration capacity in pastures was 80 times less than that for forest cover.

Table 7: Most likely land-use change scenario, without the Pax Natura project. ACCVC, Costa Rica.

Period	Index of alternative rent	Proportion of area under PES	Average area under PES (ha*year^{-1})	Estimated deforestation rate		Forest at beginning (has)	Forest at end (has)	Deforestation (has)	Cumulative deforestation (has)
				Quadrennial	Annual				
2000-2005*			6,518			34,213	32,919	1,294	1,294
2005-2009	0.34	0.15	5,071	0.103	0.027	32,919	29,515	3,404	4,698
2009-2013	0.34	0.00	0	0.148	0.039	29,515	25,141	4,374	9,072
2013-2017	0.34	0.00	0	0.148	0.039	25,141	21,415	3,726	12,798
2017-2019	0.34	0.00	0	0.148	0.039	21,415	19,765	1,650	14,448

* Observed data. Source: Prepared by authors, based on land-use map from Landsat image, 2005 (FUNDECOR, 2005); deforestation estimates from the econometric model developed for the ACCVC by Tattenbach et al (2006).

Table 8: Most likely land-use change scenario, with the Pax Natura project. ACCVC, Costa Rica.

Period	Index of alternative rent	Proportion of area under PES	Average area under PES (ha*year^{-1})	Estimated deforestation rate		Forest at beginning (has)	Forest at end (has)	Deforestation (has)	Cumulative deforestation (has)
				Quadrennial	Annual				
2000-2005*						34,213	32,919	1,294	1,294
2005-2009	0.34	0.15	5,071	0.103	0.027	32,919	29,515	3,404	4,698
2009-2013	0.34	0.26	7,625	0.080	0.021	29,515	27,145	2,370	7,068
2013-2017	0.34	0.44	12,000	0.051	0.013	27,145	25,767	1,378	8,446
2017-2019	0.34	0.47	12,000	0.048	0.012	25,767	25,144	623	9,069

* Observed data. Source: Prepared by authors, based on land-use map from Landsat image, 2005 (FUNDECOR, 2005); deforestation estimates from the econometric model developed for the ACCVC by Tattenbach et al (2006).

Table 9: Changes in the carbon pool in the project area, without the Pax Natura project. ACCVC, Costa Rica.

Year	Remaining area of forest (has)	Remaining carbon pool ($Mg*ha^{-1}$)
2009	29,515	3,406,745.11
2013	25,141	2,901,870.70
2017	21,415	2,471,817.91
2019	19,765	2,281,317.24

Source: Prepared by the authors.

In addition, the sources and wells inside the project area would be seriously affected by deforestation from the without-the-project scenario. According to Lozilla et al (2006), there are several groups of important water sources on the northern flank of Turrialba volcano, between 250 and 400 meters above sea level and within a 3 to 4 kilometer section.

The catchment area of the recharge for these sources is in the medium and high elevation foothills of Turrialba Volcano. The following sources are located at the face of a foot of lava outflow from the Turrialba Volcano:

- **Numancia 1, 2 and 3:** with an output of approximately **340 l/s**, tapped by the A&A for the Guápiles, La Rita and Roxana water supply system (System 1)
- **La Roca 1, 2, 3, 3-A and 3-B**, with a dry-season output of approximately **150 l/s** for the Cariari water supply system (System 2)
- **La Roca 4 (20 l/s) and La Angelina (120 l/s)** (System 3)

The La Roca group of sources has been sporadically gauged before tapping, revealing an annual average output of **840 l/s[3].** It emerges at the bottom of a 10-meter thick escarpment, formed by block lava that appears to be the face of a basaltic-andesite lava outflow from the northern flank of the Turrialba Volcano.

The MINAET concessions database shows 51 water sources in Pococí canton alone, for a total of 1800 l/s. of water in concession.

2.7. Effect of the "without-project" scenario on biodiversity

- The ACCVC is one of the country's five areas of concentration for endemism. Its topography, temperature, rainfall regime, and location in the national territory makes it one of the most important regions in terms of endemism, mainly for groups of land vertebrates, whose endemism represents 80.7% of the endemic species in the country, particularly in the higher elevations of the mountain ranges.

[3] Dept. Environmental Management, Hydrology, AyA (2006).

- The forests in the project area connect the protected wildlife areas of Braulio Carrillo National Park, Irazú National Park, Turrialba National Park, as well as the Pococí and Guácimo aquifers.
- The project area includes forest patches identified as conservation gaps in Costa Rica's protected areas system (ACCVC, 2007).

The expected consequence of deforestation in the without-project scenario would be a loss of habitats that would affect the biology and therefore the conservation of endemic species, producing irremediable losses and worsening the conservation gaps in Costa Rica's protected areas system.

Table 10: Infiltration tests conducted in the Cubujuquí sector near the project area. ACCVC, Heredia, Costa Rica.

N°	*Infiltration Fc (mm/ hr)*	*Land use*
1	303	primary forest
2	740	primary forest
3	701	primary forest
6	817	primary forest
7	1353	primary forest
12	1517	primary forest
8	518	abandoned pasture
9	720	early secondary forest
4	4.3	grazing land
5	29	grazing land
10	12	grazing land
11	4.5	grazing land

Source: Lozilla et al (2006).

Table 11: Water concessions registered by the Ministry of Environment, Energy, and Telecommunications for Pococí canton

Type concession	*Quantity*	*Flow (l/s)*
Total wells	133	475.96
Wells with concession in force	107	432.25
Total springs	51	1800.82
Springs with concession in force	44	1800.25
Total rivers and streams	25	2371.33
Rivers and streams with concession in force	18	263.76
Total concessions	**209**	**4648.11**

Source: MINAET

3. Description of the project

The Pax Natura project aims to mitigate the emission of carbon dioxide into the atmosphere by reducing deforestation in the project area. It can therefore be regarded a Reduced Emissions from Deforestation and Degradation (REDD) project.

3.1. Project objectives

- Mitigate carbon dioxide emissions, and protect biodiversity and water resources in forest areas bordering national parks ***by reducing deforestation***
- Contribute to efforts to prevent climate change
- Participate in maintaining the biological integrity of the landscape in the Central Volcanic Range Conservation Area

Specific objectives

- Enroll **12,000 hectares** of private forests in the project area in the Payment for Environmental Services (PES) program for a **10-year** period**.**
- Monitor deterioration or recovery according to a baseline of above-ground biomass, biodiversity, water quality, and contribution of economic resources through PES in the project area.

3.2. Project location

This is a programmatic project under which a total of **12,000 hectares** of privately-held forest, not necessarily forming a single forest block, will be recruited. The geographical distribution of these **12,000 hectares** will depend on the location of the farms of owners who voluntarily join this program.

The **12,000 hectares** will be recruited within an area of **30,000 hectares** of privately-owned forest lands located in an area of interest of **39,522 hectares** within the Central Volcanic Range Conservation Area (ACCVC), specifically, in the Central Volcanic Range Forest Reserve (RFCVC), which is located in the provinces of Cartago and Limón (Annex 1, Figure 8).

The project area does not include national parks or biological reserves, although it does border on several of them (to the west with Braulio Carrillo National Park and to the south with Irazú and Turrialba National Parks). Importantly, the Guácimo and Pococí aquifers are also located inside the project area.

3.3. Project timeframe

Under the project, the **12,000 hectares** of privately-owned forest lands will be protected for **10 years** under the PES mechanism. Once the project is launched, around 5,000 hectares are expected to be recruited in year one, and an additional 3,500 hectares each year in years two and three, until **40%** of the forest area in the area of study to 2005 is covered under the PES mechanism, and maintained under that arrangement for the duration of the project.

Although a 10-year timeframe is proposed, the commitment to reduce emissions is long term since Costa Rica has declared its intention to become carbon neutral by the year 2021 (two years after the conclusion of this project, assuming it begins in 2009).

Also, when there is a long-term commitment to reducing emissions, the claims for carbon rights are restricted to deforestation avoided during the life of the project (10 years).

Table 12: Timeframe for the activities of the Pax Natura project

Responsible party	Activity	Year										
		0	1	2	3	4	5	6	7	8	9	10
PAX NATURA	Manage/secure financing	X	X	X	X	X	X	X	X	X	X	X
FONAFIFO	Administer Payment for Environmental Services		X	X	X	X	X	X	X	X	X	X
INBio	Monitor biodiversity		X			X			X			X
CCBA standards auditor	Verification		X			X			X			X
FUNDECOR	Recruit forest owners		X	X	X							
	Regencia forestal[4]: "Forest auditor" processes PES with relevant authorities		X	X	X	X	X	X	X	X	X	X
	Update, document, supervise, resolve conflicts, and maintain portfolio of project participants		X	X	X	X	X	X	X	X	X	X
	Monitor water quality of principal sources of potable water		X			X			X			X
	Monitor PES revenues to project participants		X			X			X			X
	Monitor changes in land use		X			X			X			X
	Monitor above-ground biomass and mortality		X			X			X			X
	Monitor tree-felling permits on agricultural lands in project area		X			X			X			X

3.4. Risks

Institutional risk: The institutional risk associated with the project is minimal inasmuch as FONAFIFO has 10 years' experience implementing a PES program, making successful use of the resources, and it is duly grounded in Costa Rican environmental legislation. Moreover, the PES system has a monitoring and

[4] In Costa Rica, the "*regente forestal*" (forest auditor) is a forestry professional charged with ensuring that forestry activities are planned and executed correctly. The Costa Rican State has delegated to "forest auditors" the responsibility of overseeing the proper use of the country's forestry resources.

assessment arrangement that makes use of external audits, which has ensured proper execution of resources, including those secured through the present project.

Risk associated with catastrophic events: The risk associated with catastrophic events (fires, volcanic activity, hurricanes, earthquakes) is not seen in the historical records or natural history of the area. The presence of vegetation including trees measuring more than 100 cm in diameter, combined with the presence of shade-tolerant plant species, suggests the absence of events causing massive loss of cover in the last 100 years in the project area.

The country's experience with seismic activity suggests that loss of cover due to this type of event is restricted to landslides in steep-sloped areas, especially alongside river beds. Landslides of this nature occurred during the Limón and Cinchona earthquakes (May 1991 and January 2009, respectively).

Risk associated with illegal activity: Finally, the risk that project participants will engage in illegal activity that threatens forests, water resources or biodiversity will be controlled by semiannual monitoring visits by FUNDECOR's specialists to the forests covered by the PES program.

Any irregularities observed during these visits will be reported by the project's forest auditor (*regente forestal*) to FONAFIFO, which will proceed to terminate the contract with the project participant. If a contract is annulled, the money must be paid back and a complaint will be filed with the competent judicial authorities to ensure enforcement of the corresponding sanctions.

Forest auditors who do not fulfill their obligations will be subject to suspension or disqualified from serving as forest auditor. The Professional Association of Agricultural and Forest Engineers periodically reviews the work of forest auditors.

3.5. Stakeholders

FUNDECOR's group forest certification has been maintained since 1996 (certification code: GFA-FM/COC-001402) under the standards of the Forest Stewardship Council (FSC).

These standards require that stakeholders in the FUNDECOR area be duly identified. FUNDECOR's area of influence is the entire ACCVC and the Pax Natura project area is contained within the ACCVC. Since one of the activities certified for the ACCVC is forest protection with PES, stakeholders of this project are some of the same ones identified over the last 12 years of FUNDECOR's uninterrupted green seal certification. Specifically, they are the ones involved in decision-making in Pax Natura's area of interest. Annex 2 contains a list of stakeholders.

Also, the standard requires a dispute settlement procedure both for the institution itself (contract signers and employees), and for disputes between stakeholders and the institution. For this project, the same procedures established for green seal certification will apply (see Annex 9).

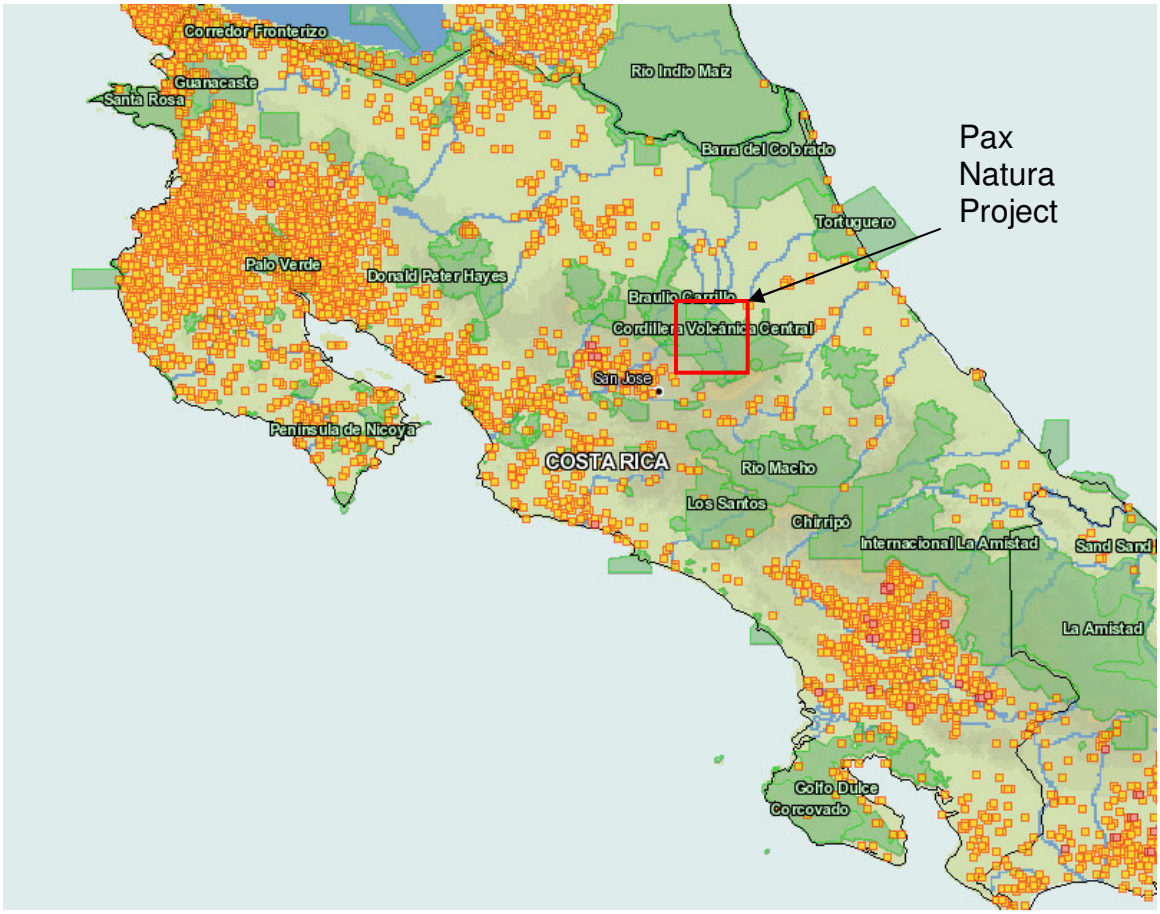

Figure 7: Fires identified in Costa Rica for the period 1 January 2000 to 5 March 2009, according to MODIS Rapid Response. Satellite source: Aqua and Terra. Source: University of Maryland, FIRMS / Web Fire Mapper (http://firefly.geog.umd.edu/firemap/)

Figure 7:

3.6. Transparency:

The areas participating in the project will be under FSC forest certification, which requires that up-to-date information be available and readily accessible for consultation by stakeholders and the general public. This information is published on the FSC website: http:/www.fsc-info.org. As the project's executing agency, FUNDECOR will also make this information available to the public on its web site: www.fundecor.org.

FUNDECOR's website also provides the general public with the email addresses of the directors of its Administrative Board, where they can file complaints or observations regarding the project or the institution's operations as a whole.

4. Management capacity

The project will be conducted by a consortium composed of the following organizations:

- Pax Natura Foundation, which will secure the resources needed to cover the payments for environmental services and all project design and implementation costs.
- FONAFIFO, which will execute the payments for environmental services to each project participant, pursuant to Costa Rican public administration regulations.
- FUNDECOR, which will implement the project pursuant to the guidelines established by the Climate, Community and Biodiversity Alliance (CCBA). FUNDECOR's duties will include:
    - promoting the project
    - recruiting forest owners
    - responding to queries, concerns, and complaints of stakeholders
    - providing training to project participants
    - monitoring the carbon pool in the project area
    - monitoring project impact on the communities
- INBio, which will monitor project impact on biodiversity in the project area

Annex 3 contains a brief description of each organization's capacities vis-à-vis their responsibilities under the project.

4.1. Forest management experience

FUNDECOR brings to the project the necessary forest management experience. It is a nongovernmental organization founded in 1989 to protect and develop Costa Rican forests located in the Central Volcanic Range. To that end, FUNDECOR has implemented forestry projects since 1991 including reforestation programs (**1,733 hectares**), forest management programs (**8,574 hectares**) and forest protection programs (**33,600 hectares**) that are FSC forest certified and supervised by the forest auditor, with oversight by the Professional Association of Agricultural and Forest Engineers (CIAgro) in the areas under the payment for forestry services arrangement (see Annex 3).

FUNDECOR has a technical staff of 19 people: **3 forestry specialists**, **9 forestry engineers**, **3 forestry engineers** pursuing master's degrees in ecology, information technology administration, and geographic information systems (GIS), and **7 engineers** with master's degrees in the areas of forestry, administration, and GIS.

Two mid-level forestry specialists and seven forestry engineers will be responsible for monitoring project participants. One forestry specialist and nine

forestry engineers will monitor the carbon pools, project impact on communities, and the project's GIS operations.

FUNDECOR has worked in the area of interest of the Pax Natura project since 1991 and currently has technical assistance agreements covering **6,610 hectares** of forests in that area. Thus, FUNDECOR's current staff roster can reasonably be expected to handle a 6000-hectare increase in coverage, which represents a 15% increase in the area currently covered by agreements signed with FUNDECOR throughout the ACCVC.

4.2. Experience with implementing PES projects

The National Forestry Financing Fund (FONAFIFO) is the institution that has experience managing and executing the funds of payment for environmental services (PES) programs. It was created by law 1996 as an autonomous organization of the State Forestry Administration, and is overseen by the Ministry of Environment, Energy, and Telecommunications (MINAET).

FONAFIFO has its own Board of Directors, whose members represent both the public and private sectors. It is authorized to manage funds earmarked for forestry management and forest protection activities with small and medium-sized landowners.

FONAFIFO is responsible for planning, securing funding, and implementing the Payment for Environmental Services Program at the national level, with an annual budget of US$15 million. It has also signed climate change prevention projects with the German Bank KFW, the International Development Bank, and the Global Environment Facility, for a total of approximately **US$60 million.**

FONAFIFO has signed contracts to purchase environmental services for more than **200,000 hectares** nationwide.

5. Land tenure

The project will be implemented on privately-owned property. To be eligible, owners must demonstrate ownership with title deeds registered with Costa Rica's Public Records Office for Properties, as well as with duly certified cadastral maps.

In the absence of title deeds, Costa Rican legislation allows for proving tenure by a verification of rights. This requires that a qualified professional collect geographic data and prepare a map, which must be accompanied by an affidavit that certifies that the property is not subject to land-tenure conflicts.

FSC standards require that land ownership be reviewed annually, or whenever complaints are filed by third parties that give rise to land-tenure conflicts. If the claim is considered legitimate by a ruling of the corresponding judicial body, the area will be eliminated from the project.

6. Legal framework

Costa Rica's environmental legislation recognizes the environmental services provided by forests, prohibits changes in forest use, regulates human activities that affect forests, and protects biodiversity. This regulatory framework provides the underpinning for this project. Following are the most relevant elements of the regulatory framework:

- **Forest Law 7575:** Defines environmental services, implements payment for environmental services, and prohibits changes in land use.
- **Law 8640 of the Ecomarkets Project:** Published in Official Gazette N° 128 on 3 July 2008, this law approves the World Bank loan to the Government of Costa Rica providing funds for payment of environmental services. This law authorizes FONAFIFO to pay for environmental services to owners of untitled farms who can prove ownership.
- **MINAE Decree 34761 of 30 September 2008:** Directly authorizes FONAFIFO to market carbon certificates and creates the relevant procedure.
- **Decrees creating the Guácimo and Pococí aquifers:** Creates the Guácimo and Pococí aquifers and brings them under protected status; also defines their borders and establishes the bodies needed to ensure proper management and administration.
- **Ownership Information Law:** Establishes titling processes and parameters for determining true property ownership; defines the steps to be taken to resolve land-tenure conflicts.
- **Other legislation:** Water Resources Law, Basic Law on the Environment, and General Health Law.

Project participants will be recruited using a protocol designed in accordance with Costa Rican environmental legislation, the FSC forest certification standard, and FONAFIFO's administrative procedures manual. The process is described below:

- Legal and technical aspects:
  Legal: Project participants must have a cadastral map and title deed duly recorded with Costa Rica's Property Records Office; if they lack the title deed, they must present legal documents proving that they have peaceful (undisputed) possession of the farm. FUNDECOR will ensure that no overlapping claims or land-tenure problems exist.
  Technical: FUNDECOR will conduct a field appraisal before an agreement is signed to ensure that the property actually exists, that the specified forest cover actually exists, that no illegal felling has taken place, and that property lines are duly defined.
- When the legal and technical aspects are in order, FUNDECOR will sign the agreement with the property owner and prepare the documents to be submitted to FONAFIFO for obtaining PES.
- Subsequently, the landowner or landholder will sign a PES contract with FONAFIFO whereby the owner transfers to FONAFIFO the rights to

carbon emissions avoided, in exchange for annual payments for environmental services produced, including the environmental service of avoided deforestation.

- Once FONAFIFO has signed a contract with a landowner, it will attach a legal notation to the title of the farm to identify it as being under contract with the State through the Public Records Office for Property. Every year, before any funds are disbursed, the farms will be visited by FUNDECOR to confirm that the activities are being carried out as planned and that the forest cover is still there.

7. Adaptive management for sustainability

The project will be monitored to ensure that its objectives and design are implemented as originally established, and to collect information to enable timely decision-making should corrective measures be necessary. To this end, the project will monitor the following:

7.1. Change in land use

Every four years, changes in land use in the project area will be monitored using satellite images and GIS technology; the information obtained will reviewed by FSC forest certification or green seal auditors.

7.2. Permits to fell trees on agricultural lands

Given the experience related to land-use changes associated with ***irregular permits*** to fell trees on agricultural lands, it is important to monitor the permits issued by the corresponding SINAC office. Permits to fell trees on agricultural lands will be monitored to ensure proper compliance with the permit and that it not be used to deforest adjacent forests.

7.3. Registry of management plan files

Each property enrolled in the project will have a management plan or technical study, which is required for registering in FONAFIFO's Payment for Environmental Services program. The instructions for preparing this technical study can be found in Annex 8.

In addition, FSC standards require that the implementing organization keep files for each project participant, duly organized into a folder (digital or physical), that includes a historical record of the activities to be carried out in the management unit.

Each management unit should have a technical assistance contract registered with the Professional Association of Agricultural and Forest Engineers of Costa Rica indicating the name of the professional responsible for ensuring proper execution of activities in the forest area and for updating the management plan.

7.4. Long-term sustainability

Even though the project was designed for a 10-year period, the commitment to emission mitigation is long term given that Costa Rica's environmental policies state that the country will be "carbon neutral" by 2021, two years after the present project comes to an end (assuming it begins in 2009). This ensures the State's commitment from now on to the international community to maintain the country's forest cover and, therefore, forest cover in the project area. This will require ongoing implementation of actions to prevent land-use changes and to protect water resources and biodiversity.

8. Dissemination of information

With due respect for the terms of confidentiality established by project stakeholders, FUNDECOR will transfer the knowledge acquired to other farm owners through its web site www.fundecor.org and by the presence of its staff in the work area. This notwithstanding, the executing agency reserves the right to protect its intellectual property, without detriment to the transfer of good practices and know-how generated.

9. Net climate impact of the project

9.1. Accounting of gases other than CO_2 (CH_4 and N_2O)

Gases other than CO_2 are not expected to comprise more than 15% of the net change in greenhouse gas emissions in the project area. This is because the project area is, for the most part, covered by natural forest (74.8%); there is some livestock on grazing lands but at a density so low that it can be defined as subsistence level. Moreover, there are no commercial plantations of agricultural crops that would represent a source of emissions other than carbon due to the use of fertilizers or agrochemicals.

This project involves no activities associated with burning, or with the use of agrochemicals. No wetlands will be altered, nor will any lands be prepared in a way involving removal.

9.2. Avoided deforestation by the project

In accordance with the deforestation scenarios with and without the project (9,750 hectares and 4,371 hectares, respectively), it is estimated that this project will prevent the loss of 5,379 hectares of forest in the area of influence of the Pax Natura project.

This is a conservative estimate inasmuch as the econometric model estimates a reduction in gross deforestation from 3.9% annually -without the project- to 1.3% annually with the project. This reflects an increase in the proportion of the initial forest area under PES coverage from 0% to 47% in the ten years of project life. At the same time, it has been observed over time (in satellite images) that an 11 percentage point increase in PES coverage (from 15% to 26%) led to a 1.7 percentage point reduction in the deforestation rate (2.5% to 0.8%). According to

the projections of the econometric model, an increase in project-fostered PES coverage, from 0% to 47%, will diminish the annual deforestation rate from 3.9% to 1.3% (2.6 percentage points). (See Table13)

Considering an avoided deforestation of 5,379 hectares and that the above-ground biomass of an average hectare in the project area contains **115 Mg*ha^{-1}** of carbon, it is estimated that the project will avoid the emission of at least **2,276,526 Mg of CO_2.**

Again, this estimate is conservative inasmuch as in calculating the carbon average, secondary forests were considered to contribute **0 Mg*ha^{-1}** of carbon to the average. (See Table 4)

Table 13: Relationship of historical performance of the deforestation rate to increases in PES coverage in the Pax Natura project area

Period	PES coverage		Deforestation rate	
	Before Pax Natura	After Pax Natura	Before Pax Natura	After Pax Natura
1996-2000	15%		2.5%	
2000-2005	26%		0.8%	
2005-2009		0%		3.9%
2009-2019		47%		1.3%

Source: FUNDECOR-GIS Laboratory

9.3. Composition of avoided deforestation

Pursuant to the econometric model developed by Tattenbach et al (2006), avoided deforestation in the project area attributable to the PES program implemented by FUNDECOR and FONAFIFO, consists of:

- **In situ avoided deforestation (by recruited landowners) (12,000 hectares of forest):** This is avoided deforestation produced directly in the areas that have been enrolled in the PES program, and occurs when changes in land use in those areas is reduced to zero.
- **Ex situ avoided deforestation (by landowners not recruited) (22,000 hectares of forest):** This is avoided deforestation produced outside the areas enrolled in the PES program, and results from forest owners' expectation of receiving PES in the near future. As forest owners "get into line" to obtain PES benefits, they conserve their forests without payment.

For the Pax Natura project, of the estimated 5,379 hectares of avoided deforestation, **3,816 hectares** correspond to ***in situ*** avoided deforestation**,** supplemented by **1,563 hectares** of ***ex situ*** avoided deforestation. Table 14 shows the calculations for in situ avoided deforestation, considering an **annual 3.9%** gross deforestation rate for the without-the-project scenario.

Table 14: Deforestation avoided *in situ* to be produced exclusively in the 12,000 hectares of forest recruited into the Pax Natura project

ACCVC, Costa Rica.

Year	Recruited area		Area not recruited (hectares)	Cover without project (hectares)	Cover with project (has)	Avoided deforestation (hectares)
	Recruited area	Accumulated (hectares)				
2008	0	0	12435	12435	12435	0
2009	5000	5000	7143	11946	12143	197
2010	3500	8500	3500	11477	12000	470
2011	3500	12000	0	11026	12000	451
2012	0	12000	0	10592	12000	433
2013	0	12000	0	10176	12000	416
2014	0	12000	0	9776	12000	400
2015	0	12000	0	9392	12000	384
2016	0	12000	0	9022	12000	369
2017	0	12000	0	8668	12000	355
2018	0	12000	0	8327	12000	341
					Total	**3816**

Source: Prepared by the authors

Table 15: Composition of avoided deforestation by the Pax Natura project

ACCVC, Costa Rica.

Avoided deforestation	Area (hectares)	CO_2 (Mg)
In situ	3,816	1,614,887
Ex situ	1,563	661,639
Total	5,379	2,276,526

Source: Prepared by the authors

10. Climate impact outside the project area

Project implementation is not expected to produce deforestation leakage since it will not displace forest owners through the purchase of land; owners join the program voluntarily; and the project does not involve activities that will change land use (crops for reforested area).

In addition, deforestation is not expected to displace to adjoining areas since the Pax Natura project is set within the CARFIX project which, in turn, is set within FONAFIFO's nationwide PES program.

CARFIX is an avoided deforestation project that is being negotiated for the area, and which is planned to be in force until 2020. Both the Pax Natura project and the CARFIX project will be implemented by FUNDECOR; their areas are exclusive and do not overlap.

Lastly, the evidence provided by Tattenbach et al (2006) regarding the existence of avoided deforestation outside the properties enrolled in FONAFIFO's payment for environmental services program (ex situ avoided deforestation) suggests that the net effect is positive, which makes the deforestation displacement effect less than the forest conservation effect of the positive policy (PES).

Deforestation leakage, limited to the emissions produced by project vehicles, was not calculated because its impact was considered negligible since it is amply exceeded by the carbon produced by the ex situ avoided deforestation, which is not being sold on any market.

11. Monitoring climate impact

Because it is a REDD-type project, monitoring of climate impact will be limited to estimating the carbon pool and its variability over time. This will take place in two phases:

- **Monitoring changes in land use.** Every three years, in accordance with the project timetable, remote-sensing images will be examined to compare land-use conditions. The images will be classified using supervised classification, with spectral signatures based on field data. This classification will be used to separate the uses of primary forest, secondary forest, reforestation, and other uses in the project area. Finally, a comparison of the forests without cloud cover in each pair of images will provide the gross deforestation rate for the project area. Gross deforestation is the loss of primary and secondary forest cover, and does not take into account any regeneration or reforestation that may have occurred during the period.
- **Monitoring above-ground biomass.** Permanent sampling plots will be established in the different life zones represented in the recruited areas. The plots will measure 30m x 100m, and all trees and palms greater than 10 cm in diameter at breast height (dbh) will be measured, in accordance with Adler's measurement standards (1980). All trees will be numbered, their dbh will be measured in centimeters, and their species will be recorded. The carbon calculation method is described in Annex 4.

12. Adaptability to climate change and climate variability

According to Jiménez and Girot (2002), although Guanacaste is the region that will be most affected by changes in temperature and rainfall patterns (intensity, duration, distribution) resulting from climate change, the project area is also likely to be affected by droughts (See Figure 7).

Accordingly, and as a measure for adapting to climate change, Jiménez and Girot (2002) recommend the design of comprehensive management and conservation programs for strategic, water-producing basins and their aquifer recharge areas.

In light of this, deforestation control in the project area is established as the main measure for adapting to climate change. The aim is for the forest to maintain its infiltration capacity and water quality associated with the geological conditions, which are especially conducive to water production in the area.

Moreover, in addition to monitoring the carbon pool in the project's permanent sampling plots, through periodic measurement of above-ground biomass, the project will also document changes in tropical forest dynamics that may increase carbon emissions due to increased tree mortality caused by water stress.

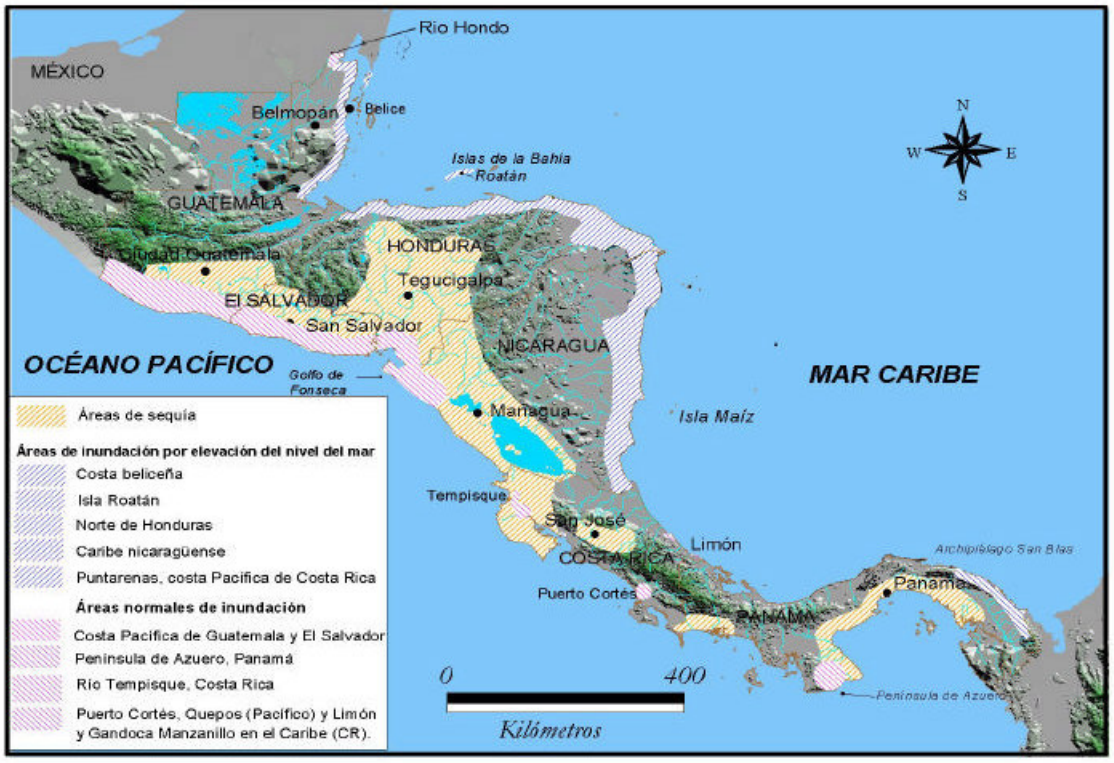

Figure 8: Drought and flood areas in Central America. Map by Jeannette Arauz, in Jiménez and Girot (2002)

13. Carbon benefits withheld from regulatory markets

The project is a REDD-type avoided deforestation project and will therefore be sold on voluntary markets. However, it will not be offering all the potential carbon benefits on those markets. In the first place, the biomass of regenerated forests in the project area is not being included. Secondly, the carbon benefits generated by the avoided deforestation outside the 12,000 hectares recruited in the project area (attributed to landowners waiting to join the PES program), will also not be offered. In this project, the latter is referred to as *ex situ avoided deforestation.*

14. Project impact on communities

Very little of the land in the project area is suitable for agricultural or livestock activity. By and large, forestry is the main land use of farms in the project area, most of which belong to small and medium-scale owners. Given the limited alternative sources of revenue for inhabitants, an injection of resources tied to forest conservation can be expected to induce forest owners to relinquish the idea of converting forest land to cropland or pasture.

Furthermore, although difficult to quantify, the project's avoided deforestation will conserve the quality and regularity of water used by local and nearby communities.

This is because the Guácimo and Pococí aquifers are the principal source of potable water in the area, supplying two important cantons in the project area (Guácimo and Pococí), the combined population of which exceeds 150,000 inhabitants.

In accordance with Lozilla et al (2006), the project is in a recharge area that provides potable water to a number of springs currently tapped for public supply by the AyA[5] and some ASADAS[6]. In the dry season they produce approximately 764 l/s, and may have the potential to supply potable water to most of the water supply systems in Pococí and Guácimo cantons in the future. In addition, it is likely that there are many other small sources in the sector that have not yet been inventoried but that may also be tapped in the future. It is considered that there must be an important discharge of groundwater as baseflow into lower-elevation mountain streams and rivers and the alluvial fan sector. It may be possible to tap these baseflows with infiltration galleries along river and stream banks. Finally, the physical-chemical quality of the water from these aquifers is very high since it moves through volcanic materials with mineral content of low solubility.

14.1. Participation of local individuals and groups in project planning

As all properties enrolled in the project will be under FSC forest certification, accredited auditors will conduct annual evaluations of project impact (both positive and negative) through interviews with stakeholders. Stakeholders are selected primarily on the basis of their representativity, as well as the legitimacy and urgent nature of their project-related concerns.

14.2. Dispute settlement

By recommendation of the green seal auditors, FUNDECOR has established a clear and transparent process for settling disputes and for defining violations, attached to the present project design document as Annex 9.

[5] AyA: Costa Rican Water Supply and Sewerage Institute

[6] ASADA: Community association responsible for administering the water supply and sewerage system

15. Impact on communities outside the project area

No negative impact is foreseen for communities outside the project area since the project will not bring any machinery in, will not involve any land or forest removal, and will not involve any industrial or agricultural processes that require the use of chemicals or dangerous substances.

Because this is an avoided deforestation project, it will not have negative impacts or require mitigation measures.

16. Monitoring of community impact

As indicated earlier, community impact is not expected because:

- there are no communities inside the project area, and inhabitants live at considerable distances from each other;
- it is an avoided deforestation project and therefore will not entail opening roads, felling trees, or installing industrial or agroindustrial projects; and
- most of the area is forest covered.

However, land-use changes can have an impact on the project. Therefore, the project will monitor same by means of satellite images, to determine which sites are under greatest threat and therefore require most protection.

In addition, given the scale and intensity of project operations, the following strategy will be used to monitor benefits received by the communities:

- establish a baseline for PES-income in the area (pre-project),
- monitor PES income in the area, and
- monitor water quality at the outlets that supply the communities in the project area.

The importance of the project area to the communities should be underscored, since most of the water used by nearby towns flows from it.

17. Capacity building

The project includes a training plan, supported by FUNDECOR's training plan for its clients, which was designed to meet the FSC group certification requirement. The plan can be seen in Annex 9.

18. Best practices for community participation

FUNDECOR's environmental policy mandates making no distinctions on the basis of race, creed, or gender. With regard to gender, FUNDECOR strives to directly involve women as responsible or co-responsible parties in its projects.

Because it is an institution that maintains forest certification for those it signs agreements with, FUNDECOR is bound to uphold the country's labor guarantees and civil and labor legislation if irregularities or legal violations are detected. FUNDECOR has an exclusion mechanism.

19. Positive net impact on biodiversity

Fauna species are directly dependent on forest cover. Without the project, it is estimated that some 9,750 hectares of forest will be eliminated, resulting in a loss of flora species and an interruption of the connectivity between forest blocks. Combined with the fragility of the area's ecosystem (see list of endangered species), it can therefore be expected to contribute to the disappearance of micro and macro species of fauna.

The baseline prepared in year one of the project will be used to monitor project impact.

Exotic species: The project is not designed to introduce exotic species, or to implement any reforestation or forest enrichment activities.

Endangered species inside the project area: The six life zones in the project area have produced a considerable amount of endemism and the establishment of a large number of endangered species within the project area. A list of these species can be found below.

Invasive species: The nature of the project (avoided deforestation) ensures that no invasive species will be introduced into the project area, nor are conditions such that they can reproduce at levels that will affect the ecosystem

Genetically modified organisms: No genetically modified organisms are involved in this project.

20. Impact on biodiversity outside the project area

No negative impact is expected on biodiversity outside the project area. Quite the contrary, a positive effect is foreseen due to the conservation of forest cover that will provide continuity between areas of absolute protection, including the Braulio Carrillo, Poás, Irazú and Turrialba National Parks.

Since no negative impacts are expected, it has not been necessary to plan mitigation and monitoring measures.

21. Monitoring impact on biodiversity

The objective of this program is to monitor the impact of Payment for Environmental Services (PES) on biodiversity conservation in the project area.

At the landscape level, efforts will monitor improvements in or deterioration of ***representativity*** (percentage representativity of phytogeographic units outside public lands), ***connectivity*** (percentage of the area of biological corridors receiving PES), ***function*** (percentage protection of aquifers), and ***composition*** (number of hectares assigned to GRUAS II prioritized sites) in the forests enrolled in the program.

At the species level, a selection was made of taxonomic groups that include critically threatened endemic species (plants and birds) as well as a bioindicator group for overall biodiversity (dung beetles).

The following indicators were selected for plants: diversity and regeneration of seedlings of interest; for birds: biodiversity and presence of key species; and for dung beetles: diversity. These indicators are related to attributes of system composition; no more than 10% of the farms that obtain PES will be analyzed. The sampling performed in year one will be regarded as the baseline; the same farms will be monitored in years four, seven and ten. Maps and satellite images will be provided by FUNDECOR or FONAFIFO.

22. Use of native species

One project objective is to conserve existing forest areas in order to prevent the deforestation that is occurring at rates referred to earlier in this document.

Since this is not a reforestation project, no exotic or native species will be involved.

23. Improvement in water and soil resources

Due to nature of the project, water and soil resources will not be affected. Since their existing condition is acceptable, the objective is to maintain them as they are.

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Annex 1: Maps

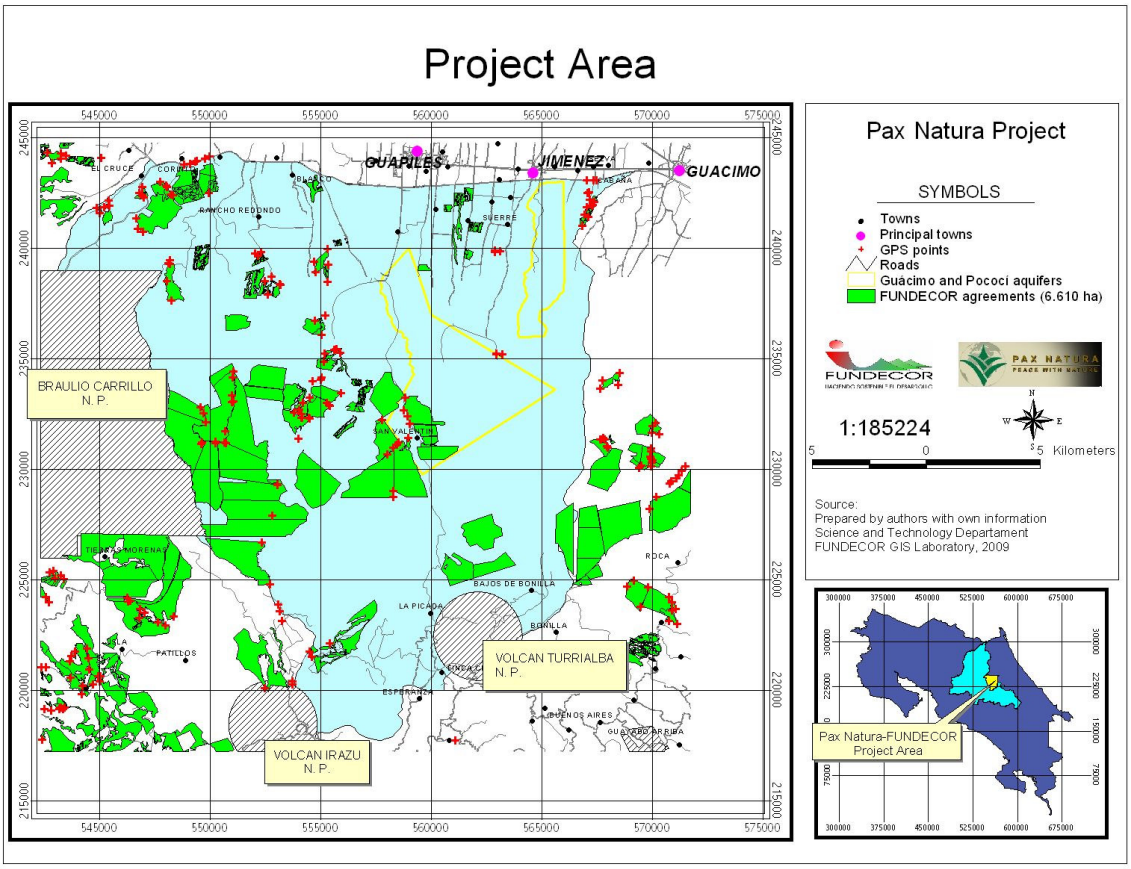


Figure 9: Forest areas whose owners have signed forest technical assistance agreements with FUNDECOR

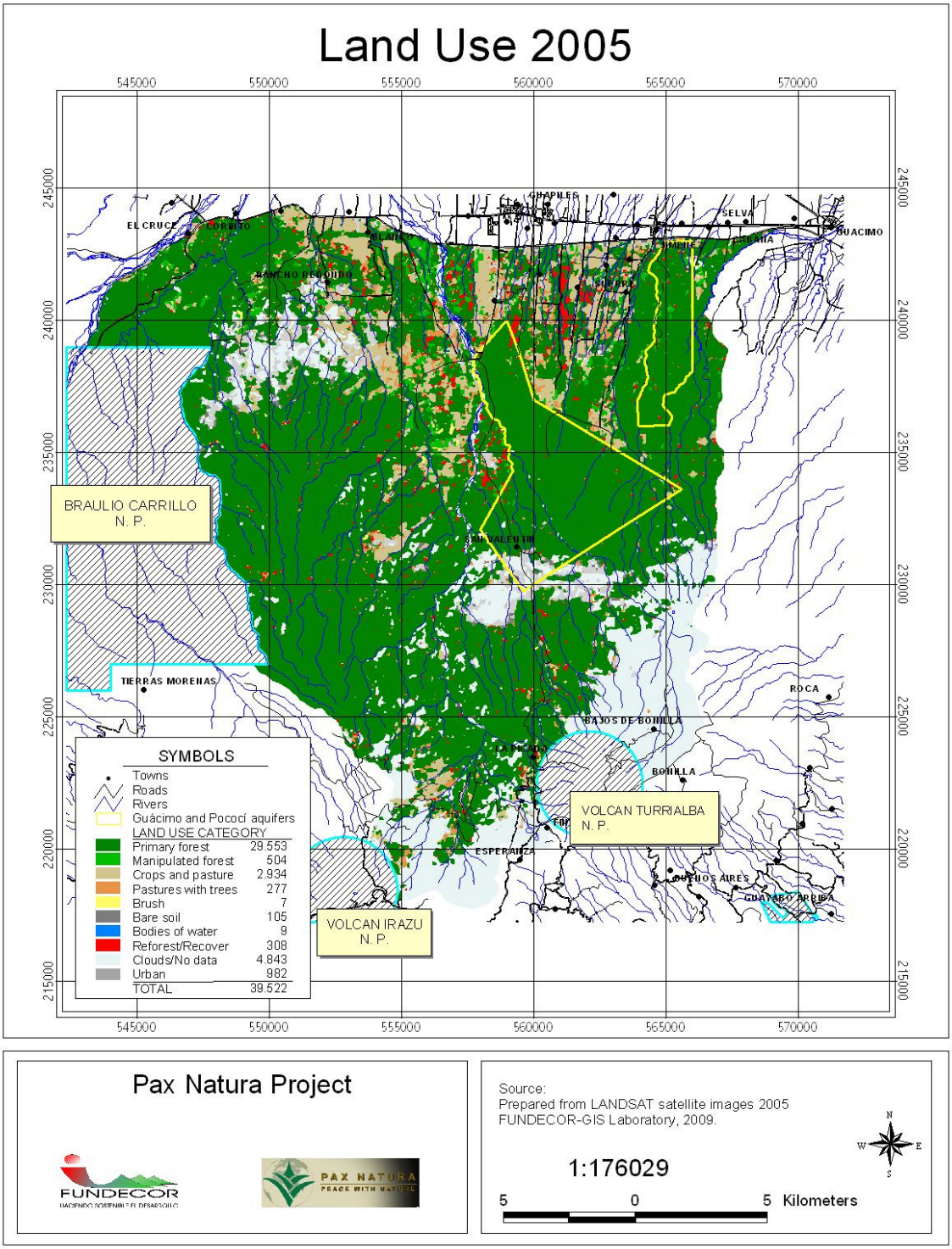


Figure 10: Land use in the Pax Natura project area of interest. ACCVC, Costa Rica.

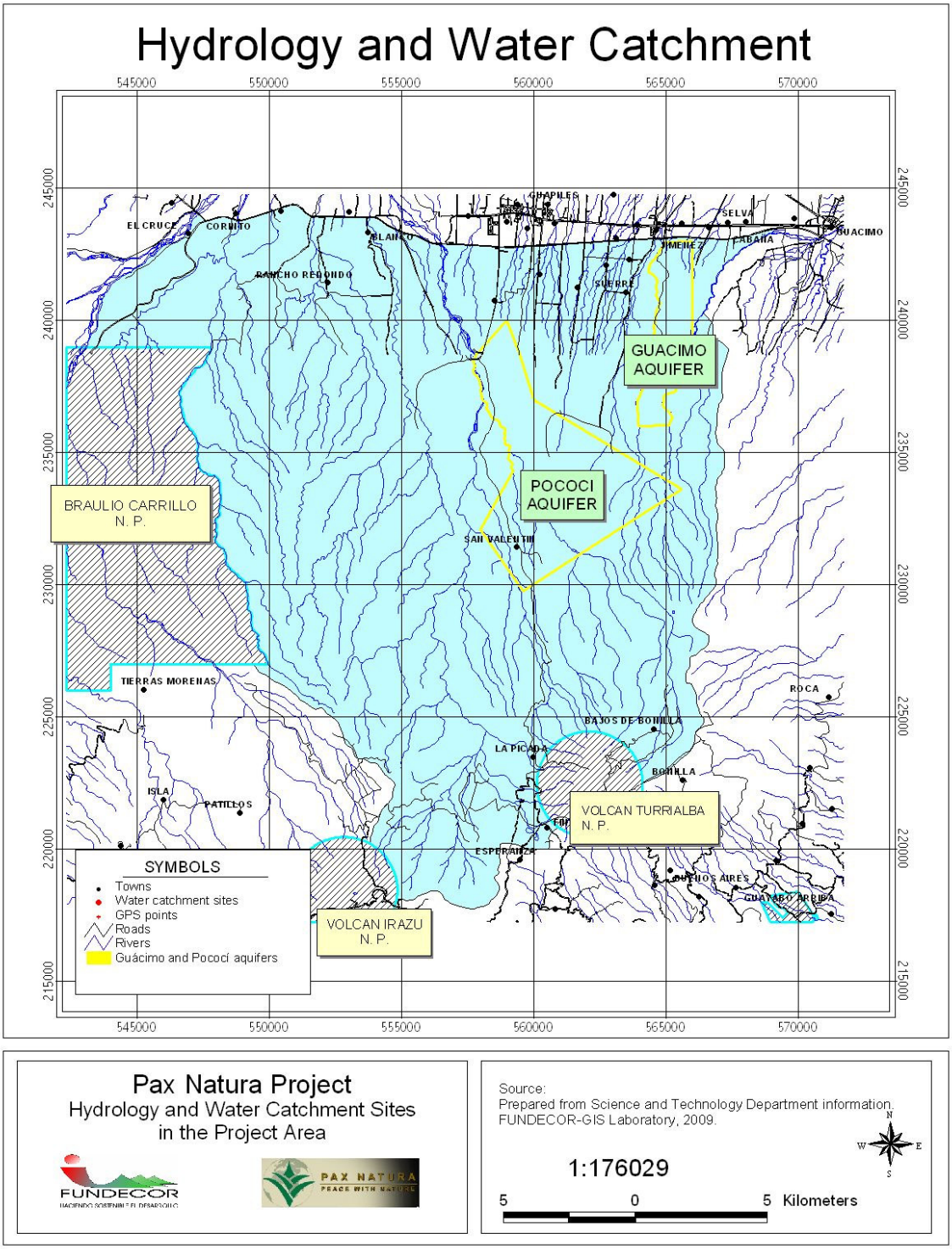


Figure 11: Hydrology and potable water catchment sites in the Pax Natura project area. ACCVC, Costa Rica.

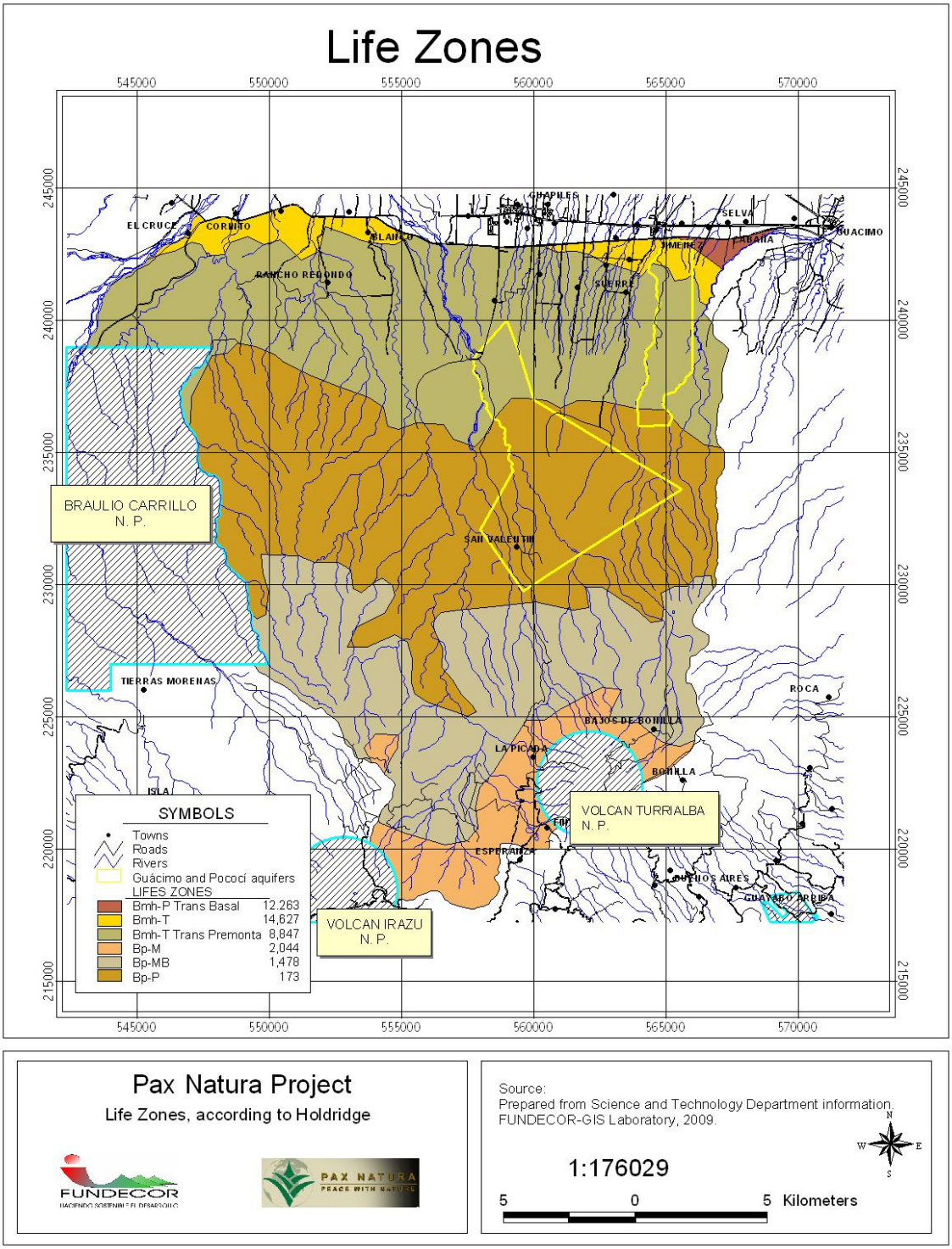


Figure 12: Life zones represented in the Pax Natura project area of interest. ACCVC, Costa Rica.

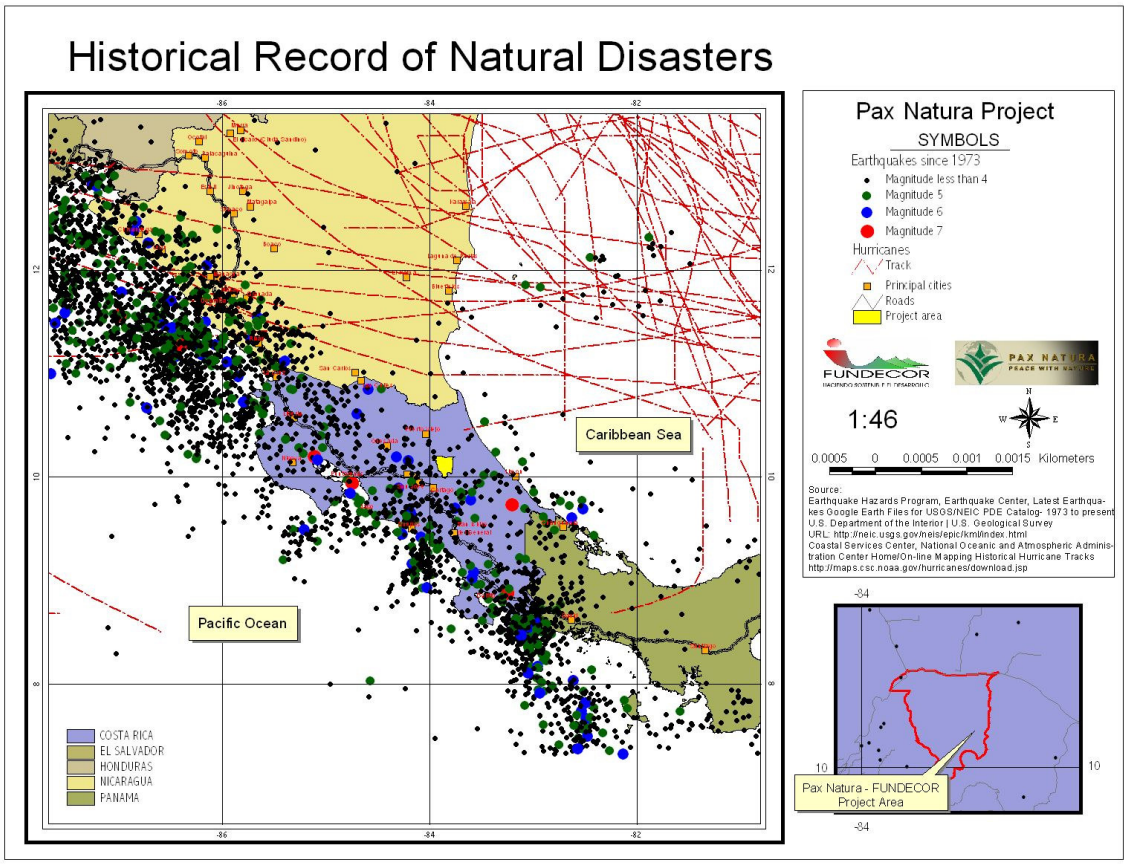


Figure 13: Historical record of natural disasters in the region. Tracks of hurricanes from 1910 to the present and earthquakes recorded from 1973 to the present. Source: Earthquake Hazard Program, Earthquake Center. US Geological Survey. Coastal Service Center, National Oceanic and Atmospheric Administration Center.

Annex 2: List of stakeholders

Organization	Contact	Telephone
Ministry of Environment, Energy and Telecommunications (MINAET)	Jorge Rodríguez, Vice-Minister.	Tel. 2233-4533 ext. 162 and 163
National System of Conservation Areas (SINAC)	Ronald Vargas, Senior Director	Tel. 2283-8004. ext. 106
Central Volcanic Range Conservation Area (ACCVC)	Rafael Gutiérrez, Director	Tel. 2290-1927
Professional Association of Agricultural Engineers of Costa Rica	Cinthya Salas. Office of Forest Audit	Tel. 2235-6909
Technological Institute of Costa Rica (ITCR)	Julio Calvo, Director, School of Forestry Engineering	Tel. 2550-2356
National Autonomous University (UNA)	Sonia Arguedas, Director, School of Environmental Sciences	Tel. 2277-3290
Tropical Agriculture Research and Higher Education Center (CATIE)	José Joaquín Campos, Director	Tel. 2556-6431
Tropical Science Center (TSC)	Enrique Ramírez, Executive Director	Tel. 2253-3267
National Forestry Office (ONF)	Alfonso Barrantes, Executive Director	Tel. 2293-5834
Costa Rican Chamber of Forestry (CCF)	Jaime Sotela, President	Tel.2260-5252
Municipality of Pococí	Enrique Alfaro Vargas, 2007-2011	Tel 8380-1551, 2711-1227, pococi@racsa.co.cr
Municipality of Guácimo	Gerardo Fuentes González, 2007-2011	Tel 8835-5547, 2716-6067, muniguac@racsa.co.cr
Regional Office - ACTo[7] MINAET		Tel. 2710-2939
Regional Office - ACTo FONAFIFO		
Sarapiquí Chamber of Tourism (CATUSA)	Carlos Roberto Chavarría, President	Tel. 2761-1579
Sarapiquí River Watershed Unit, Costa Rican Institute of Electricity ICE), Puerto Viejo de Sarapiquí Office	José Luis González, Supervisor	Tel. 2766-6301
Organization for Tropical Studies, La Selva Biological Station (OTS)	Mariechen Lang, Administrative Director	Tel. 2766-6565
Local Emergency Commission		
Guácimo and Pococí Water Supply Systems		
Agricultural School of the Humid Tropical Region (EARTH)	Ricardo Russo, Instructor; Carlos Sandí. Nursery manager.	Tel. 2713-0000

[7] ACTo – Tortuguero Conservation Area

Annex 3: Description of participating organizations

FUNDECOR:

FUNDECOR is a nongovernmental organization founded in 1989 to protect and develop the forests located in Costa Rica's Central Volcanic Range. The area under forest cover here is one of the most extensive in the country and includes many of the country's national parks.

Since it was founded, FUNDECOR's work has been guided by its mission to protect the natural resources in Costa Rica's central mountain range and surrounding areas through the use of sustainable market-based strategies, scientific knowledge, and state-of-the-art technologies to improve national public conservation policies.

Underpinning its mission is the belief that conservation and productive development must coexist harmoniously.

FUNDECOR's strategy for preserving Costa Rican forests has demonstrated that the best road to conservation and sustainable development is to provide forest owners with training so they can take charge of their own development. Activities it has undertaken with forest owners include:

Reforestation: To support forestry production, FUNDECOR designs reforestation projects. Plantation establishment involves technical assistance for selecting the site and species, and development of technological packages to ensure the greatest productivity possible in planted areas.

In this connection, genetic improvement programs are promoted for different species. By the year 2004, agreements had been signed under this program covering a total of 3,454.85 hectares.

In addition, FUNDECOR also provided field technical assistance in this area to reforestation companies in Costa Rica and Brazil, specifically ECOAMERICA, S.A. and TROPICAL FLORA REFLORESTADORA.

Forest protection: Because they usually border national parks or serve as biological corridors linking them, FUNDECOR considers the areas covered by the protection program to be of strategic importance. Under the forest protection and conservation program, forest owners sign agreements with the State to include their properties in the Payment for Environmental Services (PES) program. By 2009 more than **44,000 hectares** were covered by protection agreements with FUNDECOR.

Forest management: In this area, FUNDECOR activities seek to improve forest management through the use of techniques that minimize the impact of forest

harvesting on the forests. Planning and supervision are the cornerstones for achieving high-impact production with the least damage to forest resources.

To support the quality of planning and execution, geographic information and global positioning systems are used to prepare very accurate maps and to visually represent available resources and the constraints on their use. To date, this program has covered more than 18,000 hectares of natural forest.

Given FUNDECOR's experience in this field, different national and international companies have signed technical assistance contracts with FUNDECOR to manage forestry operations. These companies include Mansonite (nearly 6,000 hectares in Costa Rica) and Hermanos Úbeda (approximately 20,000 hectares in Nicaragua).

Similarly, FUNDECOR has provided advisory services to the PRA Project in the Peruvian Amazon region for the study and planning of work with forestry concessions in an area exceeding 200,000 hectares.

Timber auctions: In its first year of operations, FUNDECOR realized that forest owners are often forced to sell their wood at lower than market price. To correct that situation, contracts were designed to provide legal certainty to forest owners in their dealings with timber merchants. In addition, auctions are held to enable supply and demand to get them better prices.

Advance purchase of wood: Although profits from forest activities are generated in the medium and long terms, forest owners need an annual income to invest in forest resources and for earning their living. It was therefore necessary to come up with an alternative solution to cash flow problems.

This alternative was identified and created for FUNDECOR client-families as a supplementary project for interested forest owners. It consists of prepaid timber purchases, so forest plantation owners do not have to wait 15 years to reap the economic benefits of their final harvest but can obtain the needed cash flow before the felling period. FUNDECOR purchases up to 40% of the total timber to be produced and owners can sell the remaining 60% at their convenience, once felling has been completed.

Under this project more than 16,000 cubic meters of timber were purchased from plantations that are now harvesting and concluding the first project cycle.

Forest certification: Consumer trends on international timber markets demand that products meet certain international quality standards certifying the use of sustainable production practices. In this regard, FUNDECOR has been group certified by the Forest Stewardship Council (FSC) since 1996, which covers forest and plantation owners who have signed agreements with FUNDECOR.

In addition to certifying operations, harvested forest products from FUNDECOR-supervised forests have the option of being handled through a chain of custody that guarantees to consumers that the wood they purchase is produced under the highest international standards of sustainability.

FUNDECOR's experience in this field has enabled it to advise companies on how to obtain and retain certification status, specifically Mansonite, S.A. (Costa Rica) and Hermanos Ubeda (Nicaragua). In addition, based on the know-how developed on the chain of custody for wood, in 2007 the World Bank contracted FUNDECOR to design a control mechanism for mahogany in Central America.

Payment for environmental services (PES): Our forests and forest plantations generate a number of services that include mitigating greenhouse gas emissions, protecting water sources for human consumption or hydroelectric power, protecting biodiversity for pharmaceutical purposes and genetic improvement, and conserving scenic beauty for nature tourism.

In 1994 FUNDECOR designed the CARFIX project, one of the first avoided deforestation projects to serve as a mechanism for reducing and sequestering carbon emissions. It was approved and endorsed by the United States Initiative on Joint Implementation (USIJI) and by the United Nations Convention on Climate Change.

Taking into account the CARFIX project and the importance of these environmental services, as well as the desire to remunerate the owners of forests and forest plantations, the Government of Costa Rica passed Forest Law 7575 in 1996, establishing a new compensation system to recognize landowners for the services provided by their forests. These funds improve the revenues of forest owners through a market-oriented forestry policy that recognizes the value and benefits that nature provides to society. In addition, FUNDECOR helps forest owners process their requests for PES through the National Forestry Financing Fund (FONAFIFO).

With regard to the beneficiaries of its initiatives, FUNDECOR has signed 500 technical assistance agreements with client-families that own forests to help them manage their forests according to the highest and strictest standards of environmental sustainability. Approximately 50,000 hectares of land are under some type of agreement (i.e., reforestation, sustainable forest management, forest protection).

Environmental education: Since 1994, FUNDECOR has been executing a subsidized environmental education program approved by the Ministry of Public Education (MEP) and the Ministry of Environment, Energy and Telecommunications (MINAET). The principal objective is to inform the student population of the solutions Costa Rica has been implementing to sustainably

manage its natural resources. FUNDECOR's environmental education program has the following components:

- Educational Field Trips Program, which targets primary and secondary school students and supplements the subjects (science, social studies, citizenship, biology, tourism) taught by teachers in the classroom.
- Environmental Guardians Program, which focuses on raising the awareness, motivating, and involving primary school students in projects to improve the environment in their schools and communities. An important aspect of this program is the fact that it does not represent an academic burden for teachers, but rather supplements their curriculum. FUNDECOR is currently working with a company that is interested in providing community support, which shows that FUNDECOR is succeeding in raising the business community's awareness regarding the education of the new generations. For four years now, FUNDECOR has been organizing children's literature competitions, both for stories and poetry, to raise children's sensitivity to the different subjects in the school curriculum.
- Environment Clubs Program, which aims to stimulate in students a greater interest in conservation and sustainable development. For six years now, FUNDECOR now has organized Intercollegiate Environmental Mural Competitions under this program, converting art into an instrument for environmental education.

Support for the Costa Rican State. National Parks: It is important to the State that national parks achieve a certain degree of financial self-sufficiency. To that end, in 1996 FUNDECOR and MINAE designed a mechanism allowing for concession of non-essential services (cafeteria, parking lot, etc.) to the private sector. This has generated a considerable amount of resources that has made it possible to support other park activities and improve park facilities. This endeavor has been implemented mainly in the Poás and Irazú National Parks, and has led to the investment of more than US$1 million in them. FUNDECOR is currently working to implement this arrangement in national parks in other parts of the country.

Control of illegal felling: In 1999 FUNDECOR became aware that, as a result of more stringent restrictions on forest management in productive forests, forest owners were eliminating forest understory and planting pastures instead, because restrictions on harvesting wood in wooded pastures are minimal.

In light of this and because national legislation prohibits changes in land use, FUNDECOR decided to help the State develop a mechanism for detecting this situation in order to discourage changes in land use. A land-use map (year 2000) is loaded into portable global positioning devices in combination with other maps of the country. When a tree felling permit is requested for a wooded pasture, the device makes it possible to check if the wooded pasture came into being after the

year 2000 as a result of a change in land use. In that case, the permit is denied because it violates national legislation banning land-use changes.

The impact of this tool was immediate and resulted in a decline in requests for felling permits in pastures and higher wood prices. In 2005 FUNDECOR received the ANCORA Award for developing this technology.

Advisory services and technology transfer at the national and international levels. The know-how generated by FUNDECOR has been made available to other projects, companies, and institutions, through direct transfer of knowledge and advisory services provided at both the national and international levels.

In Costa Rica, FUNDECOR has signed contractual agreements and is currently providing advisory services to: Florida Ice and Farm, Empresa de Servicios Públicos de Heredia, Platanar Hydroelectric Plant, Mansonite, Plywood, Energía Global de Costa Rica, S.A. (which owns the Don Pedro and Río Volcán hydroelectric projects), Platanar Hydroelectric Company, S.A. At the international level, FUNDECOR works with Tropical Flora Reflorestadora (Brazil) in relation to reforestation, and with Hermanos Ubeda (Nicaragua) in relation to certified forest management. FUNDECOR staff have worked with the PRA project of Peru, conducting studies and providing advisory services on sustainable forest management for forest concessions in an area of approximately 200,000 hectares.

In addition, FUNDECOR has provided specific consulting services for companies and institutions including the World Bank (to develop an independent audit system on the legal origin of mahogany), and the National Forestry Financing Fund (FONAFIFO), for which it conducted studies for various companies including Beyond Timber, S.A. and Equator Environmental.

FUNDECOR has also participated in different bids, most noteworthy among which was the Forest Inventory for the Easement for the SIEPAC Transmission Line for Nicaragua, Costa Rica, and Panama, a project financed by the Inter-American Development Bank.

FUNDECOR has signed agreements with different government agencies including the Ministry of Environment and Energy, the National Geographical Institute, the Technological Institute of Costa Rica, among others.

Awards: FUNDECOR's work and staff have been recognized in Costa Rica and internationally, and it has received various awards including:

2005- ANCORA Award–Costa Rica
2003–Green Apple International Award–Great Britain
2001-Award for Contributions to the Improvement of Quality of Life–Costa Rica
2000-King Balduino International Award for Development–Belgium

1996-Friend of Nature Award ACOPROT–Costa Rica
1996-Silver Medal, Guayacán National Environment Award, MINAE–Costa Rica

The National Biodiversity Institute (INBio)

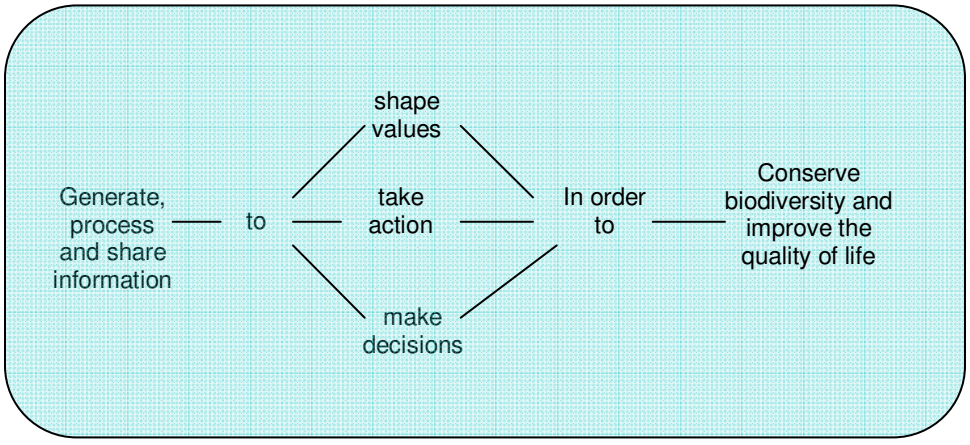
The National Biodiversity Institute (INBio) of Costa Rica (**www.inbio.ac.cr**) is a private research and biodiversity management center, established in 1989 to support efforts to gather knowledge on the country's biological diversity and to promote its sustainable use. The organization works under the premise that the best way to conserve biodiversity in perpetuity is to tap the opportunities it offers to improve the quality of life of Costa Rican society, within the framework of institutional sustainability and the uses made of same.

INBio is a civil-society, non-governmental, not-for-profit organization whose objective is of recognized public interest. It works in close collaboration with different government institutions, universities, the business sector and other public and private organizations, both within and outside Costa Rica.

Its research and conservation work has earned it several awards, noteworthy among which is the 1995 Prince of Asturias Award for Science and Technology.

Mission and areas of interest: INBio's mission is "to promote a greater awareness of the value of biodiversity as a means to ensure its conservation and improve the quality of life of human beings."

It seeks to fulfill this mission through a core process that processes and transfers to society the information and know-how on the country's biodiversity it generates. Its aim is to shape values and promote decision-making in support of the environment in order to conserve biodiversity and impact on the quality of life of human beings.



The crux of this vision is that society should make use of this knowledge, not just have access to it. For INBio, knowledge should be used to shape values and promote responsible action and (informed) decisions in support of conservation measures.

This vision is implemented at the institutional level by different strategic action units that work at the operating level, coordinated at the strategic level by a five-member directorate that implements guidelines set by the General Assembly (31 associates) and the Board of Directors, which support the institution at the political level.

The strategic action units work to generate, process, and share data:

Information generation:

- *Biodiversity inventory and monitoring:* Information is generated and collected on the diversity of species and ecosystems in the country, applying different types of scientific work including systematization, ecology, biogeography, bioinformation science, and geographic information systems. They also establish the baseline and design programs for monitoring the different elements of biodiversity (fungi, plants, arthropods) and for compiling information on other groups such as birds and mammals, which is carried out with the support of associated scientists.
- *Bio-prospecting*: Modern scientific and technological approaches are used to find sustainable and commercial uses for the genetic and biochemical resources of Costa Rican biodiversity by the chemical, pharmaceutical, agricultural, and biotechnological industries.
- *Economic assessment*: This unit seeks to determine the contribution of the goods and services provided by biodiversity to the country's economic and social development. It involves a network of collaborators who conduct research in ecological economics, and who design mechanisms for quantifying, charging for, and paying for environmental services

Biodiversity informatics: Computer tools are designed and used to support the processes to generate, administer, analyze, and disseminate information on biodiversity. These tools are intended to increase the efficiency of processes, improve the quality of products, and strengthen the institution's innovative profile at the international level. Its most significant achievement has been the Atta database, which is indispensable for processing the data generated in the biodiversity inventory, and which will be discussed in greater depth further on.

INBio shares and disseminates this information by making information and know-how related to biodiversity available to society, targeting different segments of the public (decision-makers, general public, tourists, educators, students, etc.) in order to raise awareness of the value of biodiversity and in this way foster changes in behavior that will strengthen biodiversity conservation:

- INBiopark: This is INBio's "window to society." It is a biodiversity theme park whose purpose is to display the biological wealth of Costa Rica through exhibitions, guided tours, and interpreted information, among other things. The core concept of the park is "bioliteracy," a learning process based on sharing information on biodiversity and creating greater awareness of its importance. The park has been in existence for seven years and is visited by an average 140,000 people per year.
- INBio Editorial: The research findings and know-how of INBio's specialists and partners are made available to society and used by other scientists, tourists and nature lovers through more than 100 books produced by INBio's publishing house.
- Conservation: Integrates the information generated and administered by INBio into decision-making processes aiming to protect and make sustainable use of biodiversity by both the public and private sectors. It involves establishing and administering communications networks with conservationist and production sectors, as well as processing and adding value to information to promote responsible decision-making.

These processes take shape in ecotourism plans inside and outside protected areas, management plans for protected areas, regulations governing the use of species of special interest, and prioritization of conservation actions on private lands, among others.

INBio's key function and lines of work (generating, processing and conveying information) is linked to the country's three-pronged conservation motto: "save, understand, use," which promotes conservation through the sustainable use and study of biodiversity, and dissemination of its importance

The information INBio generates is collected in its Atta database. INBio was the world pioneer to use bar codes to univocally identify every specimen in its collection; use GPS and GIS to georeference each of more than 3.1 million specimens in its collection; include multimedia information (photographs, maps, digital illustrations) to supplement text and numerical information; and provide the general public with flexible and free Internet access to the database. One hundred percent of the scientific information generated by INBio is in digital format; this is supplemented by digital information sheets (UBIS) that contain basic information on ecosystems and floral and faunal species, and includes a Central American component.

The information and know-how generated by the specialists is of key importance in the preparation of materials for the ecotourism sector. This is done by INBio's Ecotourism Unit where specialists in environmental interpretation and ecotourism create materials for different target audiences at the request of individuals, hotel groups, or the country's national parks.

This wealth of accessible knowledge, the working methodologies it has developed, the specialists skilled in inventory work, combined with the support of national and international partners, strengthens INBio's capacity to appraise the biodiversity of specific sites and to support sustainable land-use management initiatives to maintain the goods and services produced by ecosystems.

Achievements: Following is a summary of INBio's principal achievements since it was created in October 1989:

- Formulation of a conceptual framework for the protection, understanding and use of biodiversity, which today is national policy. This conceptual framework indicates that the best way to conserve the country's biodiversity is to use it to improve the quality of life of Costa Rican society, involving the most diverse sectors of society in the process.
- Development of an institution specializing in understanding and using biodiversity, in full alignment with international documents such as the Global Biodiversity Strategy and the United Nations Convention on Biological Diversity. INBio has demonstrated that a developing tropical country can attain the goals and fulfill the commitments of such initiatives.
- Development of an innovative system for inventorying biodiversity, in which taxonomic difficulties are addressed by taxonomic teams that include national and international para-taxonomists, specialists, curators and experts. Each member of the team performs specialized functions, resulting in the highly efficient processing of large quantities of samples and information collected from all parts of the country and representing many taxonomic groups.
- Innovative use of modern information technologies to develop systems that support activities to collect, manage, generate and disseminate information on biodiversity. For example, the INBio-developed Atta database crowns a bio-computing effort that pioneered, at the world level, the use of bar codes to univocally identify every specimen in the collection; GPS and GIS to georeference each of more than 3.4 million specimens in the collection; multimedia information (photographs, maps, digital illustrations) to supplement textual and numerical information; and flexible and free Internet access for the general public to the data base. One hundred percent of the scientific information generated by INBio is in digital format. INBio's web site (www.inbio.ac.cr) receives more than 20,000 hits a day.
- A Bio-prospecting Program that uses modern scientific and technological approaches to find new products from wild Costa Rican organisms for the chemical, pharmaceutical, agricultural and biotechnological industries. INBio has more than 15 years' experience negotiating with big business. It has also undertaken a series of projects with small- and medium-scale national firms. The reasons for this research include upgrading national scientific and technological capabilities and equitable sharing of the benefits obtained by marketing these products with protected wilderness

areas. INBio's agreements with national and international firms were cited as examples in formal documents agreed to at the Conference of the Parties to the Convention on Biological Diversity (COP VI) in The Hague.

- Development of various processes for sharing know-how and information on biodiversity with different sectors of society for educational, scientific, tourism, legal, political, conservationist and recreational purposes through products and services that highlight the value of biodiversity, and whose main objective is to contribute to bioliteracy.
- INBio's work has earned it national and international awards, including the Tech Museum 2003: Technology Benefiting Humanity Award, granted by the Tech Museum of Innovation in San Jose, California, and the 1995 Prince of Asturias Award for Technical and Scientific Research. INBio's work has been covered in the mass media, at both the national and international levels. INBio was also recognized by the Central American Commission for Environment and Development (CCAD) when it requested INBio in 1999 to serve as a regional advisory body on biodiversity.
- INBio has been singled out in many national and international forums as a pioneer in the field of biodiversity management. It is also a model for public-private management given its strategic alliance with the National System of Conservation Areas (SINAC) of the Ministry of Energy and Environment (MINAE), which led to the development of a joint working agenda that aims to unite objectives and integrate conservation efforts into a single effort.
- INBio has an international network of nearly 400 scientists in different research centers throughout the world, including Canada, that directly support INBio's scientific endeavors.

National Forestry Financing Fund (FONAFIFO)

FONAFIFO was created by Article 46 of Forest Law 7575, published on 16 April 1996, as a decentralized agency of the State Forestry Administration. It is authorized to conduct any type of non-speculative legal business that may be necessary for the due administration of its resources, including trusts. Its governing board is made up of three members from the public sector and two members from the private sector.

Its principal objective is to finance forest management (manipulated or natural), as well as reforestation, forestation, nurseries, agro-forestry systems, the recovery of degraded areas, and the promotion of technological change for the exploiting and processing forest resources to the benefit of small and medium-scale producers. It also secures financing for the Payment for Environmental Services (PES) program for natural forests, forest plantations, and other activities to strengthen the country's forest sector.

FONAFIFO is composed of four areas: Administration, Environmental Services, Resource Management, Credit. In May 2006 it had a total of 47 employees. It implements the PES program at the national level, with an annual budget of US$15 million.

FONAFIFO has considerable experience in planning, implementing, and executing projects in the forestry sector, such as:

Ecomarkets Project: The objective of this project was to increase forest conservation in Costa Rica by developing markets and selling, to the private sector, environmental services related to carbon sequestration and emission mitigation, biodiversity conservation, scenic beauty and water services. The project budget was US$32.6 million, with a loan from the Inter-American Development Bank, a US$8 million grant from the Global Environment Facility, and US$8.6 million in counterpart funds from the Government of Costa Rica.

KfW Project: Includes financial cooperation from the German Bank KREDISTANSTALT für WIEDERAUFBAU COOPERACION. The objective of the project is to improve the balance of CO_2 emissions in Costa Rica and to generate positive externalities from forest lands, including natural forest and forest plantation management. The project budget comprises US$11.8 million from the German Government and nearly US$3.1 million from the Government of Costa Rica.

FONAFIFO is also developing a project (Reforesta project) to reactivate reforestation in the country, with a US$302,000 grant from PHRD.

Annex 5: Methodology for calculating carbon based on above-ground biomass (AGB)

Two methods will be used to calculate the carbon stored in above-ground biomass (AGB) of trees inventoried in the permanent plots (dbh>10 cm) in forests within the project area. The first involves determining the AGB of each tree in accordance with its ecological group; the second is weighted by the value of the wood's density.

By ecological group (AGB1).

Taking into account diameter, height, and ecological group, the biomass of individual trees can be determined with the following models developed by Ortiz (1997):

$$AGB = 0.1689 * d^{1.6651} * h^{1.4412}$$

Eq 1: Model for estimating the biomass of species belonging to the ecological guild of guild of shade-tolerant species

$$AGB = 0.1363 * d^{1.8520} * h^{1.2611}$$

Eq 2: Model for estimating above-ground biomass for remaining species

where *AGB* is above-ground biomass in kilograms, *d* the diameter in centimeters, and h the total height of the trees in meters. Total height is estimated with the following models, also developed by Ortiz (1997):

$$h = 3.7802 * d^{0.5236}$$

Eq 3: Relationship of total height to diameter at breast height for trees of the genus Vochysia

$$h = 4.00048 * d^{0.5236} * e^{-0.0040 * d}$$

Eq 4: Relationship of total height to diameter at breast height of trees belonging to the ecological guild of shade-tolerant speciess

$$h = 1.9550 * d^{0.8487} * e^{-0.0085 * d}$$

Eq 5: Relationship of total height to diameter at breast height of trees belonging to the remaining species

By wood density (AGB2)

The diameter and density of the wood, both for each individual tree and the average density of the population, can be used to estimate the above-ground

biomass of individual trees according to the model of Chave et al (2001), modified by Baker et al (2004):

$$AGB = \frac{\rho_1}{\rho_2} * e^{[2.42*\ln(d)]-2}$$

Ec 6: Model for estimating the relationship of above-ground biomass to diameter at breast height and wood density,

where AGB is the above-ground biomass in kilograms, d is the diameter in centimeters, ρ_1 is the density of the wood of the tree to be assessed, and ρ_2 the average density of the wood of the population to which the tree belongs.

With data from 339 permanent sampling plots situated in the different life zones in the buffer areas of the Tortuguero and Central Volcanic Range Conservation Areas, after assessing the wood density of 27,380 trees and palms it was determined that average wood density for the population of trees in the project area is $\rho_2 = 530.7$ kg * m^{-3}.

Table 16: Average wood density of the tree population in the Pax Natura project area. ACCVC, Costa Rica.

Number of trees	Average		
	Lower limit (ρ_2Min)	Average (ρ_2)	Density (ρ_2Max)
27,380	414.7	530.7	685.0

Source: FUNDECOR forest mensuration database

Calculation of carbon and CO_2

Using the lowest value for above-ground biomass, obtained with the above methods, the following transformations are necessary to obtain the results for carbon captured and CO_2:

From above-ground biomass of trees and palms with dbh greater than 10 cm to total above-ground biomass

According to Nascimento and Laurance (2001), the biomass in trees and palms with a dbh greater or equal to 10 cm represents approximately 80% of total above-ground biomass; the remaining 20% is comprised of fallen trunks, followed by smaller trees with a dbh below 10 cm, shrubs, lianas, fallen leaves, dead tree parts, palm shoots.

The conversion is therefore as follows:

$$AGBt = \frac{AGB}{0.8}$$

Eq 7: Conversion of above-ground biomass greater than 10 cm dbh to total above-ground biomass,

where AGBt is total above-ground biomass in $Mg*ha^{-1}$, and AGB is above-ground biomass of all trees and palms greater than 10 cm dbh in $Mg*ha^{-1}$.

From total above-ground biomass to carbon

In accordance with the IPCC (2006), the percentage of carbon present in above-ground biomass is between 44% and 49% in tropical or subtropical regions. For the purpose of this project, the lower value (44%) was used to convert the biomass value to carbon. The conversion is as follows:

$$C = AGBt * 0.44$$

Eq 8: Conversion of total above-ground biomass to carbon,

where C is the carbon content of total above-ground biomass in $Mg\ has^{-1}$ and AGBt the total above-ground biomass in $Mg*ha^{-1}$.

From carbon to CO_2

The conversion ratio of carbon to CO_2 is 44/12, based on the proportions of the atomic mass of the CO_2 molecule and the carbon atom. The conversion is therefore as follows:

$$CO_2 = C * \frac{44}{12}$$

Eq 9: Conversion of carbon to carbon dioxide,

where CO_2 is carbon dioxide and C the carbon content in the total above-ground biomass in $Mg\ has^{-1}$.

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Annex 6: Protocols of the program to monitor impact on biodiversity

Indicator 1: Percentage representativity of phytogeographic units outside public lands in the project area

Definition: This indicator measures the contribution of PES to national conservation goals in the phytogeographic units within the project area. It determines the relative area of PES coverage outside the State-owned natural lands in protected wildlife areas, in accordance with the land-use system for biodiversity conservation in Costa Rica.

Rationale: The technical proposal of land-use management for biodiversity conservation in Costa Rica (GRUAS II) identified 32 phytogeographic units in Costa Rica. This new classification system stemmed from an analysis of vegetation macrotypes (Gómez 1986) and floristic regions (Hammel et al. 2004).

The conservation goal for each phytogeographic unit is at least 10,000 hectares of natural cover. Each unit is expected to conserve at least 10 functional units of 1,000 hectares each.

The minimum area to be conserved is 10,000 hectares in absolute terms. However, if in relative terms that corresponds to less than 10% of the unit, then the area should be increased until it reaches that 10%. If the 10,000 hectares represent more than 10% but less than 30% of the unit, the area does not change. However, if the 10,000 hectares represent more than 30% of the unit, then the absolute area should be decreased as necessary to ensure that the target is maintained at 30% (Aryan 2006).

These functional units may be conserved through State-owned natural lands (national parks, biological reserves, absolute natural reserves, national monuments, public wildlife refuges) as well as with other conservation strategies, for example, private protection through PES. The indicator will measure the contribution of PES to the proposed target by unit within the project area.

Method: The area will be calculated with Geographic Information Systems (GIS), using software including ArcGIS Desktop (8.X and later versions), ArcView (3.X and later versions), or free programs such as DIVA-GIS.

All farms receiving PES should be georeferenced in vector format every year. For farms not completely covered by PES, only the PES-covered portion will be georeferenced.

Other layers needed are: protected wilderness areas, phytogeographic units, and land cover. To avoid compatibility problems, only official data from the providing institutions should be used.

Extensions including Model Builder (ArcGIS) or MacroModeler (IDRISI Kilimanjaro) will be used to develop a cartographic model for performing the operations with map algebra.

Location: Impact will be analyzed using 1,000 hectare functional blocks in each phytogeographic unit making up the total project area. Special attention should be given to phytogeographic units with unique ecosystems that are not protected by the State within the project area.

Required resources: A Geographic Information Systems (GIS) laboratory, with hardware and software including: computers, printers, digital image processing software, digital cartographic inputs, and global positioning system (GPS). Specialists with experience in this type of work are also needed. Aerial or satellite images for each period under study are needed to corroborate information.

Geographical layers of protected wilderness areas, the farms receiving PES (preferably forest blocks receiving PES), the phytogeographic units, and land cover are also required, and should not be more than five years old.

Information analysis and interpretation: Findings will be represented in tables showing absolute and relative surface area that represent the baseline of the farms. Also, graphs will compare each year's contribution to conservation targets, and maps will represent, visually and spatially, the state of natural cover for each phytogeographic unit, State-protected area, and area receiving PES. A report of the findings and pertinent recommendations will be prepared.

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Indicator 2. Percentage of the area of biological corridors receiving PES for "biodiversity protection" inside the project area

Definition: This indicator will measure the contribution of PES to national conservation targets vis-à-vis connectivity of principal core areas. A determination will be made of the relative area of PES coverage in the biological corridors defined in the land-use system proposed for biodiversity conservation in Costa Rica (GRUAS II) inside the project area.

Rationale: Since 1996, biological corridors have been used as a strategy to connect protected wildlife areas, reduce natural resource fragmentation, and allow for the flow of species and genes.

Costa Rica's biological corridors proposal is currently under review (Arias 2006), and in the process criteria of biological connectivity including core areas, nodes, friction levels and species have been defined. These criteria make it possible to determine which areas are most important to biodiversity.

As a means to mitigate natural resource deterioration, FONAFIFO decided to grant PES on a priority basis to private landowners inside biological corridors prioritized by GURAS II.

Method: Geographic Information Systems (GIS) will be used to calculate the area. The software to be used includes ArcGIS Desktop (8.X and later versions), ArcView (3.X and later versions), or free programs such as DIVA-GIS.

All farms receiving PES should be georeferenced in vector format each year. For farms not completely covered by PES, only the PES-covered section should be georeferenced.

Other layers needed are: protected wildlife areas, phytogeographic units, and land cover. To avoid compatibility problems, only official data from providing institutions should be used.

Extensions including Model Builder (ArcGIS) or MacroModeler (IDRISI Kilimanjaro) will be used to develop a cartographic model for performing operations with map algebra.

Location: The total project area and biological corridors proposed by GRUAS II within it will be monitored. Special attention should be given to biological corridors with unique ecosystems that are not protected by the State.

Required resources: A Geographic Information Systems (GIS) laboratory, with hardware and software including: computers, printers, digital image processing software, digital cartographic inputs, and global positioning system (GPS).

Specialists with experience in this type of work are also needed. Aerial or satellite images for each period under study will be needed to corroborate information.

Geographical layers of protected wildlife areas, the farms receiving PES (preferably forest blocks receiving PES), the biological corridors, and land cover are also required, and should not be more than five years old.

Information analysis and interpretation: Findings will be represented in tables showing absolute and relative surface area, representing the baseline of the farms- Also, graphs will compare each year's contribution to conservation targets and maps will represent, visually and spatially, the state of natural cover of each biological corridor, State-protected area, and area receiving PES. A report on the findings and relevant recommendations will be prepared.

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Indicator 3: Percentage of protection of national aquifers

Definition: This indicator measures the contribution of PES to meeting national conservation targets, specifically on lands located in aquifers in GRUAS II prioritized sites. A determination will be made of the relative surface area covered by PES in the aquifers of each prioritized site. Stable water cycles allow for the proper development of different biological and evolutionary processes.

Rationale: Biodiversity can be analyzed through three attributes: composition, structure, and function, at the different levels of organization (genes, species and ecosystems). For many years attention focused on studying composition; it is now necessary to understand the relationship between the attributes. Therefore structure and function must also be taken into account.

For the most part, interactions between the components have social significance. For example, a proper functioning wetland filters contaminants that otherwise would deteriorate water quality and affect the system as a whole (MARN 2002).

It is natural to try to protect what we can see: species and ecosystems. However, we tend not to protect what we cannot see. Aquifers and their recharge areas are important to conservation because they perform vital ecological functions and provide goods and services to society.

Method: The area will be calculated with Geographic Information Systems (GIS), using software including ArcGIS Desktop (8.X and later versions), ArcView (3.X and later versions), or free programs as DIVA-GIS.

All farms receiving PES should be georeferenced in vector format every year. For farms completely covered by PES, only the PES-covered portion should be georeferenced.

Other layers needed are: protected wildlife areas, aquifers (preferably with recharge areas), and land cover. To avoid compatibility problems, only official data from the providing institutions should be used.

Extensions including Model Builder (ArcGIS) or MacroModeler (IDRISI Kilimanjaro) will be used to develop a cartographic model for performing operations with map algebra.

Location: The total project area and the priority aquifers inside the project area will be monitored. Special attention should be given to aquifers with unique ecosystems that are not protected by the State.

Required resources: A Geographic Information Systems (GIS) laboratory with hardware and software including computers, printers, digital image processing

software, digital cartographic inputs, and GPS (satellite tracking system). Specialists with relevant training and experience are also required. Aerial or satellite images for each period under study are needed to corroborate information.

Geographical layers of protected wildlife areas, the farms receiving PES (preferably forest blocks receiving PES), aquifers, and land cover are also required, and should not be more than five years old.

Analysis and interpretation of the information: Findings will be represented in tables showing absolute and relative surface area, representing the baseline of the farms. Also, graphs will compare each year's contribution to conservation targets, and maps will represent, visually and spatially, the state of natural cover of each national aquifer, the surface area protected by the State, and the area receiving PES. A report of the findings and pertinent recommendations will be prepared.

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Indicator 4. Number of hectares in prioritized biodiversity conservation sites (GRUAS II) that receive PES for "protecting biodiversity"

Definition: This indicator measures the contribution of PES to national conservation targets by priority site within the project area. A determination will be made of relative area of PES coverage in the prioritized biodiversity conservation sites, pursuant to the land-use management proposal for biodiversity conservation in Costa Rica (GRUAS II).

Rationale: GRUAS II is an initiative of the National System of Conservation Areas (SINAC) that receives support from a group of institutions with recognized experience in natural resource management. Its aim is to identify and prioritize marine and terrestrial conservation needs in Costa Rica and to propose compatible activities for achieving same.

For terrestrial conservation purposes, the methodological process used to select biologically important areas is based on a coarse filter and a fine filter.

The coarse filter is comprised of 32 phytogeographic units into which the national territory is divided, with specific conservation targets and objectives. The fine filter is a selected list of fauna and flora species that meet at least one of six criteria: sites considered in danger of imminent extinction, landscape species, globally threatened species, endemic species, species considered nationally at risk, and aggregations of species, groups of species, or species-rich areas.

Analysis of this information will determine the priority areas by representativity or exclusivity. Of the areas selected, those not covered by a resource conservation initiative are considered as lacking conservation strategies.

Method: The area will be calculated with Geographic Information Systems (GIS), using software including ArcGIS Desktop (8.X and later versions), ArcView (3.X and later versions), or free software such as DIVA-GIS.

All farms receiving PES should be georeferenced in vector format each year. For farms not completely covered by PES, only the PES-covered portion should be georeferenced.

Other layers needed are: protected wildlife areas, priority sites, and land cover. To avoid compatibility problems, only official data from the providing institutions should be used.

Extensions including Model Builder (ArcGIS) or MacroModeler (IDRISI Kilimanjaro) will be used to develop a cartographic model for performing the operations with map algebra.

Location: The project area and the GRUA II-prioritized sites inside it.

Required resources: A Geographic Information Systems (GIS) laboratory with hardware and software including: computers, printers, digital image processing software, digital cartographic inputs, and GPS (satellite tracking system). Specialists with training and experience in this type of work are also needed. Aerial or satellite images for each period under study are needed to corroborate information.

Geographical layers of protected wildlife areas, the farms receiving PES (preferably forest blocks receiving PES), priority sites and land cover, and should not be more than five years old.

Analysis and interpretation of the information: Findings will be represented in tables showing absolute and relative surface area, representing the baseline of the farms. Also, graphs will compare each year's contribution to conservation targets, and maps will represent, visually and spatially, the state of natural cover of each priority site, the surface area protected by the State, and the area receiving PES. A report of the findings and pertinent recommendations will be prepared.

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Indicators 5 and 6. Monitoring of plant diversity and regeneration of seedlings of interest

Definition: Plant diversity is related to richness (number of species) and abundance (number of individuals per species); special interest species can also be identified. Regeneration will be studied with emphasis on seedlings of the special interest species used to define the priority sites.

Rationale: These indicators will make it possible to note changes in biodiversity through composition (richness of species) and structure (relative abundance of species) on each farm studied. Data will also be obtained on the presence of key species (those used to define the priority sites). Measurement of regeneration will make it possible to indirectly assess functional processes such as pollination and dispersion.

Method: The Gentry transect method will be used. It is a proven, widely used procedure that yields comparable data and allows for simultaneous evaluation of adult individuals and regeneration. The basic purpose of Gentry transects is to evaluate the floristic composition of a forest; however, its area and delineation make it possible to conduct monitoring trials of other taxonomic groups.

Each transect will be established in a forest that is uniform in terms of site and vegetation. To reduce the margin effect in the area under study, a buffer zone at least 100 meters wide will be included.

Gentry's method (Boyle 1996, Phillips & Miller 2002) consists of sampling 1,000 square meters (0.1 hectares) by creating ten 2 x 50 m transects and inventorying all plants with stem diameters equal to or exceeding 2.5 cm.

Transects will be established along a pathway or any line established in the selected habitat. Each transect will be marked at the beginning, in the middle, and at the end with white ½ inch PVC tubing. Each plot will be georeferenced.

With regard to the regeneration of plants of interest, seedlings will be defined as those measuring between 0.1 □□0.3 m in height, and saplings will be those measuring 0.3 □ 1.5 m. in height. Subplots measuring 1 x 1 m and 2 x 2 m will be used.

Taxonomic identification (family, genus, species) and diameter will be collected for each individual. Botanical identification of each individual will be performed in the field by an experienced botanist or with samples deposited in a recognized national herbarium.

Location: The sites to be studied will be a sample of private farms within the project area that receive PES.

Analysis and interpretation: The following will be analyzed with the software designed by Brad Boyle (undated): alpha diversity, taxonomic composition, predominant families, genera and species in each site, and density and basal area. This will make it possible to monitor changes in plants and therefore the impact of private farms on biodiversity conservation. The studies will yield information on the contributions to diversity in general and to special interest species in particular (i.e., critically threatened endemic species).

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Indicators 7 and 8. Monitoring of bird diversity and presence of key bird species

Definition: This indicator will be used to identify changes in bird biodiversity through composition (richness of species) and structure (relative abundance of species) of the diurnal bird community over time for each farm studied. It will also yield data on the presence of the key bird species used to define the priority sites.

Rationale: The bird community has been extensively studied and monitored, and is frequently used as an indicator of the general state of a site's biodiversity. Birds occupy different niches in ecosystems as seed dispersers, pollinators, predators, and carrion eaters. The general state of biodiversity is reflected to different degrees in the various functional groups of birds. It is relatively easy to identify diurnal birds, and Costa Rica has professionals trained in bird identification, making bird monitoring feasible. This indicator is of special importance for evaluating the impact of PES on conservation in forest plantations and agro-forestry systems.

Method: The point-count methodology described below is based on the recommendations of Ralph et al. (1996) and is a modification of the methodology used by the TEAM Initiative (http:/www.teaminitiative.org/application/resources/index.html). The point-count method was selected because it is effective in all types of habitats and because the data obtained is very useful for studying changes in bird populations over time, composition by habitat, and abundance patterns by species (Hutto et al. 1986; Ralph et al. 1995).

Five point counts will be established in the most representative type of forest on each selected farm. The point counts should be 100 m apart and at least 30 m from the forest edge. Vegetation around the different point counts should be as similar as possible. Point counts should be marked so that the same ones are used in all future counts. Each count point should be a circle with a 50 m radius (25 m if the vegetation is dense), divided into three bands (0-10 m, 10-25 m, and 25-50 m). Each point count will identified with a unique code. For each point count, the point route will be surveyed each time in the same order by the same observer, who must be capable of visual and acoustic identification of local birds.

The point counts will be performed over a three-day period (preferably consecutive, to reduce costs) in each suggested month. On each count day, the observer should be at the forest edge 20 minutes before sunrise so that counting at the first point begins with the first rays of sun. The count will be suspended if the day is rainy, misty or very windy. The observer should arrive at the point count making the least disturbance possible. Before initiating the count, he/she should record the date, the code of the point count, and the time and name of the person conducting the survey. Five-minute point counts are scheduled for each

counting point. In that period of time, the observer will record the species and number of individuals for each species, the distance from which the bird was observed for the first time within the circle, whether the bird was identified visually or by bird call, if it was flying or perched, and if possible, its sex. An individual observed within the count area when the observer is arriving or leaving the point should be counted if no other individual of the same species was identified during the survey. Feed or recordings are not to be used to attract birds to the point count. Counts should be recorded on data sheets designed specifically to collect the desired data. The count at all five points should end before 9:30 am. The time after the point count will be used to record the presence of birds and mammals selected for determining the priority sites, either by observation or through interviews with the people living on the farm.

Location: The sites surveyed will be a sample of private farms inside the project area that receive PES.

Frequency: The bird community will be surveyed twice a year, once in the rainy season and once in the dry season, in years one, four, seven and ten of the project. The suggested months are May and November, the latter being when migratory species are present.

Required resources: The count will be performed by people duly experienced in identifying species in the area under study. Each will have a set of binoculars (9X40 or 10X40 recommended), data record sheets, a pencil, a watch with a second hand, and a bird field guide. Statistical software described in the section on information analysis and interpretation will be used to analyze the information.

Information analysis and interpretation: A skilled and experienced professional will be hired to analyze and interpret the data. The data from both three-day counts in each annual period will be combined. Average and cumulative values for each farm will be calculated for each month and for each year (Nur et al. 1999), as will relative abundance (average number of individuals), cumulative species richness, diversity (Shannon-Weiver index expressed as N1), and similarity (Jaccard index and Renkonen index (percentage of similarity index)).

Variance analysis (ANOVA) will be used to compare average and cumulative values for each farm between the two months of the year and between years. The trends between years will be assessed using regression analysis (Nur et al. 1999). These analyses will make it possible to determine the variation, and therefore the contribution to conservation, of bird biodiversity on farms covered by PES.

An ANOVA will be applied to measure the variation between replications on a farm and between farms; a chi-square test to measure variations in the proportion of functional groups between years; and the percentage of key

species (globally threatened or endemic) will be calculated to assess relative conservation importance among prioritized sites.

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Indicator 9. Diversity of coprophagous (dung) beetles

Definition: Bioindicators are groups of organisms whose diversity measure reflect the diversity measure of other groups in a given habitat or ecosystem (McGeoch 1998). This includes structure and composition of the communities, at both the local and regional levels.

Rationale: Dung beetles (coleoptera of the subfamily Scarabaeinae) are an important component of forest ecosystems: as decomposers they participate in reintroducing nutrients into the soil when they eat and bury excrement (Halffter & Edmonds 1982, Horgan 2005); they contribute to soil aeration and water penetration by building tunnels; they participate in seed dispersion (Estrada & Coates-Estrada 1991); they can be important agents in disseminating or destroying the larvae and eggs of flies and other parasitic vertebrate organisms (Miller et al. 1961, Ridsdill-Smith et al. 1987, Davis et al. 2001, Morón & Aragón 2003). As a species, they are highly diverse, and include specialists to generalists that are very sensitive to environmental variability (Favila & Halffter 1997). Also, it is a relatively easy to collect group, one that is very well known in Costa Rica, with clear taxonomy at the species level (Kohlmann 1996, Kohlmann & Solís 1996, 1997, 2001st, 2001b, Solís & Kohlmann 2002, 2003, 2004), making it easy to identify and quantify all specimens. Because of these and other factors (McGeoch 1998), dung beetles are frequently identified as useful ecological and biodiversity indicators (Klein 1989, Kirk 1992, Weaver 1995, Fabila & Halffter 1997, Halffter 1998, Aguilar et al. 2000, Feer & Hingrat 2005).

Human intervention (or absence of it) in ecosystems is reflected in the communities of resident dung beetles (Halffter et al. 1992, Howden & Nealis 1975, Klein 1989). The effect of diversity reduction and changes in structure (abundance and richness of species, mainly) on the dung beetle community caused by deforestation, fragmentation, selected felling, and other modifications of the natural environment have been documented in those works.

Method: To survey the beetles, pit traps will be baited with pig excrement placed in the forest soil for 48 hours. In each surveyed community, twenty (20) replications, 40 meters apart, will be used. Each replication will have four (4) pit traps. Collected material will be preserved with alcohol in plastic bags and taken to the laboratory. There it will be cleaned, separated, identified and quantified; the information will be recorded on a spreadsheet for later analysis. Some specimens will be kept for control purposes.

Frequency: The first sampling in each ecosystem will be performed twice a year in years one, four, seven, and ten. In areas with seasons, one sampling will be performed in the dry season and the other in the rainy season. Repeat samplings will be done in the same location as the first.

Required resources: The people who will collect the field samples, and who will separate, identify, and quantify samples in the laboratory, need one or two weeks prior training in the field and in the laboratory.

This work will require two-person teams: one will be in charge of the sampling and the other will serve as a field assistant; the latter will not require the same amount of training as the first. The amount of equipment needed will depend on the number of farms to be monitored and the resources available.

Each team will sample two farms in the same vicinity concurrently over a period of at least 6 days, as follows. Day 1: arrive; day 2: install pit traps on farm 1; day 3: install pit traps on farm 2; day 4: collect material on farm 1; day 5: collect material on farm 2; day 6: depart.

Means of transportation (vehicle, fuel, chains, carriers, horses, etc.) will be needed to reach and leave the site with the sampling materials and the samples.

The following materials will be needed for a single field sampling: 80 disposable plastic cups, 80 large disposable plastic spoons, 20 ml of odor-free liquid soap, 20 small whirl-pack bags, 6 liters of alcohol, 4 to 6 kg of pig excrement, 1 covered bucket with packaging for carrying the pig excrement, 2 large Le Parfait jars with packaging, 3 gallons of water, 1 soil drill, 1 compass, 1 measuring tape, GPS, 40 meters of rope, 1 machete, 1 large wash bottle, one plastic strainer, one plastic bucket, soft tongs, a roll of labels, waterproof ball-point pens, waterproof marker, scissors, 2 plastic trays, 1 covered plastic container for collected samples, 10 plastic bags (30 x 50 cm).

Laboratory materials needed for a single sampling: 2 trays for quick cleaning of the material, 4 liters of alcohol, 1 paper towel roll, a stereoscope with built-in light source, 10 petri dishes, 1 wash bottle, a notebook for recording information, access to a computer with spreadsheet or database for storing information.

The same person responsible for field sampling will be responsible for separating, identifying, and quantifying the collected material. In addition, a specialist in the group will be needed on an ongoing basis to provide information and advice. About three to four days are needed to process the material collected from one survey on each farm.

The schedule covering a 3-week work cycle for a team sampling four farms would be as follows: days 1 to 3 - prepare for the trip; day 4 - travel to sampling site; days 5 to 8 - sampling; day 9 - travel to another sampling site; days 10 to 13 - sampling; day 14 - return to laboratory; days 15 to 22 – clean, separate, identify, quantify and store information.

Information analysis and interpretation: Calculation of species richness for each sampled environment will be made with EstimateS software (Colwell 2005,

http:/viceroy.eeb.uconn.edu/EstimateS). Sampling efficiency will be determined with species accumulation curves. The Shannon-Weaver diversity index will be calculated using PAST software (Hammer et al. 2005) (http:/folk.uio.no/ohammer/past/). To compare sampled environments, a Variation Analysis will be performed. To determine if the structure of sampled communities matches the pattern of a stable community, a community in early stages of succession, or a species-poor community, chi-square goodness-of-fit tests will be performed of species abundance obtained in each sampled environment vis-à-vis lognormal distribution (stable communities in equilibrium), logarithmic series, and geometric series (communities in early stages of succession or species-poor environments).

Using the data obtained by classifying species into functional groups, the proportion of types belonging to different functional groups of Scarabaeinae in the environments studied will be determined. A chi-square test for independence (Daniel 1979) will be performed between the sampled environment variable and the 6 different functional groups defined (large and small digging beetles, large and small endocoprids, large and small chewing beetles) to compare the environments. The findings will be used to monitor the changes experienced in the species under study and, by extension, in the biodiversity on private farms.

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Annex 7: List of endangered species in the Pax Natura project area

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Agalychnis annae	Amphibian	R	AR		X
Agalychnis saltator	Amphibian	R			X
Anotheca spinosa	Amphibian	R			X
Atelopus senex	Amphibian	R	CR		X
Atelopus various	Amphibian	ES	CR		X
Bolitoglossa alvaradoi	Amphibian	R	AR		X
Bolitoglossa colonnea	Amphibian	R			X
Bolitoglossa robusta	Amphibian	R			X
Bolitoglossa subpalmata	Amphibian		AR		X
Centrolenella ilex	Amphibian	R			X
Cochranella euknemos	Amphibian	R			X
Cochranella spinosa	Amphibian	R			X
Craugastor andi	Amphibian	R	CR		X
Craugastor escoces	Amphibian	R	CR		X
Craugastor fleischmanni	Amphibian	R	CR		X
Craugastor gollmeri	Amphibian	R			X
Craugastor melanostictus	Amphibian	R	VU		X
Craugastor mimus	Amphibian	R			X
Craugastor noblei	Amphibian	R			X
Craugastor persimilis	Amphibian		VU		X
Craugastor podiciferus	Amphibian	R	VU		X
Craugastor ranoides	Amphibian	R	CR		X
Dendrobates auratus	Amphibian	R		2	X
Dermophis costaricense	Amphibian	R			X
Dermophis parviceps	Amphibian	R			X
Duellmanohyla rufioculis	Amphibian		VU		X
Duellmanohyla uranochroa	Amphibian		CR		X
Ecnomiohyla fimbrimembra	Amphibian	R	AR		X
Ecnomiohyla miliaria	Amphibian	R	VU		X
Eleutherodactylus altae	Amphibian	R	VU		X
Eleutherodactylus moro	Amphibian	R			X
Gymnnopis multiplicata	Amphibian	R			X
Hylomantis lemur	Amphibian	R	AR		X
Isthmohyla angustilineata	Amphibian		CR		X
Isthmohyla debilis	Amphibian	R	CR		X
Isthmohyla pictipes	Amphibian		VU		X
Isthmohyla rivularis	Amphibian		CR		X
Isthmohyla tica	Amphibian		CR		X
Isthmohyla xanthosticta	Amphibian	R			X
Isthmohyla zeteki	Amphibian	R	VU		X
Lithobates vibicaria	Amphibian	R	CR		X

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Nototriton richardi	Amphibian	R			X
Oedipina carablanca	Amphibian	R			X
Oedipina collaris	Amphibian	R			X
Oedipina cyclocauda	Amphibian	R			X
Oedipina gracilis	Amphibian		AR		X
Oedipina poelzi	Amphibian		AR		X
Oedipina pseudouniformis	Amphibian		AR		X
Ollotis holdridgei	Amphibian	R	CR		X
Ollotis melanochloris	Amphibian	R			X
Oophaga pumilio	Amphibian	R		2	X
Phyllobates lugubris	Amphibian	R		2	X
Smilisca puma	Amphibian		VU		X
Accipiter superciliosus	Bird	R		2	X
Accipiter bicolor	Bird			2	X
Accipiter cooperii	Bird			2	X
Accipiter striatus	Bird			2	X
Aegolius ridgwayi	Bird			2	X
Amazilia tzacatl	Bird			2	X
Amazona autumnalis	Bird	R		2	X
Amazona farinosa	Bird	R		2	X
Anthracothorax prevostii	Bird			2	X
Aphanotriccus capitalis	Bird	R	VU		X
Ara ambiguus	Bird	ES	AR	1	X
Aratinga finschi	Bird	R		2	X
Aratinga nana	Bird	R		2	X
Archilochus colubris	Bird			2	X
Ardea alba	Bird			3	x
Bolborhynchus lineola	Bird	R		2	x
Botaurus pinnatus	Bird	R			x
Brotogeris jugularis	Bird	R		2	x
Bubulcus ibis	Bird			3	x
Buteo albonotatus	Bird			2	x
Buteo brachyurus	Bird			2	x
Buteo jamaicensis	Bird			2	x
Buteo magnirostris	Bird			2	x
Buteo nitidus	Bird			2	x
Buteo platypterus	Bird			2	x
Buteo swainsoni	Bird			2	x
Buteogallus urubitinga	Bird	R		2	x
Cairina moschata	Bird	R		3	x
Calliphlox bryantae	Bird			2	x
Campylopterus hemileucurus	Bird			2	x
Campylorhamphus pusillus	Bird	R			x
Caracara cheriway	Bird			2	x
Cephalopterus glabricollis	Bird	R	VU		x
Chalybura urochrysia	Bird			2	x

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Chondrohierax uncinatus	Bird	R		1	x
Ciccaba nigrolineata	Bird			2	x
Ciccaba virgata	Bird			2	x
Circus cyaneus	Bird			2	x
Claravis mondetoura	Bird	R			x
Colibri delphinae	Bird			2	x
Colibri thalassinus	Bird			2	x
Cotinga amabilis	Bird	R			x
Crax rubra	Bird	R		3	x
Crypturellus boucardi	Bird	R			x
Deconychura longicauda	Bird	R			x
Dendrocygna autumnalis	Bird			3	x
Dendroica cerulea	Bird		VU		x
Discosura conversii	Bird			2	x
Doryfera ludovicae	Bird			2	x
Elanoides forficatus	Bird			2	x
Elanus leucurus	Bird			2	x
Elvira cupreiceps	Bird			2	x
Eugenes fulgens	Bird			2	x
Eupherusa eximia	Bird			2	x
Eupherusa nigriventris	Bird			2	x
Eurypyga helias	Bird	ES			x
Eutoxeres aquila	Bird			2	x
Falco deiroleucus	Bird	ES		2	x
Falco peregrinus	Bird	R		1	x
Falco rufigularis	Bird	R		2	x
Falco columbarius	Bird			2	x
Falco sparverius	Bird			2	x
Florisuga mellivora	Bird			2	x
Geotrygon violacea	Bird	R			x
Geranospiza caerulescens	Bird	R		2	x
Glaucidium costarricanun	Bird			2	x
Glaucidium griseiceps	Bird			2	x
Glaucis aenea	Bird			2	x
Harpagus bidentatus	Bird			2	x
Harpyhaliaetus solitarius	Bird	ES		2	x
Heliodoxa jacula	Bird			2	x
Heliomaster longirostris	Bird			2	x
Heliornis fulica	Bird	ES			x
Heliothryx barroti	Bird			2	x
Herpetotheres cachinnans	Bird			2	x
Hylocharis eliciae	Bird			2	x
Ibycter americanus	Bird	ES		2	x
Ictinia mississippiensis	Bird			2	x
Ictinia plumbea	Bird			2	x
Ixobrychus exilis	Bird	R			x

Scientific name	Gruop	MINAET	IUCN	CITES	Present in project area
Jacamerops aureus	Bird	R			x
Klais guimeti	Bird			2	x
Lampornis calolaema	Bird			3	x
Lampornis hemileucus	Bird			2	x
Lanio leucothorax	Bird	R			x
Laniocera rufescens	Bird	R			x
Leptodon cayanensis	Bird			2	x
Leucopternis semiplumbea	Bird	R		2	x
Leucopternis albicollis	Bird			2	x
Leucopternis princeps	Bird			2	x
Lophornis helenae	Bird	R		2	x
Lophostrix cristata	Bird	R		2	x
Megascops guatemalae	Bird	R		2	x
Megascops choliba	Bird			2	x
Megascops clarkii	Bird			2	x
Mesembrinibis cayennensis	Bird	R			x
Micrastur semitorquatus	Bird	R		2	x
Micrastur ruficollis	Bird			2	x
Microchera albocoronata	Bird			2	x
Morphnus guianensis	Bird	ES		2	x
Notharchus tectus	Bird	R			x
Odontophorus leucolaemus	Bird	R			x
Pandion haliaetus	Bird			2	x
Panterpe insignis	Bird			2	x
Penelope purpurascens	Bird	R		3	x
Phaethornis guy	Bird			2	x
Phaethornis longirostris	Bird			2	x
Phaethornis striigularis	Bird			2	x
Pharomachrus mocinno	Bird			1	x
Pionopsitta haematotis	Bird	R		2	x
Pionus senilis	Bird	R		2	x
Piprites griseiceps	Bird	R			x
Platalea ajaia	Bird	ES			x
Procnias tricarunculata	Bird	R	VU		x
Pseudoscops clamator	Bird			2	x
Pulsatrix perspicillata	Bird			2	x
Ramphastos sulfuratus	Bird			2	x
Sarcoramphus papa	Bird	R		3	x
Selasphorus flammula	Bird			2	x
Selasphorus scintilla	Bird			2	x
Spizaetus ornatus	Bird	R		2	x
Spizaetus tyrannus	Bird	R		2	x
Spizastur melanoleucus	Bird	R		2	x
Thalurania colombica	Bird			2	x
Threnetes ruckeri	Bird			2	x
Tinamus major	Bird	R			x

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Touit costaricensis	Bird	R	VU	2	x
Trogon aurantiiventris	Bird	R			x
Trogon clathratus	Bird	R			x
Tyto alba	Bird			2	x
Xiphocolaptes promeropirhynchus	Bird	R			x
Epigomphus camelus	Insect		AR		x
Palaemnema chiriquita	Insect		AR		x
Palaemnema gigantula	Insect		AR		x
Palaemnema melanota	Insect		AR		x
Alouatta palliata	Mammal	ES		1	x
Ateles geoffroyi	Mammal	ES		1	x
Balaenoptera physalus	Mammal			1	x
Bassaricyon gabbii	Mammal	R		3	x
Bassariscus sumichrasti	Mammal	R		3	x
Bauerus dubiaquercus	Mammal		VU		x
Bradypus variegatus	Mammal			2	x
Cabassous centralis	Mammal	R		3	x
Caluromys derbianus	Mammal		VU		x
Cebus capucinus	Mammal	R		2	x
Choloepus hoffmanii	Mammal	R		3	x
Coendou mexicanus	Mammal			3	x
Cryptotis gracilis	Mammal		VU		x
Cuniculus paca	Mammal			3	x
Dasyprocta punctata	Mammal			3	x
Eira barbara	Mammal			3	x
Galictis vittata	Mammal	R		3	x
Herpailurus yaguaroundi	Mammal	ES		1	x
Leopardus pardalis	Mammal	ES		1	x
Leopardus wiedii	Mammal	ES		1	x
Lontra longicaudis	Mammal	R		1	x
Mazama americana	Mammal			3	x
Nasua narica	Mammal			3	x
Odocoileus virginianus	Mammal			3	x
Panthera onca	Mammal	ES		1	x
Potos flavus	Mammal			3	x
Puma concolor	Mammal	ES		1	x
Reithrodontomys rodriguezi	Mammal		VU		x
Sylvilagus dicei	Mammal		AR		x
Tamandua mexicana	Mammal			3	x
Tapirus bairdii	Mammal	ES	AR	1	x
Tayassu tajacu	Mammal			2	x
Vampyrum spectrum	Mammal	R			x
Aegiphila panamensis	Plant		VU		x
Amphitecna sessilifolius	Plant		VU		x
Anaxagorea crassipetala	Plant		AR		x

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Bactris longiseta	Plant		VU		x
Cedrela odorata	Plant		VU		x
Cornus disciflora	Plant		VU		x
Dendropanax globosus	Plant		VU		x
Hyperbaena leptobotryosa	Plant		VU		x
Ilex costaricensis	Plant		VU		x
Ilex pallida	Plant		VU		x
Ilex vulcanicola	Plant		VU		x
Inga latipes	Plant		AR		x
Inga mortoniana	Plant		AR		x
Lacunaria panamensis	Plant		AR		x
Nectandra ramonensis	Plant		VU		x
Nectandra smithii	Plant		VU		x
Oreomunnea pterocarpa	Plant		AR	2	x
Oreopanax oerstedianus	Plant		VU		x
Persea schiedeana	Plant		VU		x
Platymiscium pinnatum	Plant		AR	2	x
Pouteria austin-smithii	Plant		VU		x
Pouteria calistophylla	Plant		VU		x
Pouteria congestifolia	Plant		VU		x
Pouteria macrocarpa	Plant		VU		x
Pouteria silvestris	Plant		VU		x
Protium pittieri	Plant		VU		x
Quercus bumelioides	Plant		VU		x
Quercus costaricensis	Plant		VU		x
Schefflera brenesii	Plant		VU		x
Spachea correae	Plant		VU		x
Terminalia bucidoides	Plant		AR		x
Vitex cooperi	Plant		AR		x
Zanthoxylum acuminatum	Plant		AR		x
Zanthoxylum panamense	Plant		AR		x
Atropoides mexicanus	Reptile			3	x
Boa constrictor	Reptile	R		1	x
Bothriechis schlegelii	Reptile			3	x
Bothrops asper	Reptile			3	x
Caiman crocodilus	Reptile	R		1	x
Celestus cyanochloris	Reptile	R			x
Chelydra serpentina	Reptile	R			x
Clelia clelia	Reptile	R		2	x
Coleonix mitratus	Reptile	R			x
Corallus annulatus	Reptile	R		2	x
Dactyloa frenata	Reptile	R			x
Dactyloa insignis	Reptile	R			x
Dactyloa microtus	Reptile	R			x
Epicrates cenchria	Reptile	R		2	x
Iguana iguana	Reptile			2	x

Scientific name	Group	MINAET	IUCN	CITES	Present in project area
Kinosternon angustipons	Reptile	R	VU		x
Micrurus mosquitensis	Reptile			3	x
Norops altae	Reptile	R			x
Norops carpenteri	Reptile	R			x
Norops lemurinus	Reptile	R			x
Norops pentaprion	Reptile	R			x
Norops sericeus	Reptile	R			x
Polychrus gutturosus	Reptile	R			x
Porthidium nasutum	Reptile			3	x
Techadactylus rapicaudus	Reptile	R			x
Ungaliophis panamensis	Reptile			2	x

1 = Appendix I
2 = Appendix II
3 = Appendix III
CR = At critical risk
AR = At risk
ES = Endangered species
R = Reduced population
VU = Vulnerable

Note: To determine whether a species is present in the area under study, the species distribution area was compared to the area under study. If the two overlapped at all, the species was considered present (presence probability rather than absolute certainty).

Annex 8: Instructions for technical studies for projects on forest protection, forest protection in conservation gaps, water resource protection, and natural regeneration[8]

The undersigned _____, professional license Nº _____, in my capacity as Forest Auditor (*regente forestal*), holding fidelity policy Nº _____, under the terms of the Forestry Law, its regulations and amendments, as well as all forest audit regulations and standards in force, hereby certify the contents of the following technical study:

1. Name of beneficiaries, identification document number, folio real number(s), map number(s), total area of folio(s), current use, administrative location, exact address(es) of farm(s) and boundary markers.
2. Number of forest-audit form, date of visit.
3. If the property in located in a protected wilderness area, indicate its name.
4. Indicate the type and number of the pre-application form provided by the corresponding Regional Office.
5. For forest protection projects, do not specify the protected areas since they are part of the area covered by PES. It is only necessary to quantify and deduct from the effective area the area attributed to primary roads and collection yards, and to indicate the location of areas covered by earlier PES contracts and that are currently in force. Water mirrors (vegetation-free reservoirs or lakes) larger than one hectare should be considered and deducted from the area that will receive compensation.
6. For forest protection projects in conservation gaps and water resource protection projects, describe in detail the characteristics of the areas to be covered.
7. For pastures in natural regeneration, certify the state of vegetation on the site and the estimated length of time in abandonment.
8. For natural regeneration projects with productive potential, it must be certified that there are at least 1,240 small seedlings of commercial species per hectare or/and 720 commercial saplings per hectare, depending on the age at which the natural regeneration process began (Annex 15). In this scenario, do not quantify remnant trees and palms from primary forests, or tree stumps with multiple shoots. The density of remnant trees should not exceed 5 individuals per hectare. Include a description of forest audit tasks.
9. Georeference the property map with at least three GPS points in WGS84 datum and in decimal-degree format (GG.dddd). At the very least, two of these points should be vertexes on the map. All GPS points should be at least 50 meters apart. (Point location should be indicated on the map, and furnished in digital format in a point shapefile in the same coordinates system as the map's, indicating the reference for each point). Include the information on the GPS points.

[8] Published in Official Gazette Nº 46 on 6 March 2009. Regulations. Ministry of Environment, Energy and Telecommunications. National Forestry Financing Fund. Pursuant to agreement 11 reached during regular session 01-2009 on 28 January 2009.

10. All technical studies are to include a map of the area to be covered by PES, relative to the entire property, with an indication of the course and vertex numbers. Indicate what system was used and its accuracy. Tie the starting point of the area to be covered (point 1) to a point with known coordinates. The map of the actual PES area and the full map should be provided both in print and digital form. Requirements for the digital map are as follows:

- Files must be in Arcview shapefile format (polygon); no other format will be accepted.
- Shapefiles should be named with the application form number assigned by the Regional Office (i.e., SJ01000108).
- A single shapefile should be submitted, which includes in the table of attributes: area quantification, use (PES area, rest of farm), and cadastral map number, when appropriate.
- If any contracts are in force, indicate where.
- The file should be georeferenced in the CRTM05 coordinates system (authorized under Decree 33797-MJ-MOPT published in La Gaceta Nº 108 on Wednesday, 6 June 2007) or in the geographic coordinates system, WGS84 datum, in decimal-degrees format (GG.dddd).
- Files should be delivered on compact disk (CD).

11. For PES projects on indigenous lands, the Forest Auditor should provide three GPS points for the vertexes in forest blocks larger than 50 hectares; for smaller areas, information on one GPS point, in the format described above, will suffice.
12. The scale for areas smaller than 30 hectares should be between 1:5,000 and 1:10,000. For larger areas, the scale can be determined by the specialist.
13. The study should be based on the legal area of the property, that is, the 'agricultural area,' defined as the area of a given portion of a property determined by a horizontal projection of its perimeter.
14. Clearly indicate if there are other PES contracts in force, specifying area, location and certifying the validity of the contracts.
15. For farms in peaceful (undisputed) possession or having an expired annual contract, certify that the forest was protected during the 12 preceding months.
16. For rental properties, certify that the PES-covered areas are outside the rental area if the property owner is requesting PES. Otherwise, certify that the rented area effectively corresponds to PES areas requested by the renters.
17. Certified technical studies will not be accepted if maps show cartographic displacements in excess of 500 meters vis-à-vis the map and the real location of the farm. Should displacement exceed 500 meters, a certification by a duly licensed topographer of the correct location of the map will be required.
18. All certified technical studies must be prepared on safety paper and include the name, professional license number, and signature of the person who prepared the study, the date it was conducted, and be affixed with the respective legal stamps.
Note: Precautionary signs installed should contain the following information: name of beneficiary, type, area covered by PES, and forestry contract number.

Annex 9: Group Certification Manual. Foundation for the Development of the Central Volcanic Range (FUNDECOR). Green Seal Program. First version, October 2006. Sarapiquí Operations Department.

1. FUNDECOR: The organization

The Foundation for the Development of the Central Volcanic Range (FUNDECOR) is a nongovernmental organization (NGO). As such, it does not receive financing from the Government of Costa Rica. It is a private, independent organization financed with resources from an endowment fund and from the sale of its technical services. It is a not-for-profit organization created to support the work of different national agencies entrusted with safeguarding and protecting, conserving and recovering forest resources in central and northern Costa Rica. It began operations in 1991, in Sarapiquí canton, and at present promotes the development of projects on natural forest management, absolute forest conservation, and commercial reforestation, primarily with native species.

2. Mission

Its mission is to promote forest conservation and forest recovery using market-based strategies that increase the value of forest goods and services, without changing current land use.

3. Description of the Group

FUNDECOR strives to find economic alternatives that will add value to natural forests and forest plantations in order to increase the competitiveness of forestry activity as compared to other land-use alternatives.

Thus, an important aspect of its work is to provide technical assistance and forestry advice to forest owners and owners of land suitable for reforestation in FUNDECOR's area of action: the Central Volcanic Range Conservation Area (ACCVC).

For all purposes, these forest owners have been given the title "FUNDECOR client-families," in the understanding that the relationship is with all the family members of the legal owner of the property.

The FUNDECOR Group is made up of some 550 client-families, who own a total of approximately 43,000 hectares. Most are small and medium-scale owners, holding an average 75 hectares each per Forest Management Unit (forest).

Some live on the property and earn their livelihoods through their own agricultural and forest activities; others live on their farms but do not earn their livings from production activities because they earn salaries from stable jobs in the goods and services industries of the region. Other client-families do not live on their farms but contract an overseer to care for and provide maintenance for the farm.

With regard to forest resources, **FUNDECOR** supports three types of projects: **sustainable natural forest management**, where timber is harvested periodically; **absolute forest protection,** when management is not feasible; and **commercial reforestation** of sites stripped of forest coverage. All are implemented in accordance with the strict planning set out in management plans designed for each farm.

Other common activities in the area are livestock for meat production and, to a lesser degree, dual-purpose (meat and milk) production. Heart of palm (pejibaye), cassava, pineapple, and other tubers are the most common crops in the area of action.

4. Area of action

FUNDECOR works within the perimeter of the ACCVC, one of the 10 bioregions into which the Ministry of Environment, Energy and Telecommunications (MINAET) has decentralized its work. The ACCVC includes a significant portion of the Greater Metropolitan Area, the northern parts of the San José, Alajuela, and Heredia provinces, a substantial part of Turrialba, Guápiles, and Siquirres cantons and, especially, the greater part of Sarapiquí canton.

Sometimes farms outside the area of action have been included in FUNDECOR activities due to their strategic location, proximity to other farms, or very easy access.

5. Technical assistance agreements

To formalize the relationship between **FUNDECOR** and each client-family, an agreement for technical assistance and forestry advice is signed (see Annexes). In addition to specifying the responsibilities and obligations of the parties, this document includes a clause indicating: “accept being included in the **Environmental Certification System,** also known as ***Green Seal***, of which **FUNDECOR** is currently a part, and as an **OWNER,** to respect all regulations pertaining to that condition.”

6. The Green Seal or forest certification

The Green Seal is an arrangement that **FUNDECOR** offers its client-families with the intention of improving the performance of project operations. It includes periodic, very stringent audits of overall management and specific activities being carried out in a natural forest or forest plantation. The audit is performed independently by a world-level organization, accredited with the Forest Stewardship Council (**FSC)**, and is based on a group of principles and criteria that have been internationally accepted and recognized as standards for ensuring proper forest management.

The Green Seal Certification Mark ensures consumers and other interested parties that forests are not being destroyed but are being managed in an appropriate and sustainable manner. It is expected that, in the short- or medium-

term, this arrangement will provide economic benefits for products sold under the Green Seal mark.

7. Organizational chart for Green Seal management

FUNDECOR administers operations and monitors client-family compliance with FSC Principles and Criteria at three levels of authority. Zone supervisors and reforestation program managers provide the most direct monitoring as a personalized service to each client-family in the Green Seal program. Above them is the final administrative unit of the Green Seal program (the Technical Committee), made up of the Executive Assistant Director of **FUNDECOR**, the Directors of Operations in Sarapiquí and Guápiles, the Director of Research and Development; as well as two staff members from Sarapiquí Operations involved in implementing the arrangement. In brief, the committee is made up of six people, is coordinated by the Executive Assistant Director, and meets once every month or two; its deliberations are recorded in minutes, and are duly kept on file.

8. Green Seal priorities

The Green Seal is a process of continuous improvement, and is especially important for projects that aim to market products from managed forests or forest plantations.

FUNDECOR promotes two types of programs that aim to produce goods: **natural forest management** and **reforestation programs**, since both types allow for the utilization of wood.

For this reason, **FUNDECOR** promotes Green Seal certification in forest management and reforestation projects. Nonetheless, client-families involved in absolute protection projects may become Green Seal certified if they express their interest in doing so.

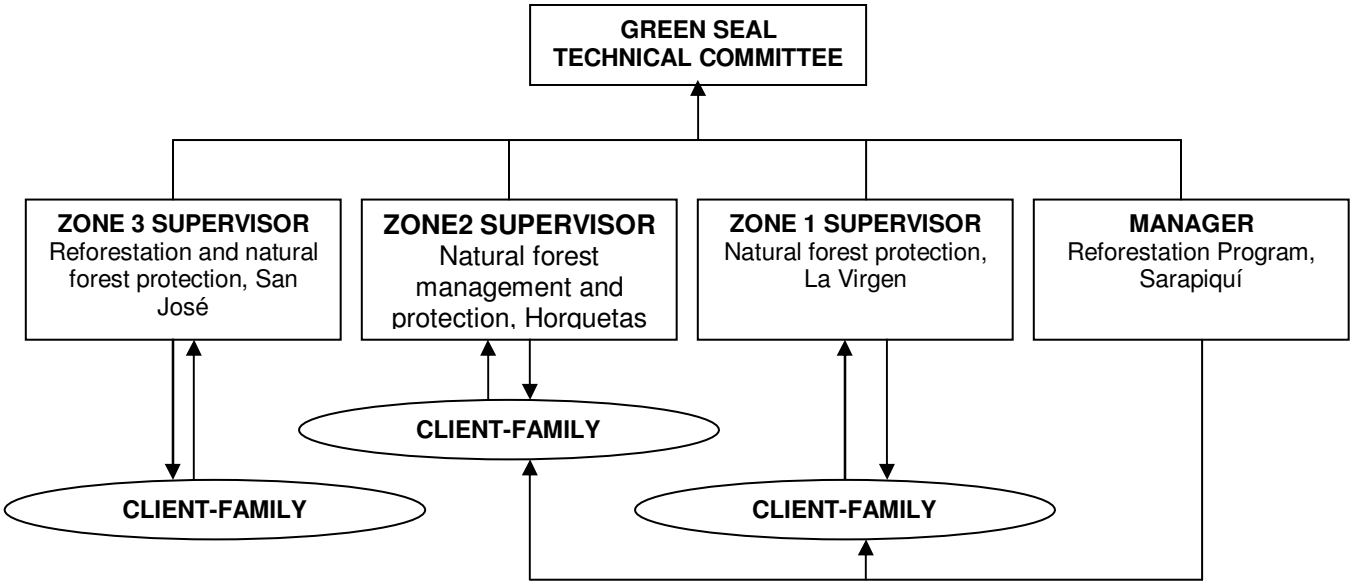

Figure 14: Administrative structure of the FUNDECOR Green Seal program

9. Requirements for joining the Green Seal program

A client-family is admitted into the Green Seal program after it has signed the agreement for technical assistance and forest advice with **FUNDECOR,** and once:

- the forest study (management plan) for the forest management unit has been duly signed by a Forest Auditor; and
- it complies with **FUNDECOR's** Environmental Policy.

Reforestation projects have an added requirement: having begun the work to establish the plantation.

10. Training program

In order to fulfill the institutional responsibilities acquired under the Green Seal arrangement, detailed and in-depth training is provided to client-families joining the program (See Annex).

The training is keyed to each group of client-families and where they live; sometimes training events are organized for more than one client-family but training is normally provided personally by a staff member of **FUNDECOR's** Operations Department**.**

The foregoing takes into account the provisions and strategy of FUNDECOR's general training plan.

11. Responsibilities of FUNDECOR and the members

FUNDECOR's responsibilities in implementing the Green Seal program are to provide the information and training needed to enable all client-families to fully understand the objectives pursued and the responsibilities they have assumed. **FUNDECOR** is also responsible for performing periodic assessments of forest operations to ensure that established standards are being faithfully met, and to follow up on possible corrective actions until fully implemented.

For their part, client-families pledge to faithfully comply with the FSC Principles and Criteria and to accept periodic audits by **FUNDECOR** staff and, as the case may be, the FSC-accredited external auditor hired by **FUNDECOR.** This commitment is made clear at the time the agreement is signed with **FUNDECOR**.

12. Compliance monitoring and follow up

Compliance monitoring and follow up of FSC regulations is to be performed with previously-created Audit Forms that can be found in the Master Documents.

The purpose of using the Green Seal Audit Forms is to provide the administrator, in this case **FUNDECOR's** Operations Department, with an effective mechanism for monitoring client-families' compliance with FSC standards.

A review of the standards identified three monitoring stages:

- Assessment of the management plan or technical study (Form 1)
- Assessment of membership requirements (Form 2)
- Monitoring of operations on the Forest Management Unit (FMU) (Form 3)

Only two results are possible when assessing the standards listed on each form:

- *YES:* when the standard or the entire group of standards audited in the standard was duly observed or met under the project.
- *NO:* when the standard or any standard assessed was not duly observed or met under the project.

Observations can be included for each standard being assessed, and may indicate that a client-family is not ready to join the Green Seal arrangement.

Form 1: Guidelines for Green Seal assessment of management plans

The purpose of this form is to ensure that the recommended plan and activities have been carried out in accordance with the standards. When filling it out, the following should be considered and observed:

☑ The form is to be filled out by the Zone Supervisor responsible for overseeing the FMU, or by a staff member from the Operations Department appointed by its director.

☑ If any standard has not been met, the person filling out the form is to inform the person who prepared the management plan of the noncompliance so that corrective measures can be undertaken.

☑ Once the corrections have been made in the management plan, the form is to be completed again.

Form 2: Guidelines for assessment of Green Seal membership requirements

This form is used to ensure that all client-families accepted into the Green Seal program meet membership requirements. To this end, the following should be taken into account and fulfilled:

- ☑ Before completing this form, an agreement must have been signed with the owner, who accepts being included in the Green Seal program.

- ☑ The Zone Supervisor is responsible for filling out this form.

- ☑ Confirm that the person signing the agreement with **FUNDECOR** has property rights or rights of peaceful (undisputed) possession over the land where the FMU is located. This can be checked online with the Property Consultation System (National Public Records Office), or by means of copies of sales contracts presented before filling out the form.

- ☑ When it is a forest management project or any project other than the State-promoted PES program, owners must sign an affidavit stating that they are up to date with their tax obligations (CCSS, INS, and municipality where the property is located).

- ☑ When it is a project implemented under the State-promoted PES Program, the affidavit is not required because the State will officially check the information as a matter of course.

- ☑ If any of the standards are not met, the person filling out the form is to inform the owner of the requirements that are not being met so the necessary steps can be taken to correct the irregularities.

- ☑ Once the requirements of Forms 1 and 2 have been met, the Zone Supervisor will recommend to the Director of Operations that a new project be accepted into the Green Seal program. Final acceptance of the client-family into the Green Seal program will take place at a meeting of the Technical Committee, and be recorded in the minutes of the meeting.

- ☑ After the form has been completed, the client-family will receive more detailed training on the scope of and obligations agreed to by their acceptance into the Green Seal program. This will include a talk by the Zone Supervisor or participation in a course offered by **FUNDECOR** on environmental policy, environmental and labor legislation, Green Seal, and hazardous substance management.

Form 3: Guidelines for monitoring FMU operations under the Green Seal program

The purpose of this form is to ensure that all client-families in the Green Seal program comply with the standards governing activities undertaken in the forest management unit. In filling out the form, the following should be taken into account and fulfilled:

- ☑ The Zone Supervisor is responsible for filling out this form.
- ☑ This form should be filled out at least once a year.
- ☑ Once a year, the Public Records Office for Properties is to be consulted to confirm that ownership has not changed. When an FMU is covered by the State-promoted PES Program, this step will not be necessary so long as payments are being received. In the case of untitled farms, on-site verification will be done to determine whether there are any land ownership conflicts by checking boundaries and signs, and verifying that there are no squatters on the land.
- ☑ The form has two sections. The first is the monitoring form or on-site report; the second contains a list of standards to be considered when assessing the progress of each project.
- ☑ When short visits are made to monitor specific forest operations in the project area, the Zone Supervisor needs only to complete sections A and B of form 3. If the Zone Supervisor notes client-family noncompliance with any of the standards during this visit, he/she is to immediately fill out sections C through G of the **List of Standards.**
- ☑ If the client-family fails to comply with any of the standards, the Zone Supervisor should proceed in accordance with the Corrective Actions Procedure.

13. List of minor and major infractions

Possible violations of the Principles and Criteria were classified as **MINOR** or **MAJOR** to aid in identifying noncompliance**.** Since all client-families received the relevant training and agreed to comply with them, application of these criteria is in order.

Table 17: Classification by severity of violation in the Green Seal program

VIOLATION	ACTIVITY	VIOLATION
MAJOR	General	Existence of land-ownership conflict (squatting; legal dispute) Felling of protected species Felling of trees in protected area Illegal felling of trees Change in land use
	Management	Felling of bearing trees Felling at unauthorized times Dragging at unauthorized times Clearing of understory
	Reforestation	Illegal felling of forests (primary or secondary) for establishing forest plantations
	Protection	Clearing of understory
MINOR	General	Disregarding the guidelines of the management plan or the Forest Auditor Repeated evidence of illegal hunting Property boundaries are not cleared. No signs have been posted banning entry, felling activities and hunting. The project does not have the equipment, infrastructure, and basic services required for safe execution of forest operations, when strictly necessary. Use of genetically modified organisms, biological controls, pesticides, or banned substances Workers do no comply with the provisions of the Occupational Health Manual. Hazardous and contaminating substances are not stored in accordance with the standards of the Occupational Health Manual. Waste and spillage of hazardous and contaminating substances are not disposed of in accordance with the standards of the Occupational Health Manual. Forest operations are not performed in accordance with safety guidelines. Illegal labor is used on the project. Permanent non-family employees are not duly registered with the CCSS and do not receive the Christmas bonus and paid vacations. Forestry operations use temporary workers without complying with relevant national regulations. Agrochemicals not included on FUNDECOR's list of authorized pesticides are used.
	Management	Trees are felled but not extracted. Unauthorized feeder roads are opened. Unauthorized works are built. Recommended works are not constructed. Cables are not used for extraction purposes. Logs are inadequately prepared for dragging. Machinery in poor working order is used, affecting forest utilization work. Feeder roads are not closed when so ordered. Obstacles are not removed from streams Livestock is not kept out of forest area. Machinery is moved through areas not authorized by the State Forestry Administration (SFA) or the Forest Auditor.
	Reforestation	Inadequate weed control Weeding and pruning recommended by the Forest Auditor not carried out. Sanitary controls not implemented. Noncompliance with the rule banning livestock from planted area. Machinery is moved through areas not authorized by the SFA or the Forest Auditor
	Protection	Livestock not kept out of forest area.

14. Corrective action

Procedure for minor violations:

a) The Zone Supervisor or person responsible for the reforestation program is to inform the Sarapiquí Operations Director that a corrective action is being ordered for a given client-family; that person, in turn, will inform the client-family, in writing, of the violation.

b) A reasonable amount of time will be allowed, depending on the activity, for implementing the corrective measures.

c) In the event that the client-family does not carry out the corrective measures within the allotted timeframe, the situation will be raised by the Sarapiquí Operations Director to the Technical Committee, which may authorize an extension for implementing the corrective measures, or provide the client-family with an opportunity to answer the charges.

d) The decision of the Technical Committee will be communicated in writing to the client-family. If appropriate, a calendar month (30 calendar days) will be allowed for the client-family to appeal or to submit the corresponding explanation.

e) If the client-family has not complied with the order by the deadline set in accordance with the above and/or within the period of time allowed by the Technical Committee, the case will be reexamined by the Technical Committee, which will proceed to immediately remove it from the "certified" (Green Seal) list. The certifying firm will be informed of this decision, with an explanation of the causes.

The client-family will be informed in writing of the decision.

Procedure for major violations

a) The Zone Supervisor or manager of the reforestation program is to inform the Sarapiquí Operations Director that a corrective action is being ordered for a client-family; this person will investigate the violation and talk with the client-family, which will also receive a written communication regarding the matter.

b) FUNDECOR's Technical Committee will analyze the situation and, in the event that it is determined that the "violation" was involuntary, due to negligence or accidental, the case will be referred to the State Forest Administration or another relevant authority. If the possibility exists of taking measures to amend the situation, the client-family will be requested to do so within a reasonable amount of time, in the understanding that otherwise they will lose Green Seal certification.

c) If the "violation" was due to negligence, was accidental or involuntary and the client-family does not take the offsetting measures, the procedure will begin for removing the client-family from the Green Seal program. This decision will be communicated to them in writing and they will have one month (30 calendar days) to appeal.

d) If the client-family has not complied with the order by the deadline set in accordance with above and/or within the period of town allowed by the Technical Committee, the case will be reexamined by the Technical Committee, which will proceed to remove it from the "certified" (Green Seal) list. The certifying firm will be informed of this decision, with an explanation of the causes.

The client-family will be informed in writing of this decision.

15. Use of the FSC logo

The rules regarding use of the FSC logo will be discussed when the client-family indicates the need to use it. As administrator of the Green Seal, it is **FUNDECOR's** responsibility to ensure compliance with FSC regulations, specifically those contained in the "Brand Pack" document, as well as all other official FSC regulations, when the logo will be used on products or promotional materials.

16. Communication with accreditation firm

At least once every six months, or whenever deemed necessary by the Technical Committee, the accreditation firm will be informed of any changes in the Green Seal arrangement administered by **FUNDECOR,** or of any changes in the list of client-families in the Green Seal program.

17. Member representation

If for any reason a client-family wishes to delegate its representation in the Green Seal Group to another (third) person, they must submit the corresponding legal documentation, which in this case will be a special power of attorney that clearly defines the scope of this representation and that has been duly registered by a lawyer authorized for these purposes.

Annex A: Agreement for Technical Assistance and Advisory Services on Natural Forest Management

The undersigned, **Franz Tattenbach Capra**, adult, married once, economist, resident of Escazú, personal identification card number: **one-six two two-three two five (1-622-325),** in his capacity as Executive Director of the **Foundation for the Development of the Central Volcanic Range,** legal document number: **three-zero zero six-zero nine nine eight eight six-eleven (3-006-099886-11)**, a legal body registered with the Public Records Office in volume: one hundred and thirteen, Folio: fifty-six; entry: one hundred and thirty-one; hereinafter **FUNDECOR**; and **XXXXXXXXXX XXXXXXXXXXXXXXXXXXXXX, S.A.**, legal document number: **XXXXXXXXXX (X-XXX-XXXXXX)**, whose agent and legal representative is: **XXXXXXX XXXXX XXXXXXX**, resident of XXXXXXXXXXXXX, personal identification card number: **xxxxx xxxxxx xxxxx xxxxxx (x-xxx-xxx);** hereinafter **THE OWNER,** do hereby sign the following **Agreement for Technical Assistance and Forest Advisory Services** in order to implement a **Natural Forest Management Plan** and participate in executing the project. This Agreement will be governed by current Costa Rican laws, regulations, and decrees relating to Forestry Legislation, and especially by the following clauses:

ONE: THE OWNER owns property measuring an area of **xxxx hectares and XXXXXX square meters,** located in XXXXXXXXXXXX of XXXXXX of Sarapiquí; as indicated in the Public Record of Properties under:

Folio Real:	**XXXXXXXX-000**
Cadastral map:	**H-XXXX-XX**

TWO: FUNDECOR agrees to:

1-) Draw up a management plan (technical study) for (approximately) **XXX** hectares of natural forest.

2-) For that same area, design an Operational Management Plan for **XXX** hectares of forest, in order to bring that forest into utilization.

3-) Serve as the project's Forest Auditor, pursuant to the regulations of the **School of Agricultural Engineers of Costa Rica**, for the duration of the present Agreement, and to conduct the inspection visits as provided for in current regulations.

THREE: THE OWNER will pay the costs incurred by **FUNDECOR** in executing the points listed in clause **TWO** with revenues from the first sales of wood authorized under the permit granted by the Ministry of Environment, Energy and Telecommunications, as it is extracted. The first sale should prioritize paying off in full the debt with **FUNDECOR.**

The total amount to be paid to **FUNDECOR** for its services to plan and supervise the management plan is **US$ XXXXX.00** (exactly XXXXXX United States dollars).

This amount includes the cost of forestry treatments to cut vines and lianas.

The cost of the Forest Audit will be paid by **THE OWNER** directly to **FUNDECOR,** as established by the **School of Agricultural Engineers of Costa Rica** with regards to the rates and periodicity of visits to be made during forest utilization.

FOUR: THE OWNER pledges to **FUNDECOR** to:

a - Not change land use, in other words, to permanently maintain the forest cover.

b – Comply with the provisions of the **management plan** prepared for the farm, as well as the recommendations of the **State Forestry Administration** and **FUNDECOR** while the management plan is in force.

c - Accept **FUNDECOR** as the only **FOREST AUDITOR** *(regente forestal)* for handling all technical and/or administrative formalities, and to comply with recommendations arising from periodic inspections.

d - Agree to be included in the **Environmental Certification System,** also known as ***Green Seal,*** currently held by **FUNDECOR** and, as **THE OWNER,** to comply with all regulations associated with that condition.

e - Provide all necessary information and facilities so that **FUNDECOR** can meet its obligations under the present Agreement.

f – Place visibly throughout the farm the signs provided by **FUNDECOR** that inform about the project and **FUNDECOR,** and that mention the advisory services provided.

FIVE: THE OWNER may transfer the benefits acquired under the present Agreement, in total or in part, to third parties after communicating this intent in writing to **FUNDECOR** in the understanding that each new owner will assume the same rights and obligations (pending reimbursements) stipulated herein.

SIX: Non-compliance with any of the clauses of the present Agreement, by any of the parties, will result in its immediate annulment. The complying party will have the right to receive payment for damages of the total amount invested in the project to that point for professional services, plus the interest corresponding to the years the Agreement has been in effect, calculated with the national banking system's current average interest rate for ecological or agricultural projects.

SEVEN: This Agreement may be terminated at the request of either of the parties, by stating this intent at least one year in advance. The party interested in breaking the Agreement must guarantee full compliance with the obligations agreed to originally.

EIGHT: The present Agreement will enter into effect for a period of **five (5) years** when it has been signed by the parties**,** and may be renewed for equal periods of time by mutual agreement.

Having read the foregoing and being in agreement with it, the parties sign in **Puerto Viejo de Sarapiquí**, on the **XX** day of the month of **XXXX** in the year two thousand XX.

_____	_____
Mr. Franz Tattenbach Capra	**Mr. XXXXXXX XXXXX XXX**
Executive Director	**Owner**
FUNDECOR	

Annex B: Topics covered by client-family training

A. FUNDECOR environmental policy

a. Compliance with national and international environmental legislation
b. Property rights
c. Coordination with local government and organizations
d. Recognition and utilization of forest and plantation goods and services
e. Assessment of forest operations impact on the environment
f. Sustainable forest management plans
g. Activity monitoring and control systems
h. Land-use changes prohibited
i. Reforestation
j. Protection of National Parks
k. Gender issues
l. Archaeological sites
m. Environmental strategy
n. Restrictions on pesticide use
o. Environmental education

B. Forest Law #7575 and its regulations

a. Definitions
b. Competencies
c. Regulations for natural forest management.
d. Forest protection
e. Regulations for the establishment of reforestation projects
f. Incentives
g. Protected areas
h. Penalties

C. Forest Audits (*Regencia Forestal*)

a. Professional Association of Agricultural Engineers of Costa Rica
b. Regulations governing forest audits
c. Contracts of Forest Auditors
d. Forest audit reports
e. Periodicity of visits
f. Penalties

D. Green Seal or forest certification

a. Background
b. What is the Green Seal?
c. Creation of the Forest Stewardship Council (FSC)
d. Financing of the FSC
e. Functions of the FSC

f. Firms accredited by the FSC
g. What are the Principles, Criteria and Indicators?
h. Examples of application
i. Costs of the Green Seal
j. Chain of custody (optional)
k. Benefits of Green Seal
l. Disadvantages of Green Seal
m. Types of Green Seal
n. Umbrella or group certification

E. FSC Principles and Criteria

a. Principle #1: Compliance with Laws and FSC Principles
b. Principle #2: Tenure and Use Rights and Responsibilities
c. Principle #3: Indigenous Peoples' Rights
d. Principle #4: Community Relations and Workers' Rights
e. Principle #5: Benefits from the Forest
f. Principle #6: Environmental Impact
g. Principle #7: Management Plan
h. Principle #8: Monitoring and Assessment
i. Principle #9: Maintenance of High Conservation Value Forests
j. Principle #10: Plantations

F. Compliance monitoring system

a. Standard compliance assessment forms
b. Corrective action procedure

G. Workers' rights

a. Worker-employer relations, pursuant to current legislation
b. Contracts
c. Working hours
d. Rights and duties (obligations)
e. Wages

H. Occupational health

a. Health-work relationship
b. Safe pesticide handling
c. Personal protection and safety standards
d. Protective equipment
e. Appropriate use of residues and waste products
f. Personal hygiene
g. Accident prevention and management

I. **Acceptable agro-chemical products**