Return to Forest: Mitigating Climate Change through the Restoration and Conservation of Endangered Forest Ecosystems

Paso del Istmo Conservation Corridor
Rivas Province, Nicaragua

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INTRODUCTION

As it becomes increasingly clear that climate change poses a very serious threat to society, immediate action to mitigate climate change has become a priority. The impacts of climate change will most adversely affect developing countries where poverty and limited infrastructure leave communities vulnerable to extreme climate events. Threatened species and ecosystems with a limited or fragmented distribution will also be disproportionately impacted by climate change. The Return to Forest Project (Hereafter referred to RTF) will mitigate climate change while restoring threatened forest ecosystems and increasing the sustainability of local communities and their resilience to climate change.

This project is part of Paso Pacífico's initiative in western Nicaragua known as the *Paso del Istmo corridor.* Restoring native forests will serve to mitigate climate change and its impacts by increasing carbon sinks, reducing the vulnerability of local communities to extreme climate events, improving ecosystem services, and increasing the viability of threatened and endangered species. The Climate, Community, and Biodiversity Standards provide a framework for designing, implementing, and evaluating the success of this project.

G1. ORIGINAL CONDITIONS AT PROJECT SITE

1. General Information

Location
The RTF project is located in Southwestern Nicaragua, Central America and encompasses two major provinces, Rivas and Granada. Project sites are also strategically placed within or near the biological corridor *Paso del Istmo*, an area identified by Paso Pacífico for creating connectivity across a protected and sustainably managed landscape. This corridor stretches from Nicaragua's southwestern border of Lake Nicaragua to the Pacific coast, and then north along the narrow isthmus of land between Lake Nicaragua and the Pacific Coast.

Figure 1. Location of the Paso del Istmo Corridor in Central America.

The *Paso del Istmo* Corridor has areas of influence in five main municipalities within the Rivas and Nandaime Provinces: Cárdenas, San Juan del Sur, Rivas, Tola, and Nandaime. However, reforestation activities are focused within the Cárdenas, San Juan del Sur, and Nandaime municipalities.

Table 1. Project Site Number, farm names, reforestation areas, and locations of sites in the RTF project. The total area planted is 406 Hectares. Site Numbers will be used as a reference to these farms throughout this document. Site #8 will be mapped and planted during May-June of 2008.

Project Site Number	Farm Name	Area (Ha)	Province	Municipality	Nearest Community	Latitude	Longitude
1.	1. Domitila	105.18	Granada	Nandaime	Domitila, Dolores de Lago	85º 55' 32"	11º 43' 29"
2.	2. El Guacapolca – Dr. Arce	22.313	Rivas	Cardenas	Sapoa	85º 36' 52"	11º 14' 38"
2.	2. Cuyupani – Dr. Arce	51.46	Rivas	Cardenas	Sapoa	85º 35' 56"	11º 14' 36"
2.	2. La Casita – Dr. Arce	18.013	Rivas	Cardenas	Sapoa	85º 36' 00"	11º 14' 44"
2.	2. El Emporio – Dr. Arce	73.442	Rivas	Cardenas	Sapoa	85º 37' 03"	11º 14' 12"
3.	3. La Tigra	4.485	Rivas	Cardenas	Ostayo	85º 39' 10"	11º 15' 45"
4.	4. Guacamaya	10.818	Rivas	Cardenas	Cuajiniquil, Mercedes, Calula	85º 34' 04"	11º 14' 09"
5.	5. Isla Vista	21.26	Rivas	Cardenas	Cuajiniquil, Mercedes, Calula	85º 33' 07"	11º 13' 00"
6.	6. Las Fincas	34.547	Rivas	San Juan del Sur	Escamequita	85º 48' 24"	11º 12' 41"
7.	7. Chumbulum	14.024	Rivas	Rivas	Chocolata	85º 50' 32"	11º 23' 09"
8.	8. Santa Marta (or other similar site)	50	Rivas	Rivas	Sapoa	85º 39' 10"	11º 16' 45"

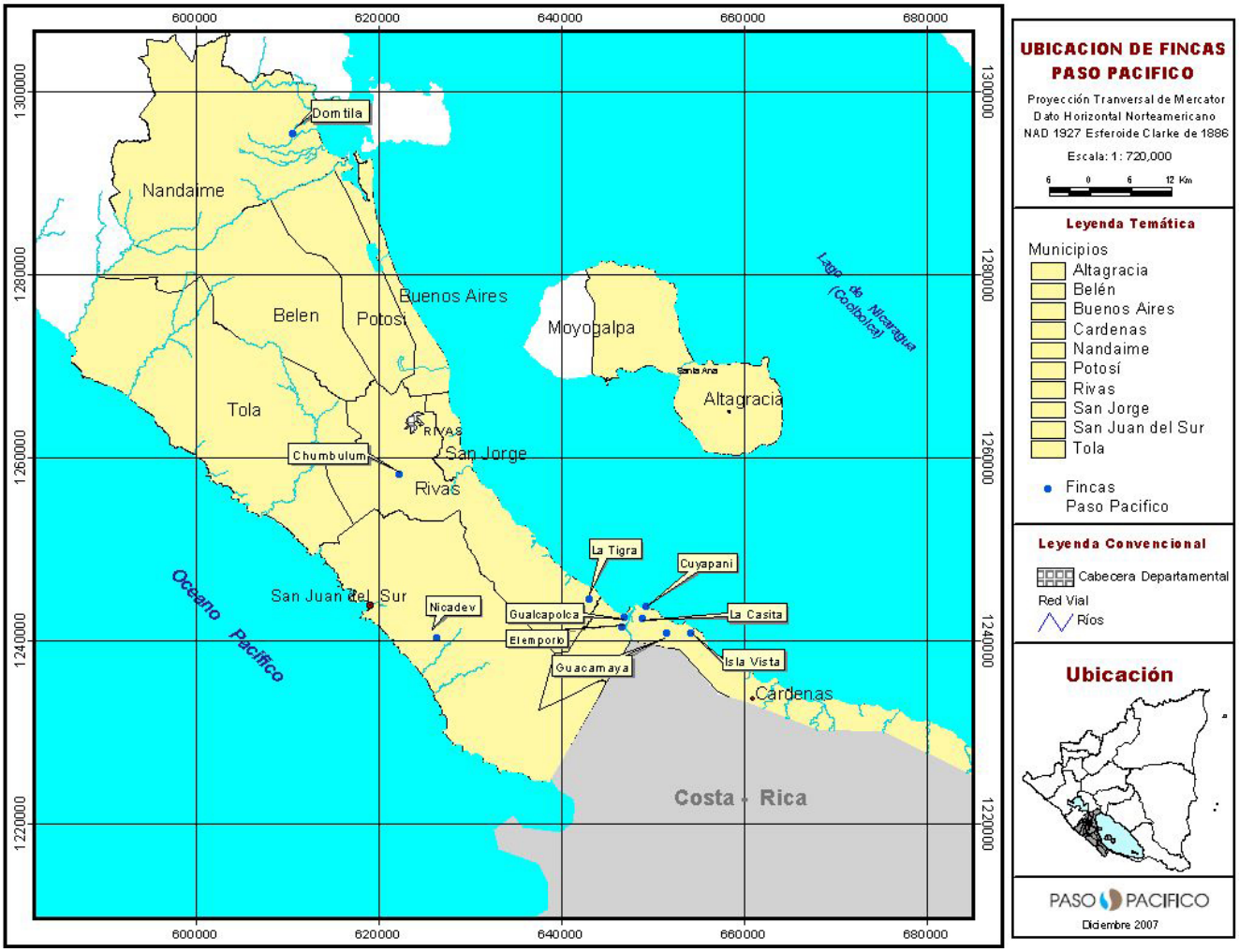

Figure 2. Location of reforestation sites across the Paso del Istmo.

Topography

Elevation ranges across sites, however all sites are located at an elevation of less than 200 a.m.s.l. in the lowland elevation zone. The coastal mountains that extend Northwest and Southeast along the corridor greatly influence the precipitation across the corridor. These mountains rise to 600 m elevation and divide moist lowland forest on the east from seasonally tropical dry forest vegetation along the Pacific coast and north-western shores of Lake Nicaragua.

Figure 3. Topographic features of the Paso del Istmo area.

Climate Regimes

Climate regimes across project sites are typical for lowland tropical moist and tropical dry life zones. The rainy season is seven to eight months long and is followed by a marked dry season. At the south-eastern extreme, the Cardenas municipality is greatly influenced by humidity from Lake Cocibolca (Lake Nicaragua). Cardenas is located at an elevation of 35 a.m.s.l., and has a mean annual precipitation of 1995 mm/year and a mean annual temperature of 26.7 °C[1].

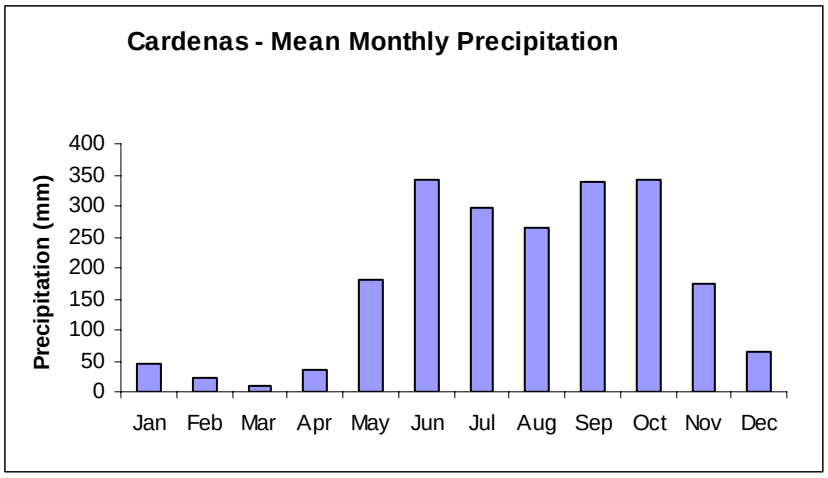

Figure 4. Mean Annual Precipitation Cardenas, Nicaragua. Total Annual Mean Precipitation is 1995 mm.

As one moves 20 km north along the corridor, the climate transitions to become more seasonal. Precipitation is 1455 mm/year at Rivas and mean annual temperature is 26.7 °C. This is also a lowland area and elevation is 70 m amsl. This climate regime continues west across the isthmus and north to Nandaime where precipitation is 1444/year.

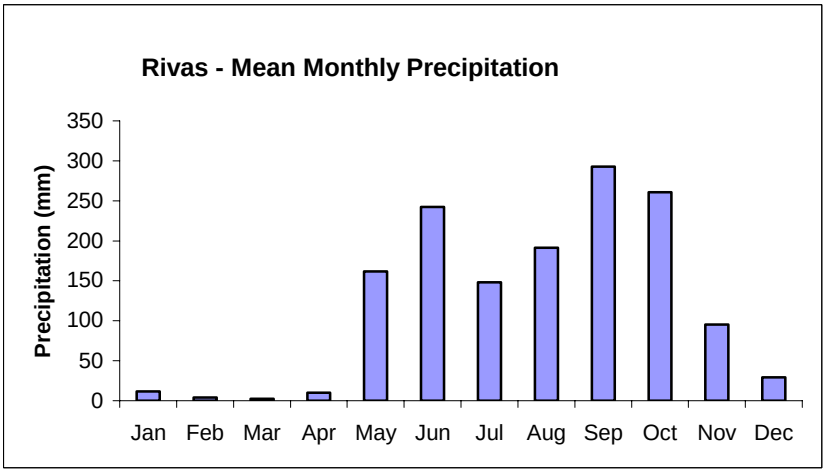

Figure 5. Mean Monthly Precipitation Rivas, Nicaragua. Total Annual Mean Precipitation is 1450 mm.

[1] INETER 2000. Annual precipitation data from 1970 – 2000. Instituto Nicaraguense de Estudios Territoriales. Managua, Nicaragua.

Hydrology
Project Sites #1-5, and 8 are located at the Lake Cocibolca/Río San Juan Watershed, which empties in the Caribbean Sea. These rivers include Ochomogo, Las Lajas, Cárdenas, and La Sapoa. They run only several kilometers in length across the narrow isthmus before emptying into Lake Nicaragua. For project sites #6-7, the rivers are short Pacific slope Rivers that run from the top of the coast range (600 m a.m.s.l.). The rivers at this site include Río Brito and La Escamequita River.

Soils
As is typical across the tropics, the soils are very diverse across project sites. Site #1 has soils that are very diverse and not easily characterized and are defined as Entisols. Soils at sites #2, #3, #6, and #7 are dominated by rich Alfisols, which are a combination of clay and nutrient rich subsoil. Sites #5 and #6 along the southern edge of Lake Cocibolca are characterized by their sandy texture and have been defined as Molisols.

Ecosystems
The eastern side of the Paso del Istmo corridor are dominated by tropical moist forest ecosystems, though wetlands grace the shores of Lake Cocibolca. Along the Pacific Coast, tropical dry forests are the dominant forest ecosystems, and mangrove vegetation is found in the coastal wetlands. Project Sites #1-5, and #8 are all found in tropical moist or tropical moist transitioning to tropical dry forest life zones. Sites #1, 4, 5, and 6 all have forest remnants within the property boundaries, some of which were protected from grazing and others that were extensively grazed by cattle. Other important ecosystems are those found in the wetland areas of Lake Nicaragua (fresh-water wetlands) and the Pacific Coast (mangroves).

Vegetation Conditions
The vegetation across the corridor area is dominated by pasture areas. Additionally, what little forest there is dominated by open secondary forest. Therefore, from the perspective of conservation, there is a great need for restoration of many of the land areas that are currently abandoned pasture or are have the potential to transition from pasture to other land uses.

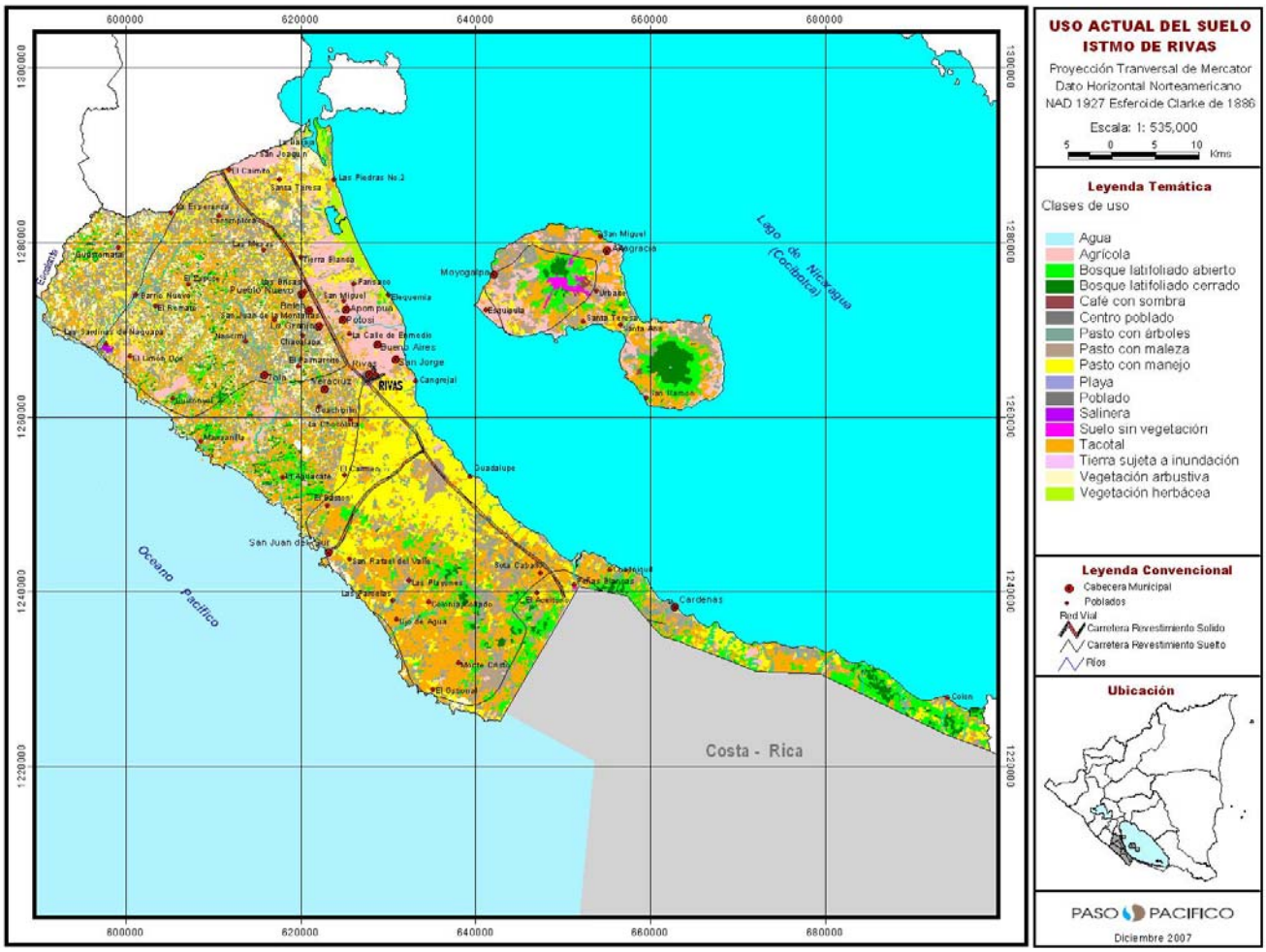

Figure 6. Land Use map 2006, Rivas Isthmus.

In August and September of 2007, vegetation was sampled across RTF sites and also at two other farms representative of vegetative conditions in the corridor. These additional farms, La Flor and Santa Isabel, represent dry forest and moist forest zones respectively. This study is explained in greater detail in supporting document "*Biodiversidad en Fincas Reforestación*" where a species list for flora is also provided.

Table 2. Vegetation communities across RTF Farm Sites.

Types of Vegetation Communities at RTF Project Sites		Farms									
		***La Flor**	**Las Fincas**	**Guaca-maya**	**Tigra**	**Isla Vista**	**Guaca-polka**	**Clinica**	**Emporio**	**Santa Isabel**	**Domitila**
Forests and Natural Areas	Mature Forest		x			x					
	Closed Canopy Forest	x	x			x					x
	Open Canopy Forest	x	x	x		x			x	x	x
	Gallery Forest	x	x						x	x	x
	Shrubland	x	x	x					x		x
	Weedy	x	x	x				x			
	Flood Zones							x			x
Pasture	Managed Pasture	x	x	x		x	x				
	Weedy Pasture	x	x	x	x	x		x	x	x	x
	Pasture with Trees							x		x	x
Agriculture	Annual crops		x	x						x	
	Abandoned Fields	x	x		x	x	x			x	x
Other	Coastal Veg							x			x
Diversity of Vegetation Types		8	10	6	2	6	2	5	4	6	8

Figure 7. Vegetation conditions typical at sites that are a mix of grasses and shrubby vegetation. Photos from Project Site #7 Las Fincas in reforestation area.

Figure 8. Pasture conditions at reforestation Site #4 Isla Vista. Typical of pasture dominated reforestation sites.

2. Climate Information

In order to gather accurate information on carbon stocks, first each reforestation site was mapped and land use at each farm was classified according to information from orthophotomaps (2004) and ground-truthing exercises.

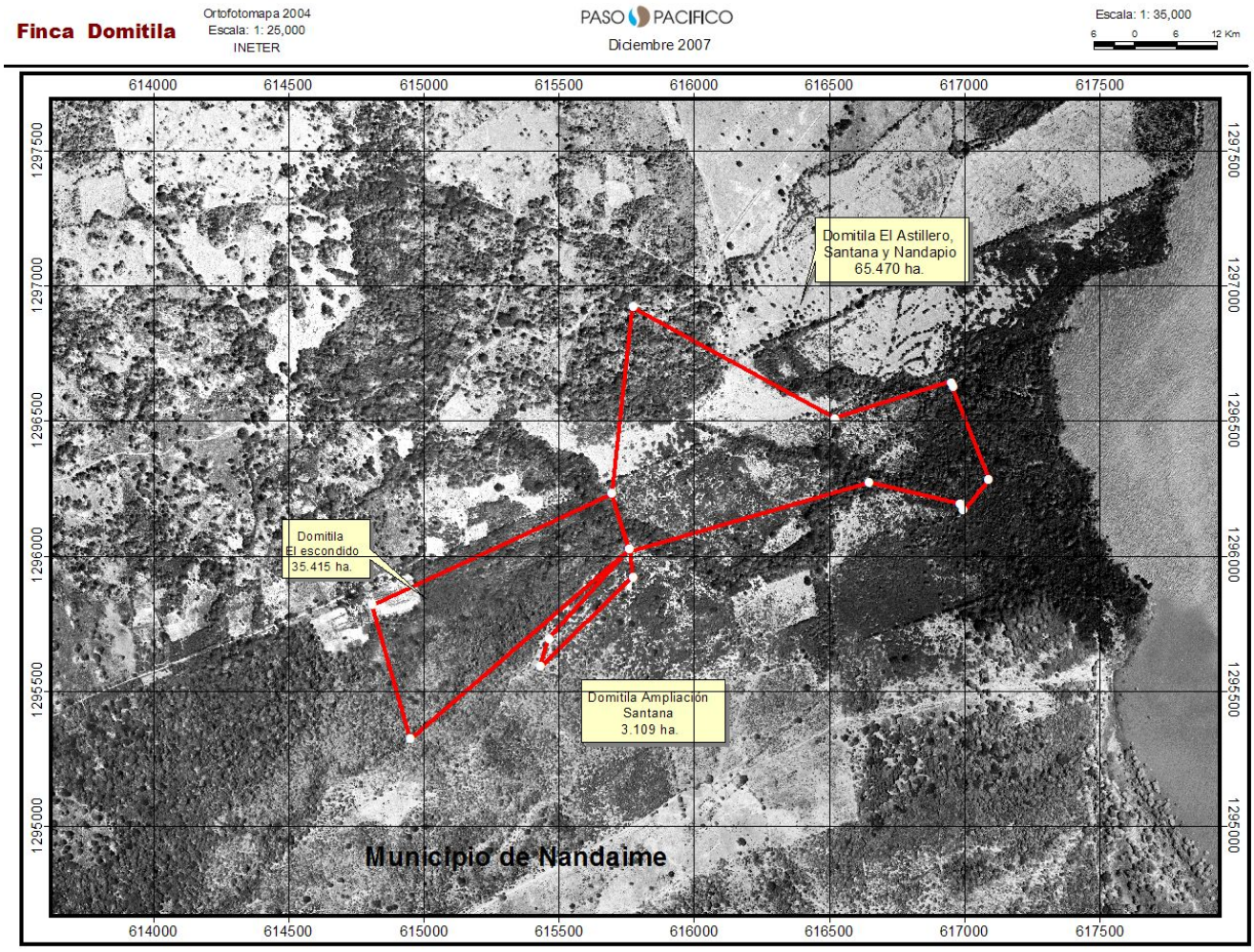

Figure 9. Project Site #1 – Domitila Farm, main reforestation area.

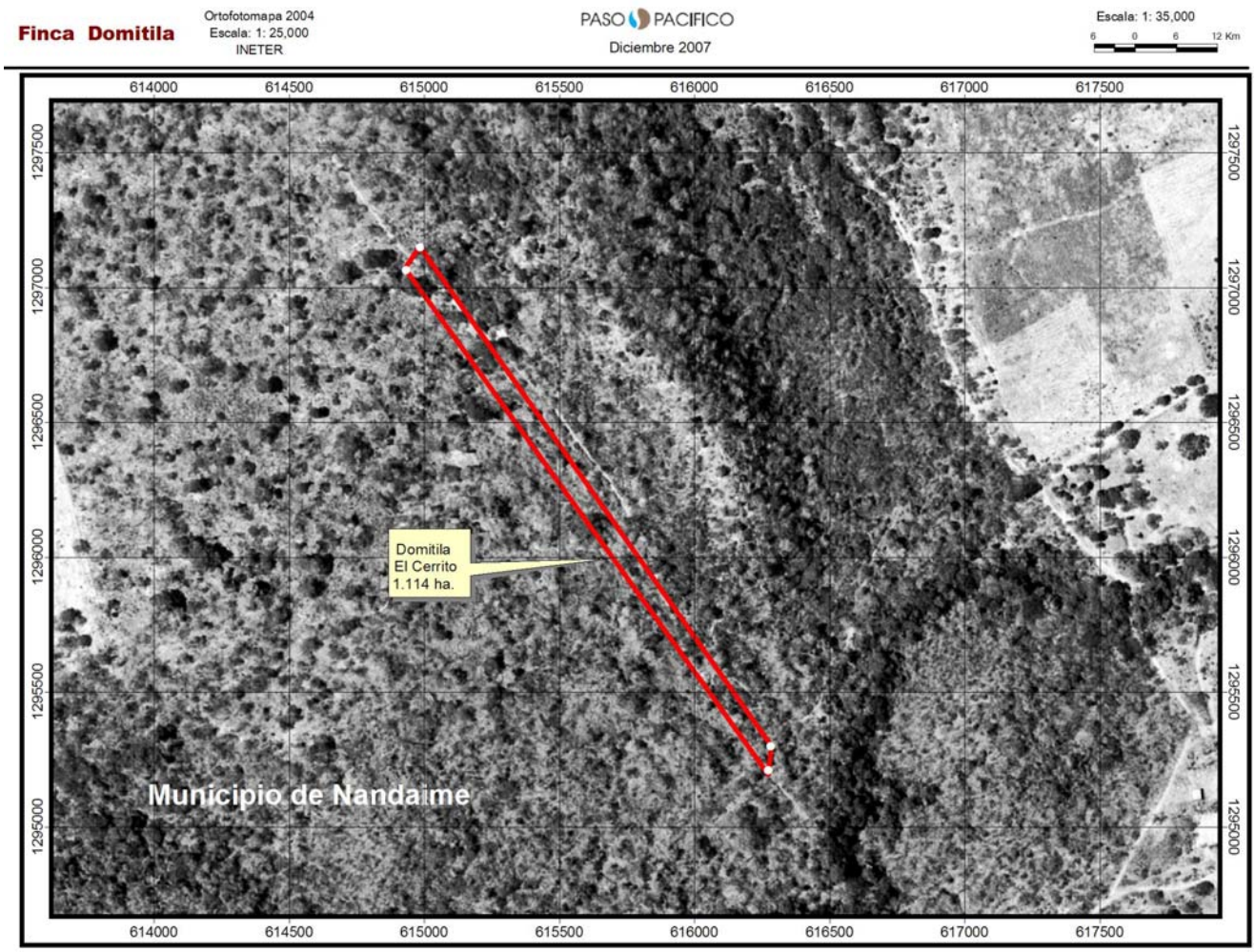

Figure 10. Project Site #1 Domitila, additional reforestation area.

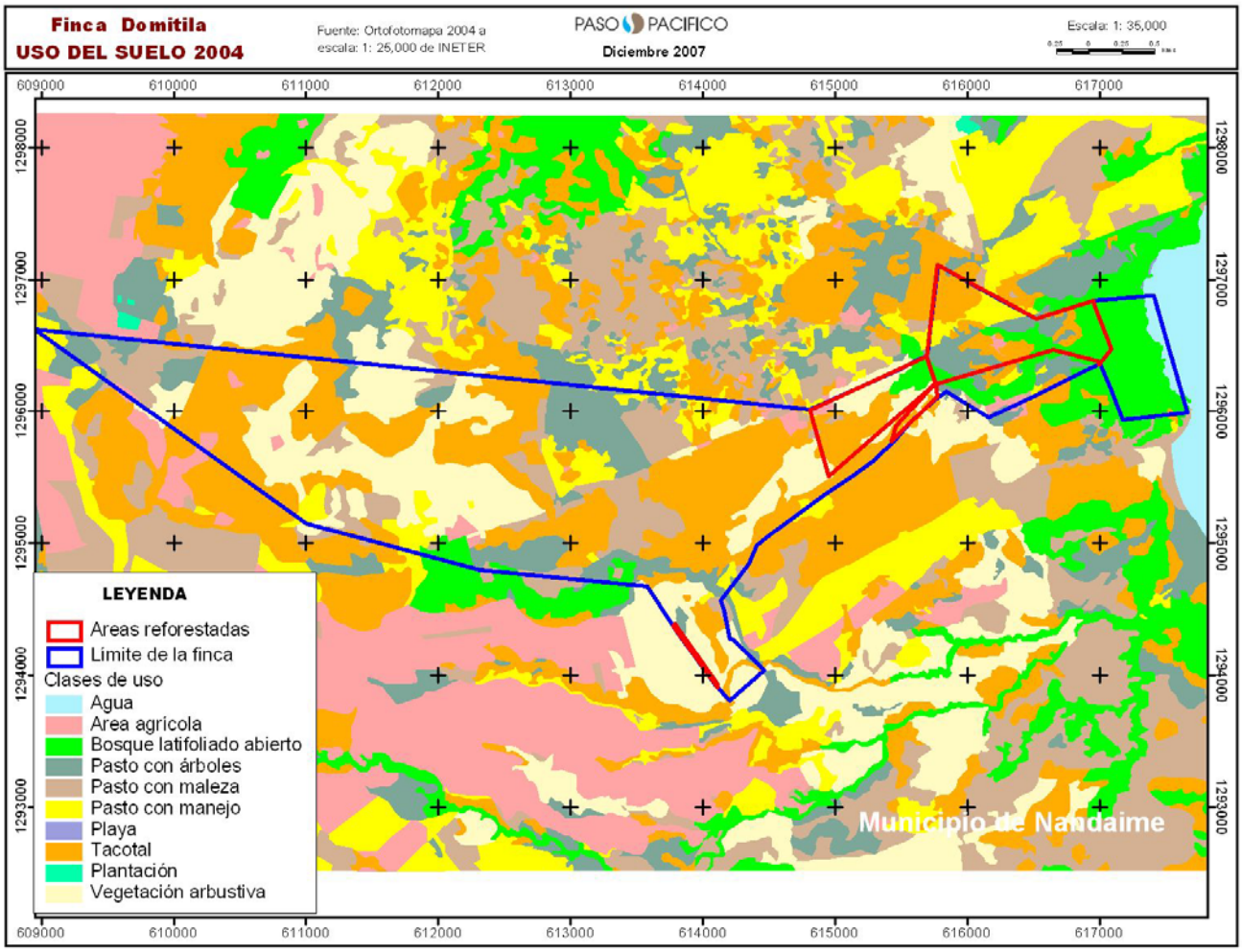

Figure 11. Project Site #1. Domitila current land use.

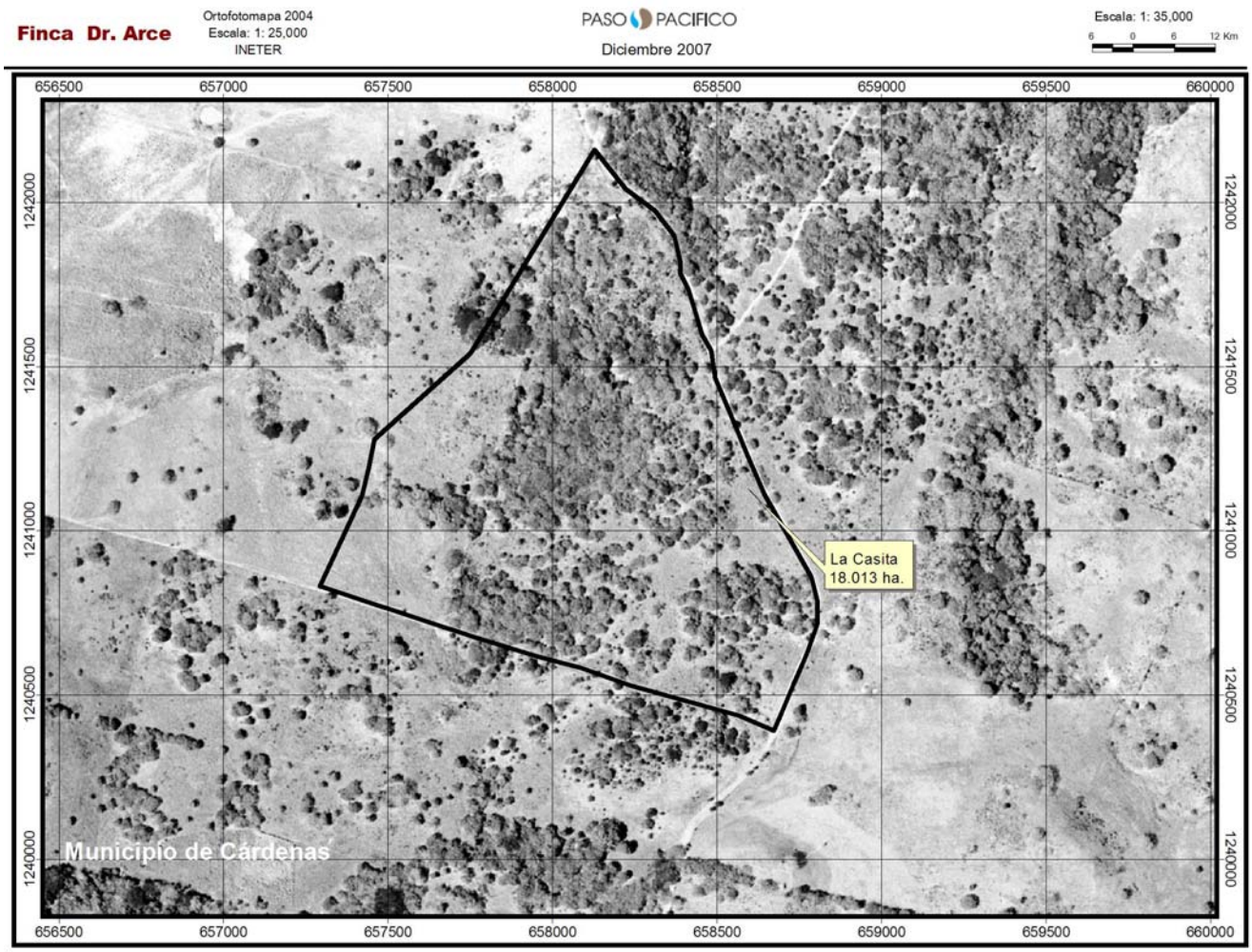

Figure 12. Project Site #2 – Dr. Arce Farm – La Clinica reforestation area.

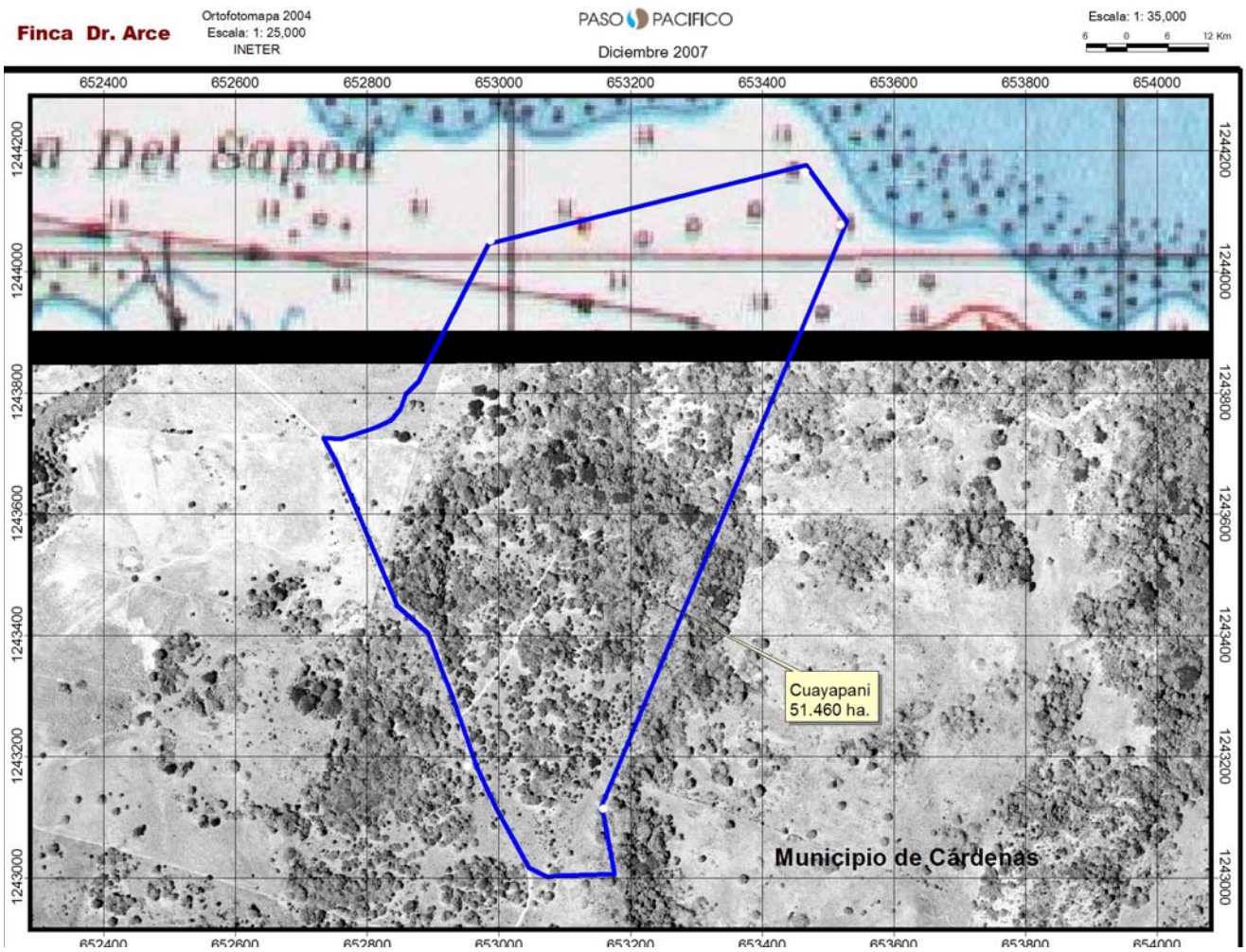

Figure 13. Project Site #2 – Dr. Arce – Cuayapaní reforestation area.

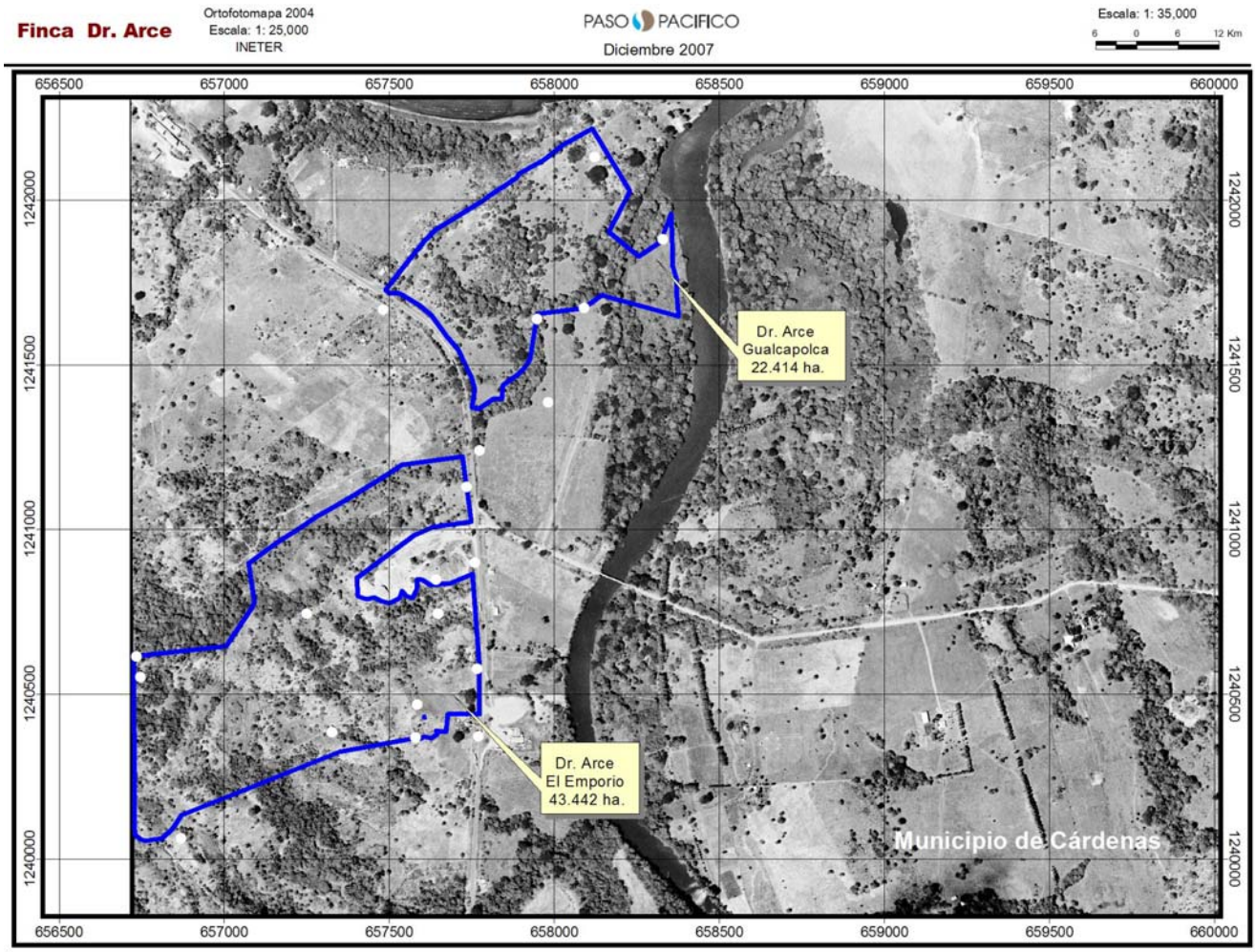

Figure 14. Project Site #2 – Dr. Arce - Guacapolca and El Emporio reforestation areas. An additional area of 30 hectares that has not yet been mapped will be mapped and planted with trees in May 2008 on the El Emporio farm.

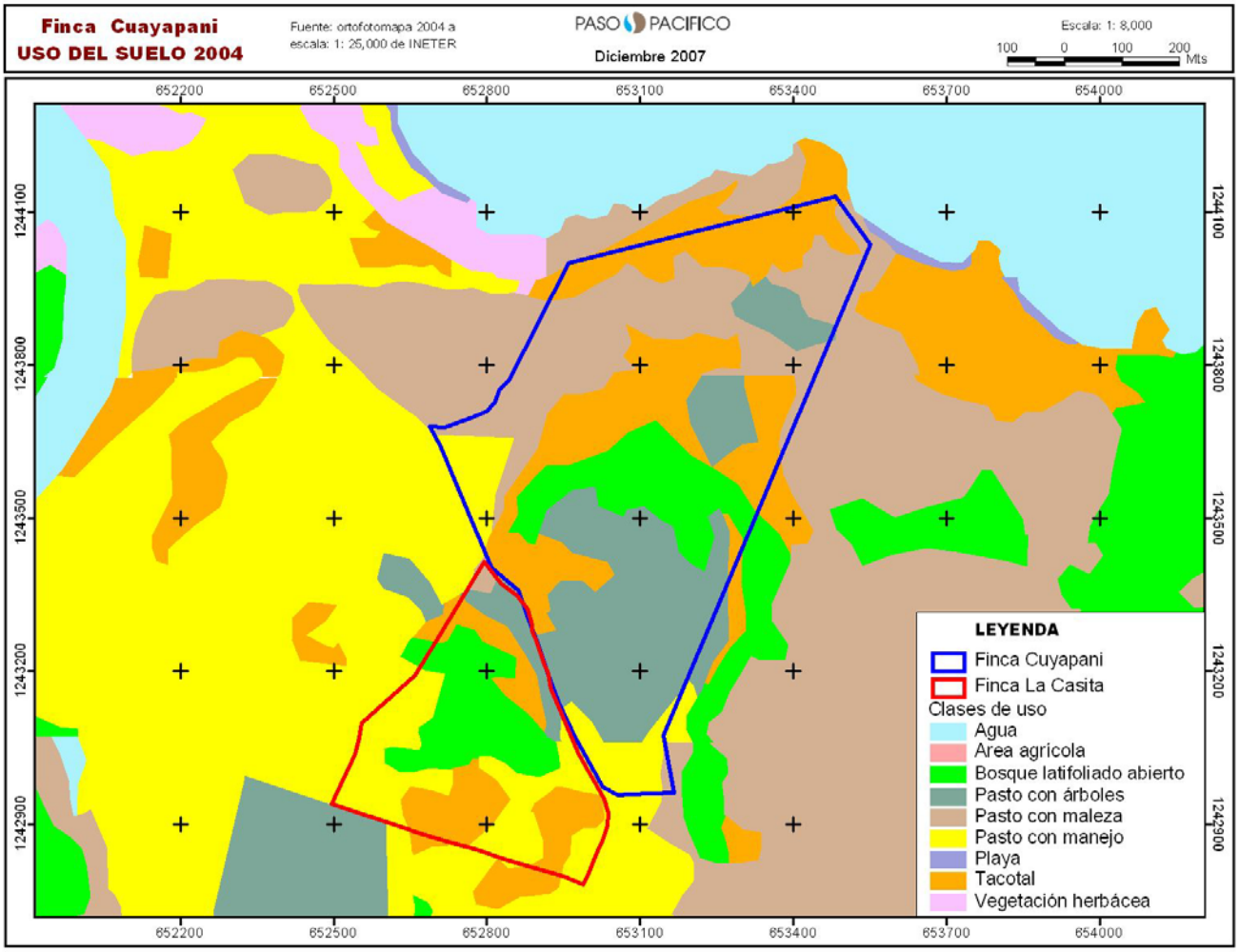

Figure 15. Project Site #2 – Dr. Arce – Cuayapani and La Casita Farms, current land use.

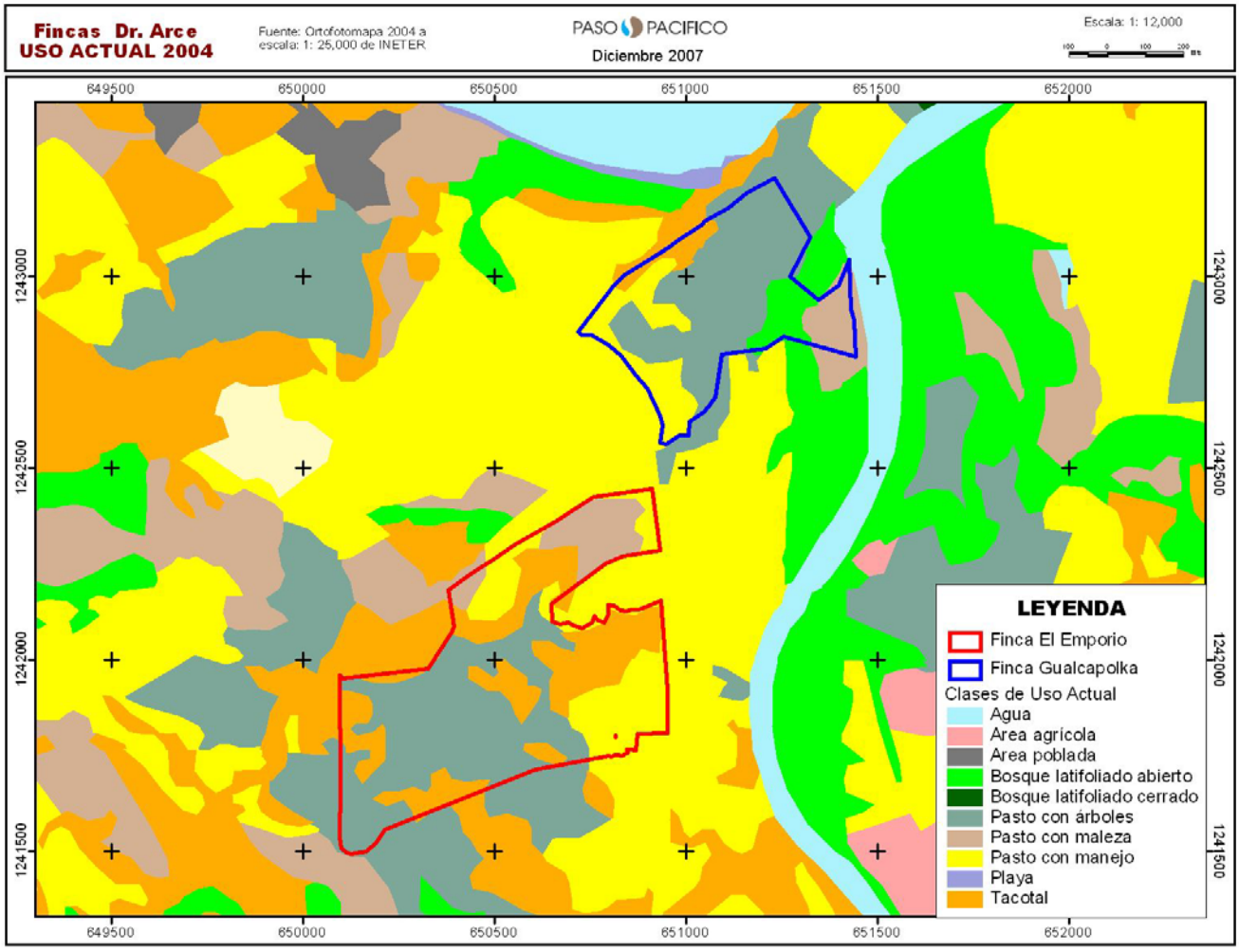

Figure 16. Project Site #2 – Dr. Arce-Guacapolca and El Emporio, current land use.

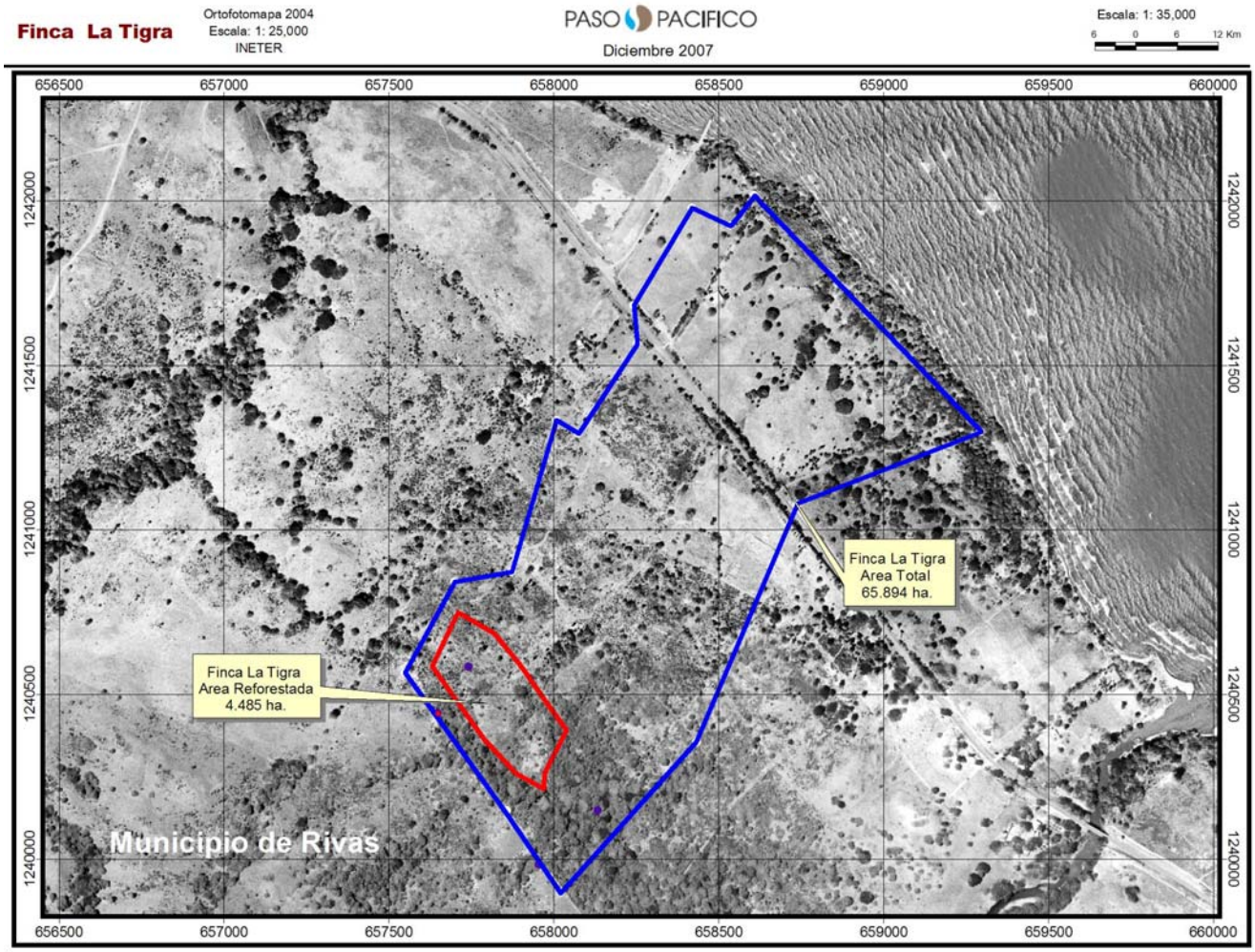

Figure 17. Project Site #3 La Tigra farm reforestation area.

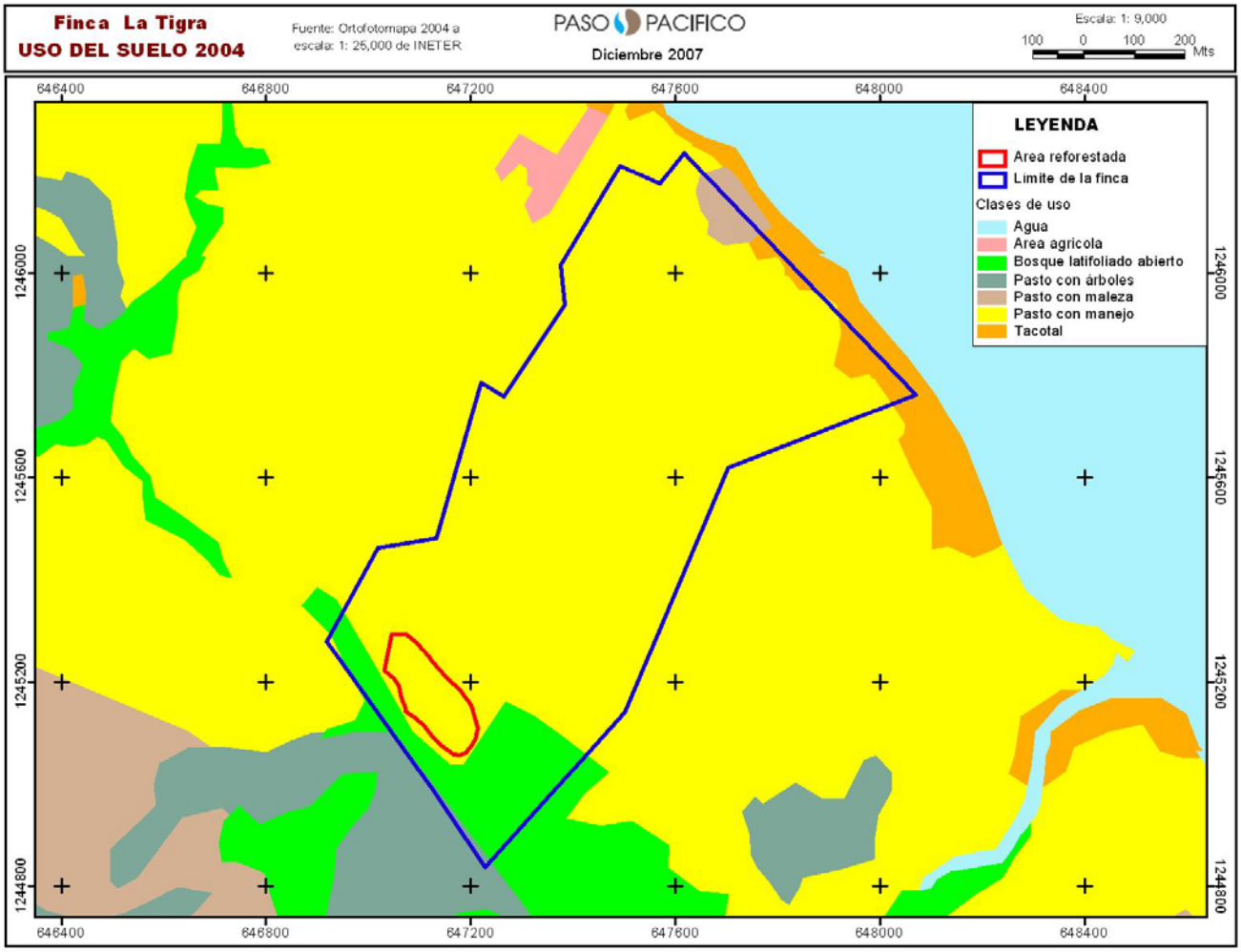

Figure 18. Project Site #3 – La Tigra, current land use.

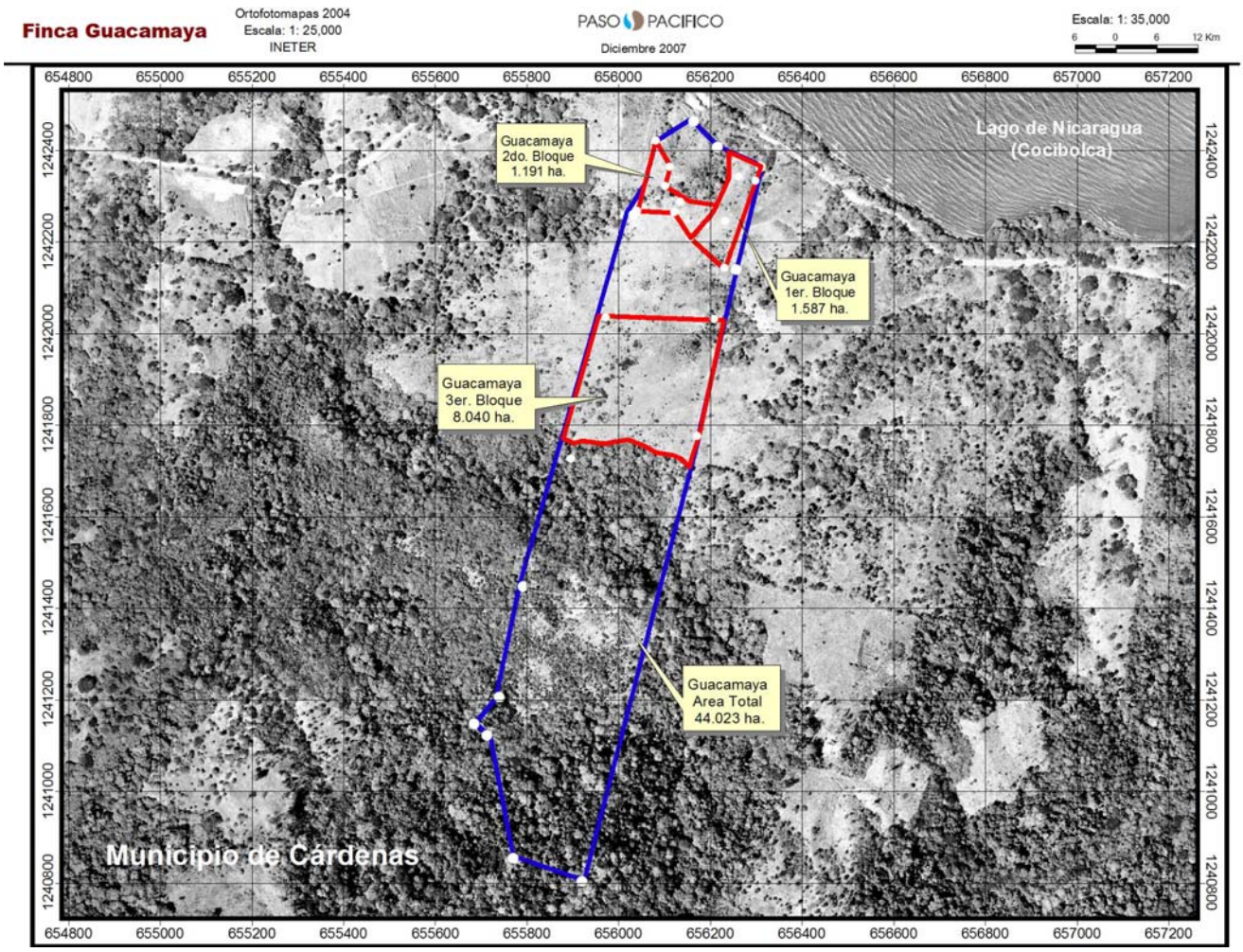

Figure 19. Project Site #4 – La Guacamaya reforestation area.

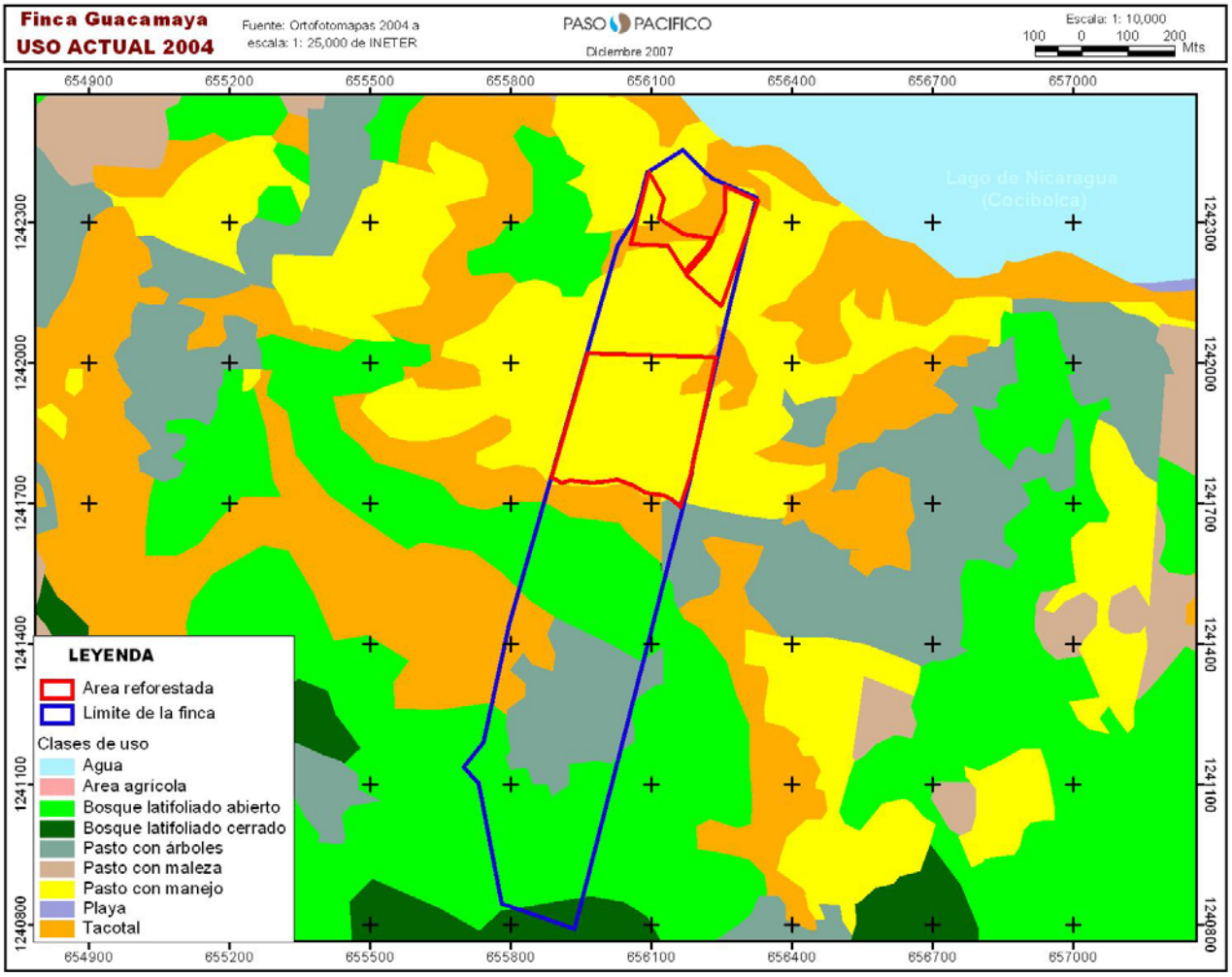

Figure 20. Project Site #4 – La Guacamaya current land use.

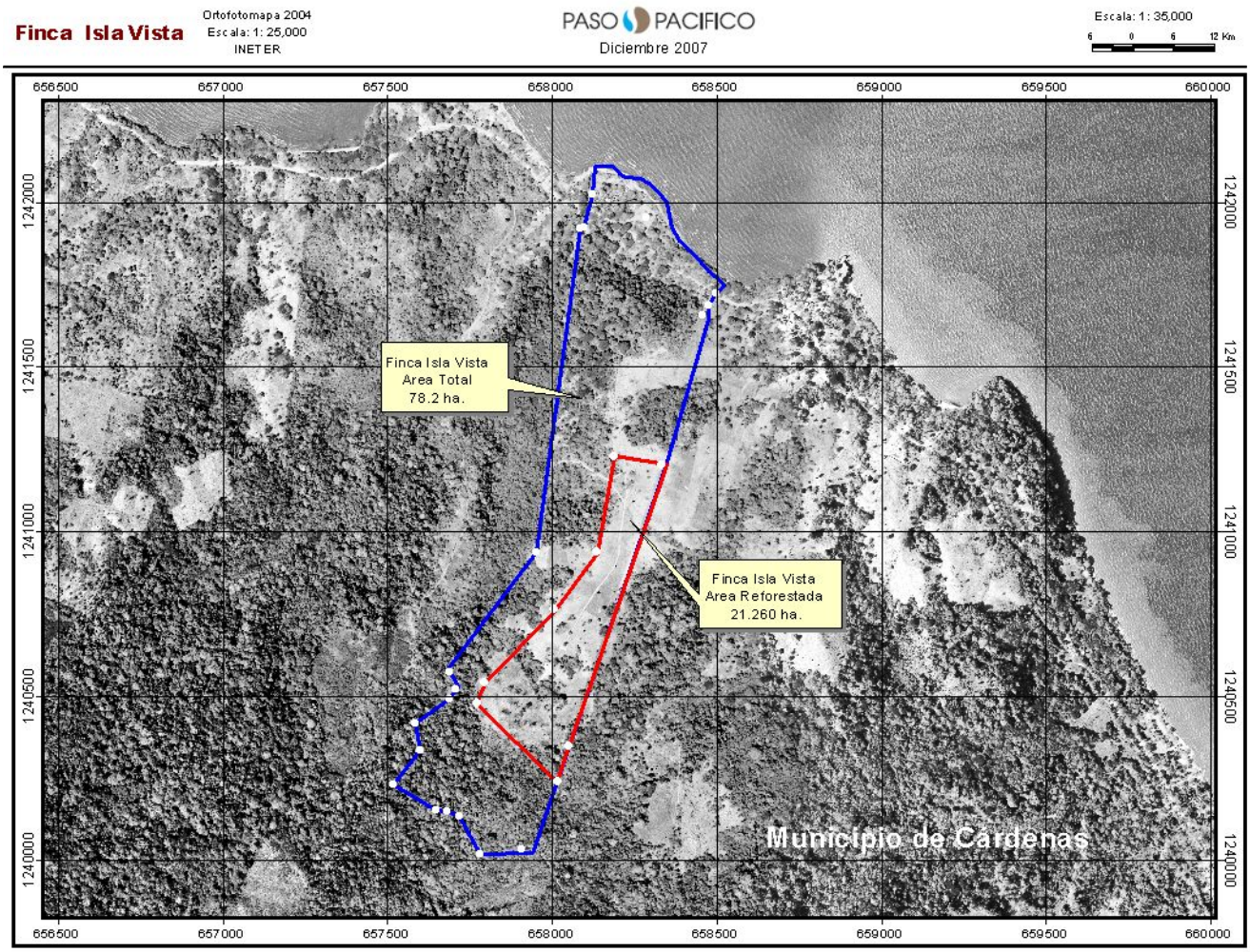

Figure 21. Project Site #5 – Isla Vista reforestation area.

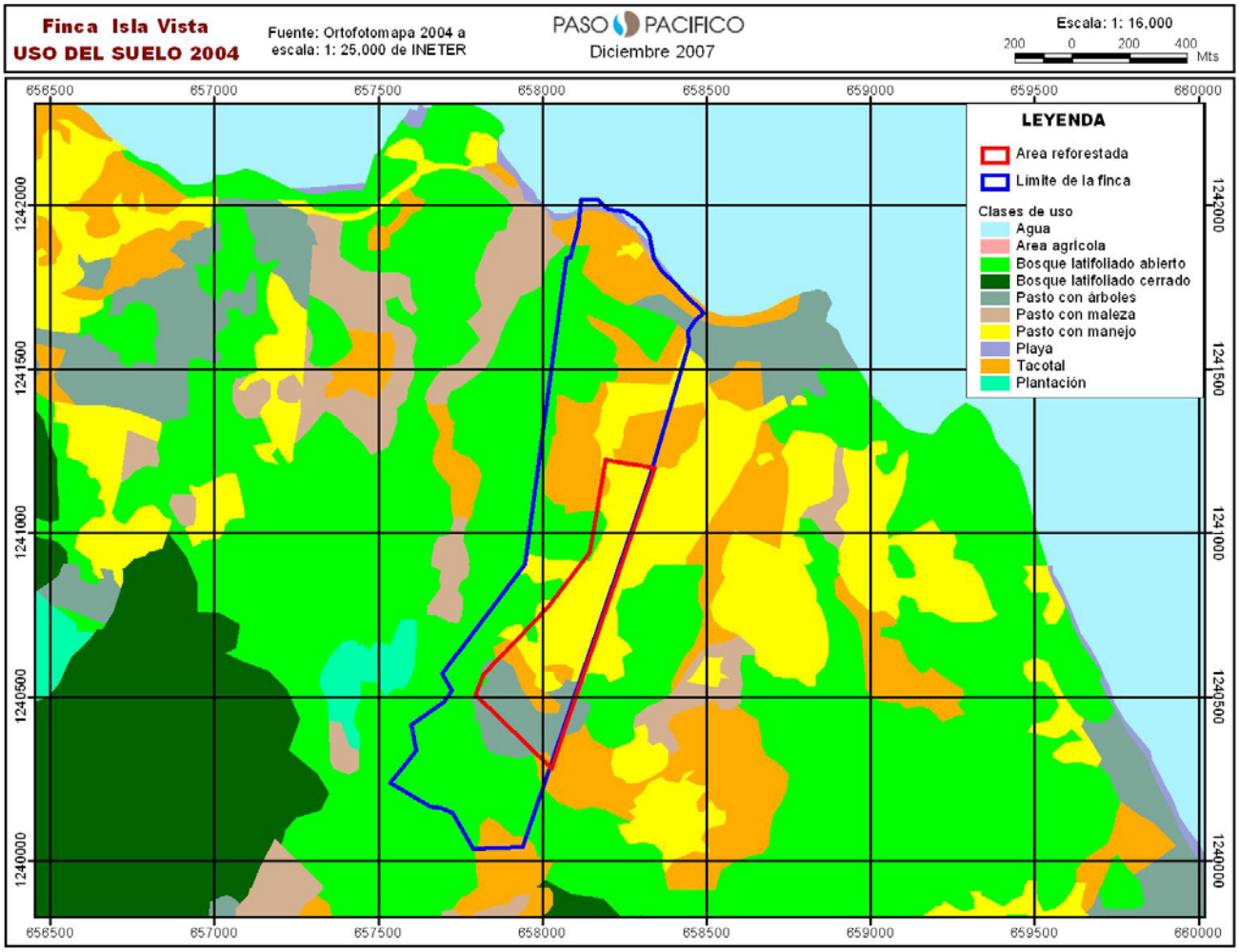

Figure 22. Project Site #5 – Isla Vista current land use.

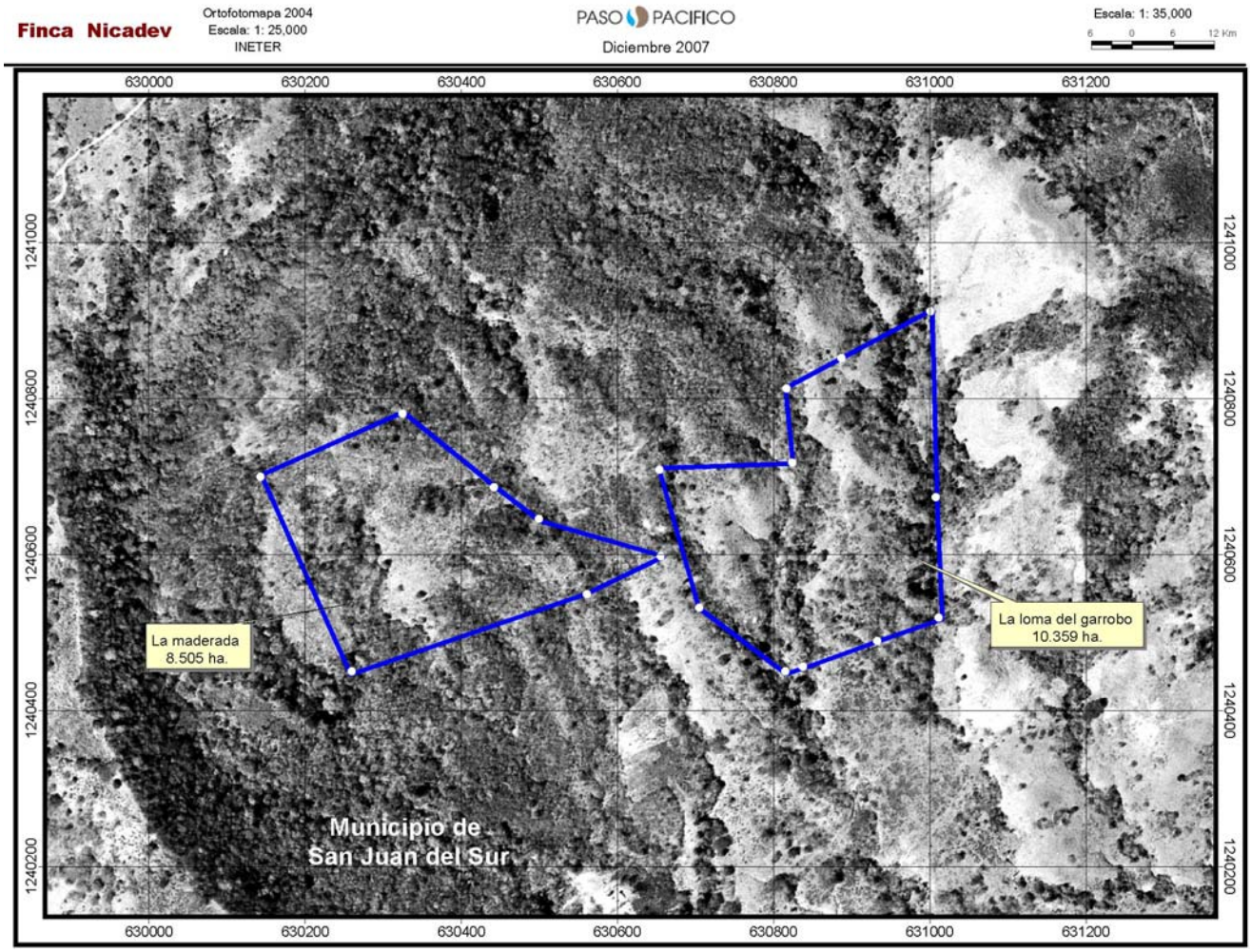

Figure 23. Project Site #6 - Las Fincas/Nica Dev reforestation areas: La Maderada and Loma de Garrobo.

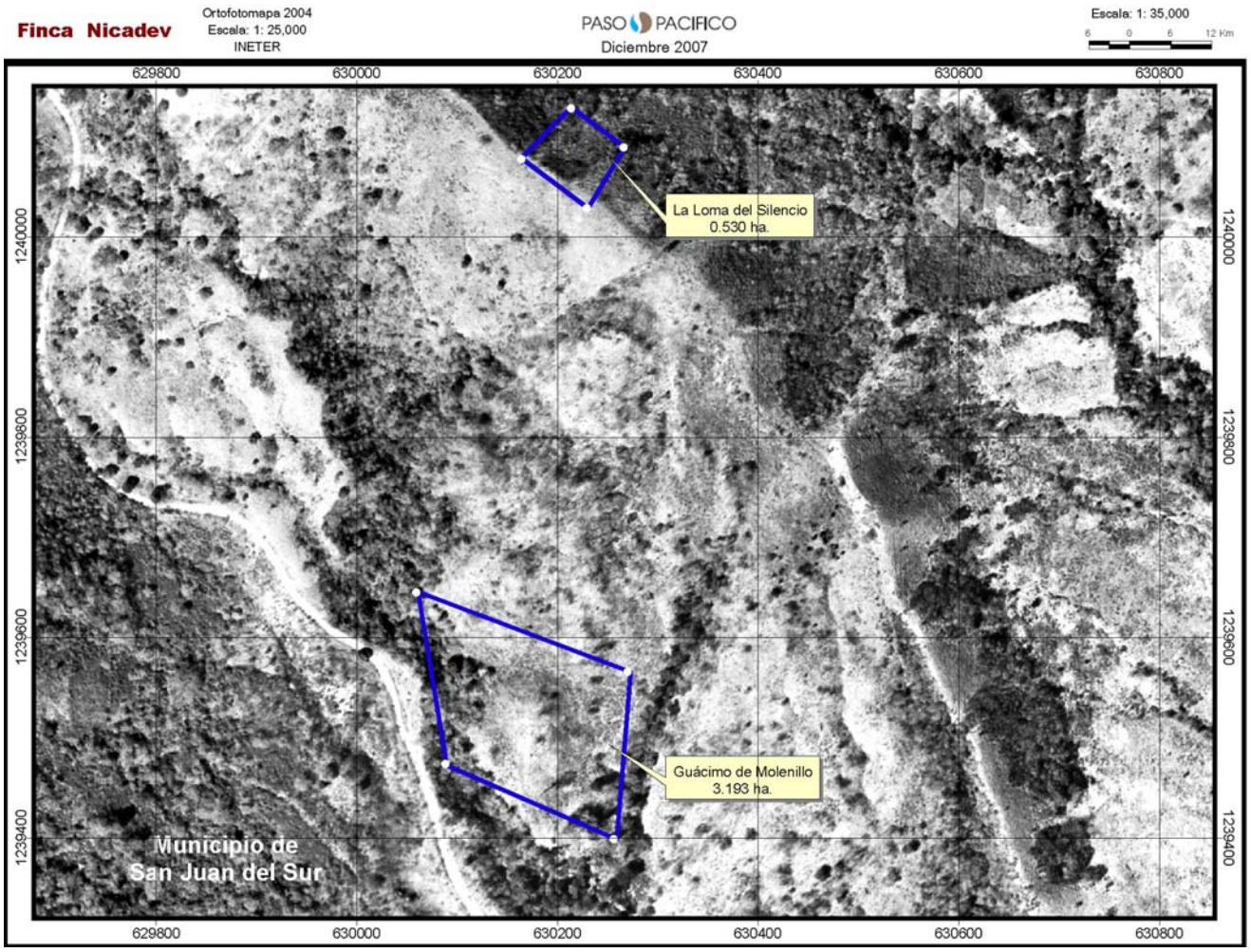

Figure 24. Project Site #6 - Las Fincas/Nica Dev reforestation areas: Guacimo de Molenillo, La Loma de Silencio

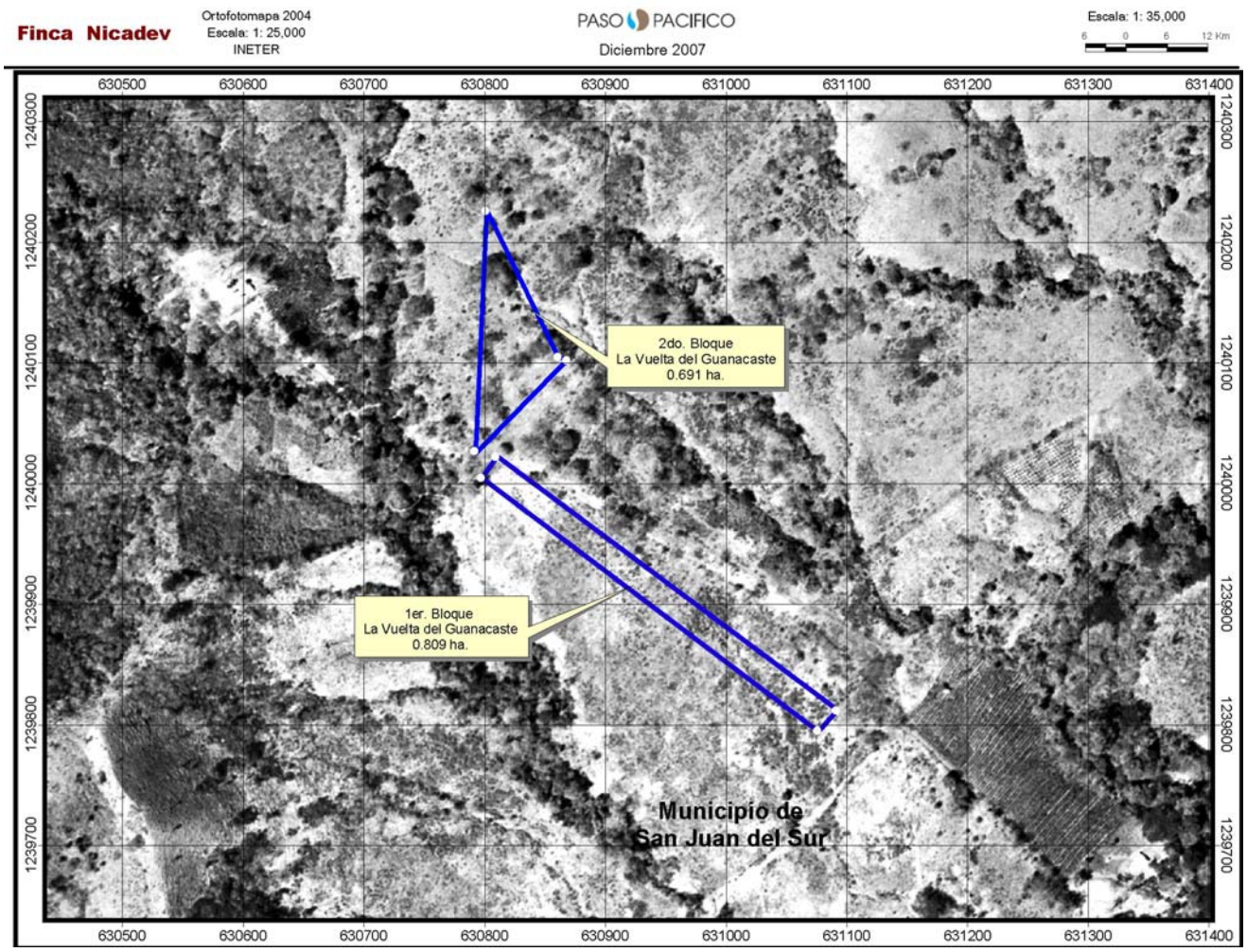

Figure 25. Project Site #6 - Las Fincas/Nica Dev reforestation area la Vuelta del Guanacaste

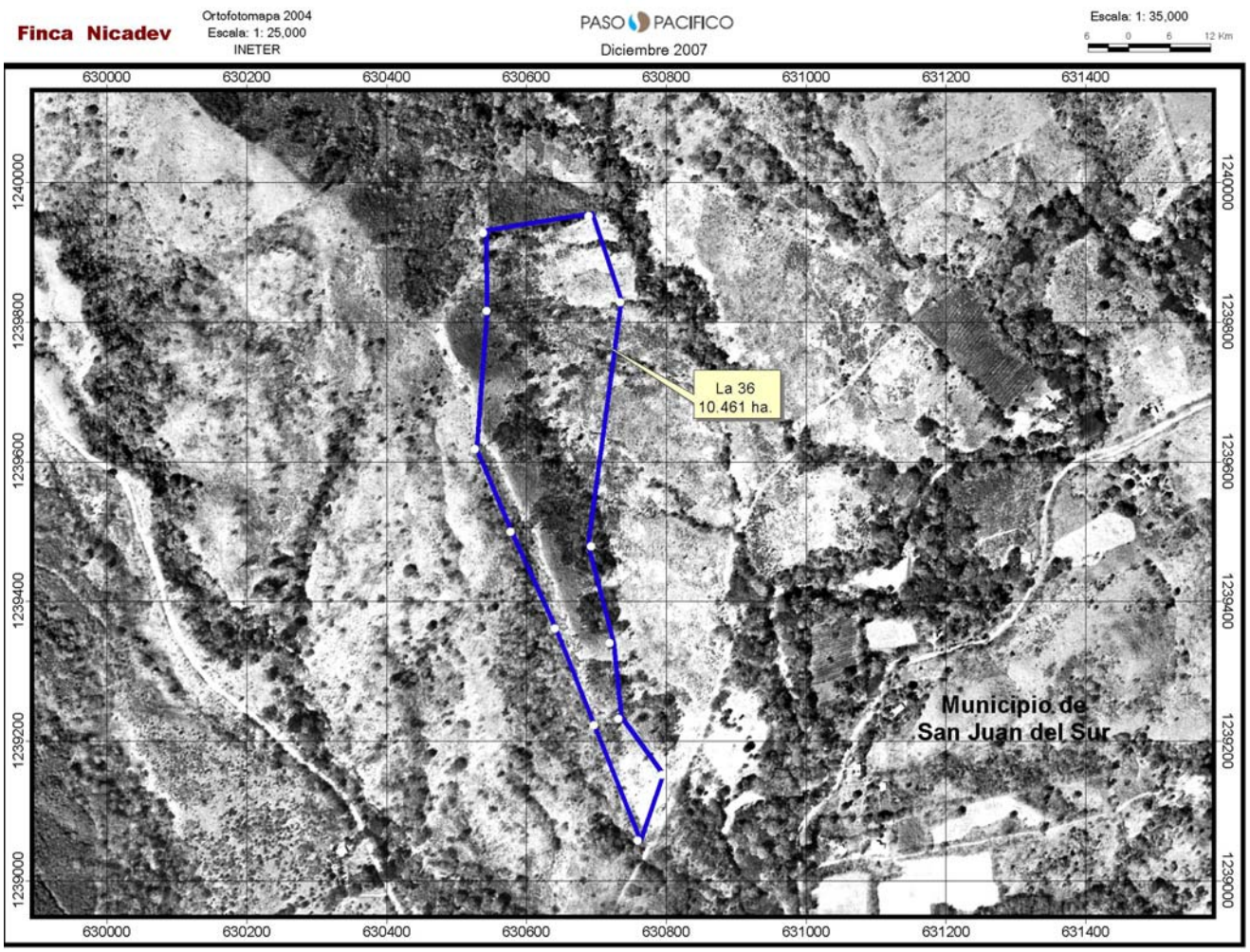

Figure 26. Project Site #6 - Las Fincas/Nica Dev reforestation area 'La 36'.

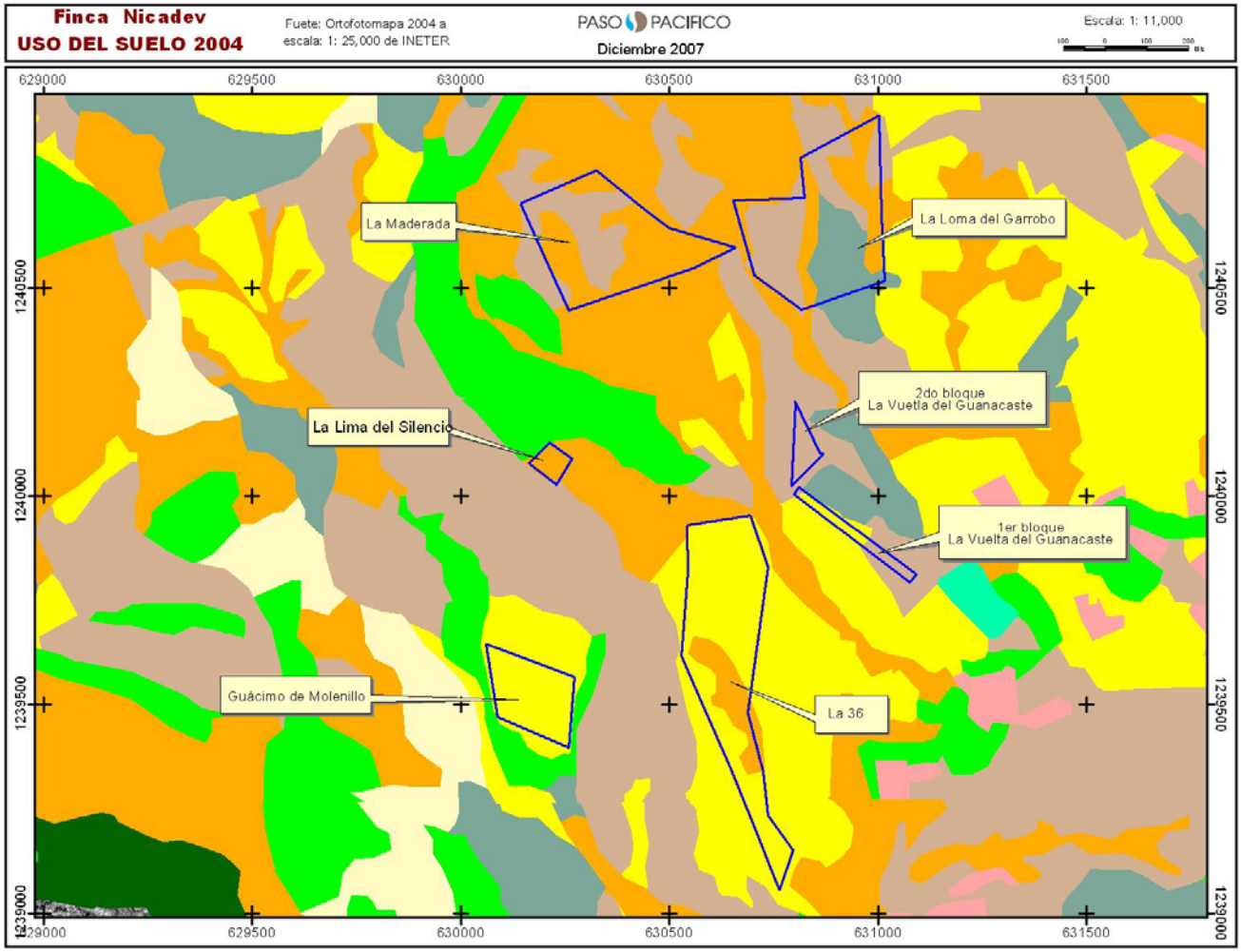

Figure 27. Project Site #6 - Las Fincas/Nica Dev current land use.

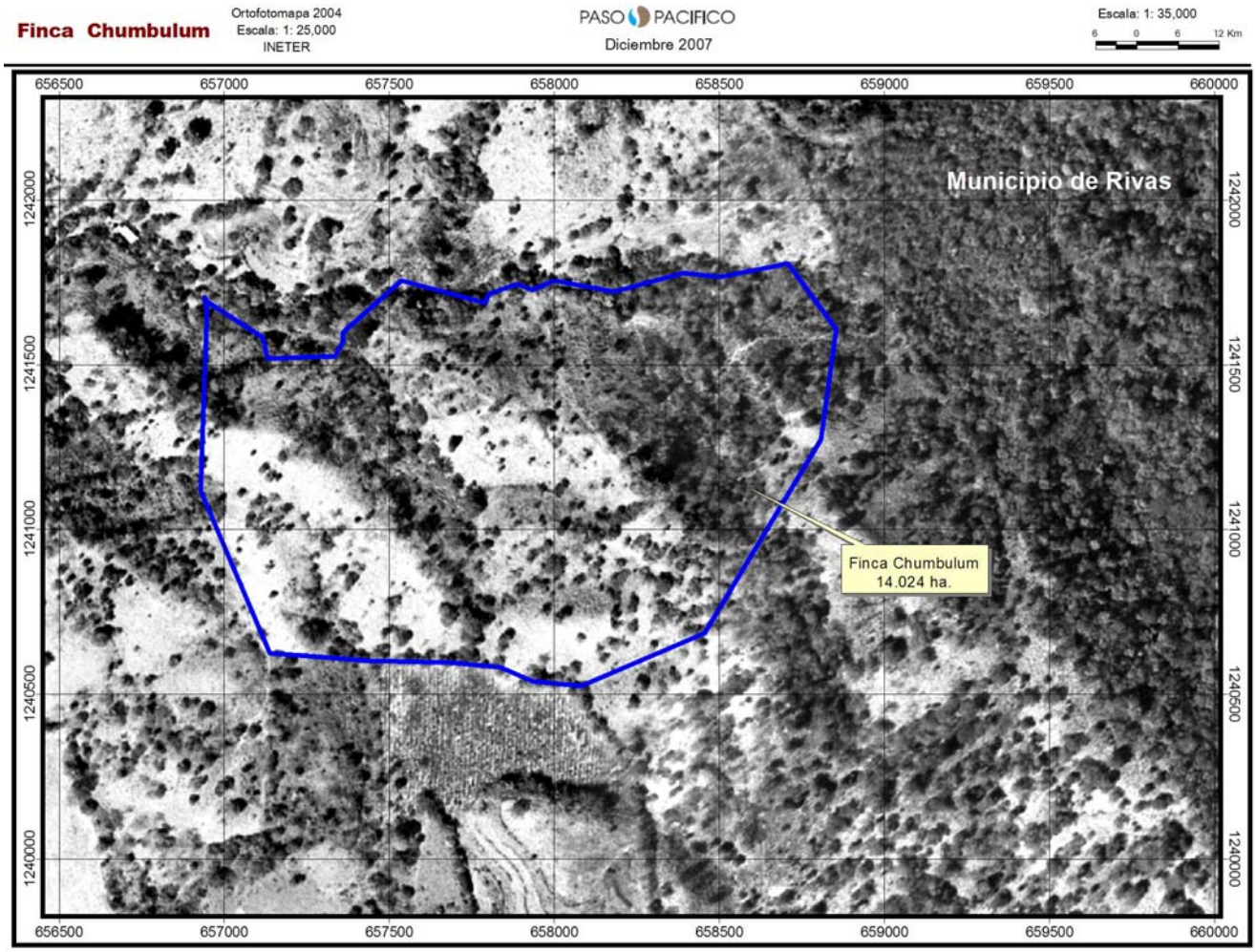

Figure 28. Project Site #7 Chumbulum reforestation area.

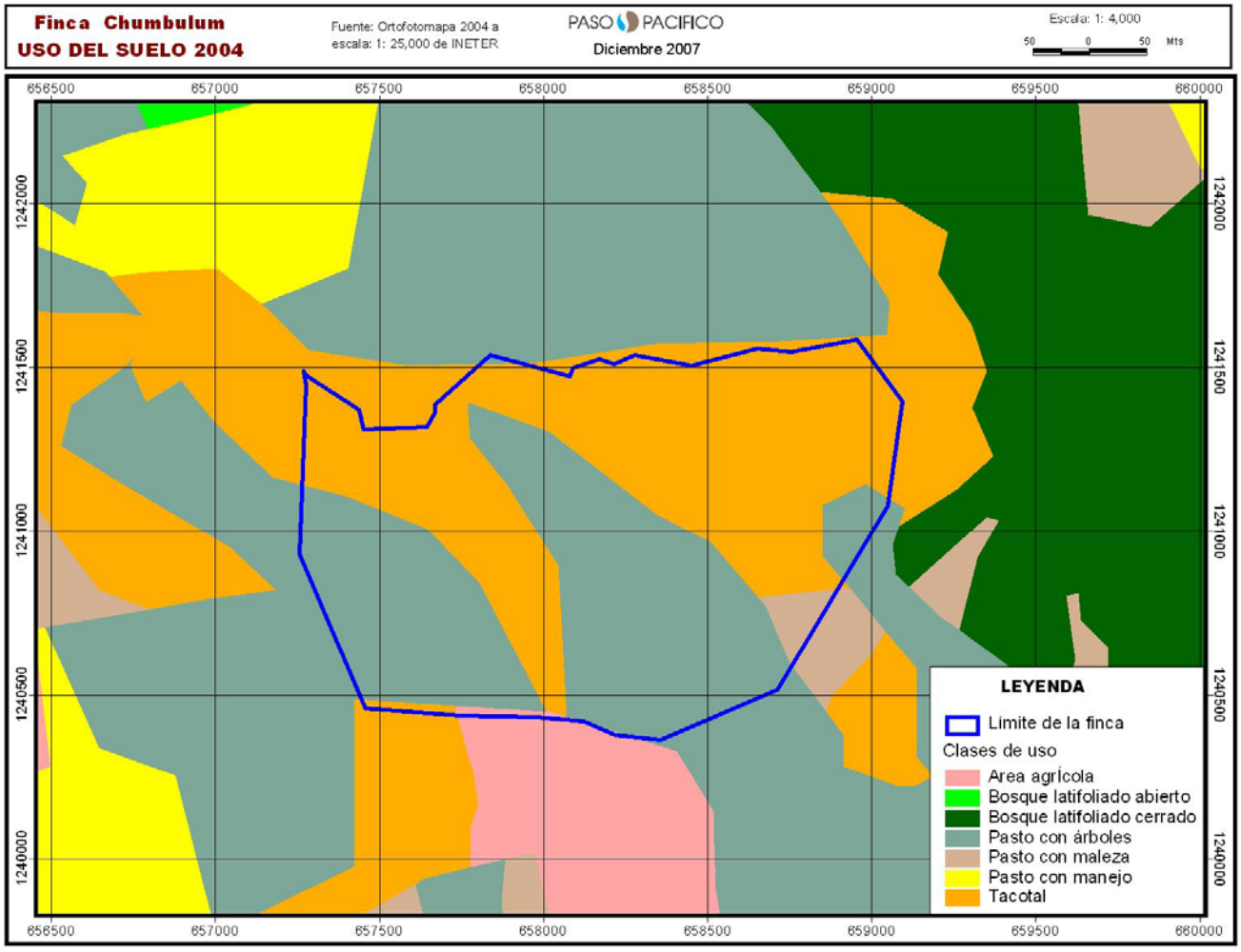

Figure 29. Project Site #7 - Chumbulum current land use.

Project Site #8. Map of this site have not yet been developed. This area will be planted in May 2008.

Current Carbon Stocks

In order to estimate current carbon stock at each RTF site, we established randomly placed 15m radius circular plots. Maps of reforestation areas were graphed on a grid, and then random points were selected across that grid using a random selection of numbers. The number of plots varies according to project site, but sample size was selected according to total area and variance in woody species cover. Roads, trails or other physical features void of vegetation were not considered. Circular plots were permanently located with cement markers. Then, all woody species with a height greater than 1.5 m were identified; diameter at breast height was measured, and height was estimated.

To estimate current carbon stocks, the Brown allometric equation for moist forest[2] was used to estimate aboveground biomass of trees in permanent plots. Non-permanent shrubs typical of pastures were excluded from the analysis (i.e. Cornizuelo - *Acacia colinsii*). Belowground biomass for this vegetation was estimated based on recommended allometric equation[3]. Seedling biomass was estimated based on the percent of seedling biomass found at proxy forests across the Paso del Istmo (seedling biomass estimated to be 2% of biomass). A conservative estimate was made for the Site #8 - Santa Marta property, based on known field conditions, and comparing it to similar sites (the reforestation area is similar or slightly more open than #4 -Guacamaya. Therefore the carbon at this site was used to estimate pre-project carbon. Nevertheless, pre-project carbon stocks will be measured prior to planting in 2008.

Table 3. Current carbon pools at Project Sites. Strata measured includes aboveground and below ground biomass of trees >5 cm dbh and an estimate of seedling biomass.

Project Site	Current Conditions	Current GHG Tons CO2/Ha
1a.	Dominated by grasses and dispersed trees and shrubs	10.29
1b.	Dominated by woody shrubs and savannah- like vegetation from past land use	44.45
2.	Dominated by non-native pasture grasses, presence of trees	78.98
3.	Dominated by non-native pasture	1.73
4.	Dominated by non-native pasture grasses, presence of disperse trees	6.41
5.	Dominated by non-native pasture	1.16
6.	Mix between non-native grasses and weedy vegetation, tree seedlings, and shrubby vegetation	129.38
7.	Dominated by non-native pasture grasses	4.22
8.	Dominated by non-native pasture grasses	(estimated 6.41)

[2] Brown 1997. Estimating Biomass and Biomass Change of Tropical Forests: a Primer. (FAO Forestry Paper - 134)
[3] Cairns et al. 1997. Root biomass allocation in the world's upland forests. Oecologia 111:1-11.

3. Community Information

Project sites are located near rural communities that are dispersed settlements. Site #6-Las Fincas is surrounded by Escamequita, La Parcelas, Carrizal, and la Tortuga in the San Juan del Sur municipality. Project Sites #2,3,4,5, and #8 are located near the communities of El Acetuno, Santa Ana – El Carmen, Ostayo, Las Mercedes, Calula y Cuajiniquil, Sapoa and Cárdenas, all of which are located within the municipality of Cárdenas. Finally, the community of Domitila is located at Site #1 and Chocolata is located at Site #7 and are located in the Nandaime and Rivas Provinces respectively.

Socio-economic Information

A detailed characterization of each community near reforestation sites is available via the supporting document "*Estudio Social y Ecónomico de comunidades Retorno a Bosque*".

Table 4. Poverty levels across principle municipalities where RTF sites are located[4].

Niveles de pobreza por municipios	Índice de Desarrollo Humano	% de la población bajo nivel de pobreza	% de la población en pobreza extrema	% de la población rural bajo nivel de pobreza	% de la población rural en pobreza extrema
Rivas	0.748	43.1	11.6	65.0	60.2
San Juan del Sur	0.652	57.1	19.7	84.7	75.9

Table 5. Human Development Index (UNDP) across municipalities near project sites[5].

Departamentos/ Municipios	Poblacion	Extension territorial (km²)	Densidad (pob.x km²)	EVN	Cobertura de agua potable (%)	TAA	TBP	Indice de consumo	IDHM
Rivas Dept.	**158,142**	**2,161.8**	**73.2**	**70.0**	**54.3**	**85.6**	**59.0**	**0.52**	**0.656**
San Juan del Sur	15,146	411.1	36.8	70.0	49.5	88.0	54.7	0.52	0.652
Cardenas	5,762	226.6	25.4	66.0	19.4	79.2	49.9	0.37	0.528
Rivas	42,408	280.5	151.2	70.8	77.7	91.0	74.1	0.62	0.748
Granada Dept.	**179,437**	**1,039.70**	**172.6**	**68.8**	**84.1**	**84.1**	**58.7**	**0.56**	**0.690**
Nandaime	37,714	372.0	101.4	68.9	60.4	83.7	55.4	0.50	0.642

[4] Plan Desarrollo Municipal 2006 - 2010, Municipio San Juan del Sur

[5] UNDP 2002. El desarrollo humano en Nicaragua: las condiciones de la esperanza/programa de la Naciones Unidas para el Desarrollo, 1er. Ed.; Managua, Nicaragua, 2002

Education

All of the rural communities across project sites include elementary educational centers. Nevertheless, as is typical across rural Nicaragua, secondary education is less accessible due to a limited number of schools and the high cost associated with secondary school.

Table 6. Indicators of educational efficiency across Rivas Municipalities[6].

INDICADORES DE COBERTURA Y EFICACIA ESCOLAR DE LOS MUNICIPIOS DE RIVASMunicipios	TNE			Retención			Aprobación		Repetición		Valor del IEEM	Posición y clarificación según el IEEM
	Pre	Prim	Sec	Pre	Prim	Sec	Prim	Sec	Prim	Sec		
Rivas	42.89	100.3	80.7	86.05	99.4	92.84	84.87	67.21	9.63	5.37	1.99	54 Buena
San Juan del Sur	62.57	117	56	90.86	97.57	90.97	82.64	76.26	11.52	10.84	5.39	5 Buena
Cárdenas	37.02	98.26	24.8	98.38	97.66	90.26	78.33	72.16	11.8	11.62	0.58	74 Buena
Nandaime	45.76	113.3	58.5	92.75	99	97.92	90.82	76.15	5.82	3.01	3.75	23 Buena

Land Use and Tenure

There is little variability in land use among small-scale landholders in communities near project sites. The majority of the households cultivate a mix of staple crops including beans, corn, rice, and sorghum. Beans and corn are the dominant crop across households. These staple crops have been cultivated by rural communities for centuries and represent food security and an insurance against hard economic times.

Table 7. Land use across farms in the Escamequita community. This is representative of land use patterns across small-scale farming households near project sites[7].

Crops	Beans	Rice	Plantain	Corn	Sorghum	Pasture
	21	3	1	23	1	2
%	80%	11.53%	3.84%	88.46%	3.84%	7.69%

Source: Interviews by Paso Pacifico Researchers 2007

[6] Ministerio de Educación, Cultura y Deportes (MECD); Cobertura y eficacia a nivel municipal, Diciembre 2006

[7] Interviews by Paso Pacifico Researchers 2007

4. Biodiversity Information

Given the intersection between aquatic and moist and dry tropical forest ecosystems, there is significant diversity across a relatively small geographic area (400 km2).

Key Species Habitat Analysis
Two groups were selected for Key Species Habitat Analysis, Primates and Psittacidaes, with emphasis placed on the species Yellow-naped Parrot (Amazona auropalliata auropallita) and the Central American Spider Monkey (*Ateles geofroyi*). Findings were that forest cover is insufficient to sustain populations of either of these threatened species over the long term. Both key species are only found in mature forest habitat areas and within large tracts of land. For further information refer to: Supporting document "Key Species Habitat Analysis." Findings recommend further study of these species and restoration across key areas where populations are found. Forest enrichment with tree species beneficial to spider monkeys was also recommended.

Threatened Species
In particular, there are many species of unique flora that are either endemic or are threatened. More detailed information regarding forest habitats and biodiversity across the Paso del Istmo is available through the supporting document "*Biodiversidad en Fincas Reforestación*".

Table 8. Reptiles found across RTF project area[8].

Family	Reptiles	CITES
Boidae	*Boa constrictor*	I y II
Colubridae	*Oxybelis aeneus*	
Elapidae	*Micrurus nigrocinctus*	III
Emydidae	*Rhinoclemmys pulcherrima*	
Iguanidae	*Anolis (Norops) cupreus* *Anolis (Norops) limifrons* *Iguana iguana* *Sceloporus variabilis*	II
Scincidae	*Mabuya unimarginata*	
Teiidae	*Ameiva cuadrilineata* *Ameiva festiva* *Ameiva undulata*	
Viperidae	*Crotalus durissus*	III
Iguanidae	Prob. *Anolis* (*Norops*) *pentaprion*	
Iguanidae	prob. *Bothrops asper*	III

[8] Source: *Köhler, Gunther (2001 y 2003)
** Ruiz, G.A. y Buitrago V., F. (2003); Köhler, Gunther (2001 y 2003).
*** Revisión personal del prof. G. A. Ruiz.

Table 9. Threatened Birds found across project area.

Family	Bird Species	UICN	CITES
Accipitridae	*Buteo magnirostris*	LC	II y III
	Buteo platypterus	LC	II y III
	Ictinia plumbea	LC	II y III
Anatidae	*Cairina moschata*	LC	III
Ardeidae	*Ardea alba*		III
	Bubulcus ibis	LC	III
Burhinidae	*Burhinus bistriatus*	LC	III
Cracidae	*Crax rubra*	NT	III
Dendrocygnidae	*Dendrocygna autumnalis*	LC	III
Falconidae	*Herpetotheres cachinnans*	LC	II
Psittacidae	*Amazona albifrons*	LC	II
	Amazona auropalliata	LC	I y II
	Aratinga canicularis	LC	II
	Brotegeris jugularis	LC	II
	Pionus senilis	LC	II
Strigidae	*Ciccaba virgata*	LC	
	Otus cooperi		II
Trochilidae	*Amazilia rutila*	LC	II
Accipitridae	*Harpyhaliaetus solitarius*		II y III*

Table 10. Threatened mammals found across project area[9].

Family*	Species*	UICN	CITES
Cebidae	*Alouatta palliata*	LC	I
	Ateles geoffroyi	LC	I y II
	Cebus capuchinus	LC	II
Megalonychidae	*Choloepus hoffmanni*	LC	III
Procyonidae	*Potos flavus*	LR/lc (out of date)	III
Agoutidae	Frutos consumidos por *Dasyprocta punctata*	LR/lc (out of date)	III
Cervidae	*Huellas de Odocoileus virginianus*	LR/lc (out of date)	III
Felidae	*Leopardus sp.*	LC	I y II

9 *Reid, F. A. (1997); Emmons, L.H. (1990).

Table 11. Threatened or endemic flora present in RTF project areas[10].

Species	Status
Bidens oerstediana	Endemica/UICN estimada
Coursetia apantensis	Endemica/UICN estimada
Hedyosmum goudotianum var. mombachanum	Endemica
Parathesis rothschuhiana	Endemica/UICN estimada
Psittacanthus minor	Endemica/UICN estimada
Randia nicaraguensis	Endemica/UICN estimada
Epidendrum vulcanicola	Endemica, CITES II/UICN estimada
Acanthocereus tetragonus	CITES II
Hylocereus costaricensis	CITES II
Opuntia cochenillifera	CITES II
Opuntia decumbens	CITES II
Opuntia guatemalensis	CITES II
Peniocereus hirschtianus	CITES II
Pereskia lychnidiflora	CITES II
Cyathea fulva	CITES II
Swietenia humilis	CITES II
Brassavola nodosa	CITES II
Elleanthus caricoides	CITES II
Elleanthus curtii	CITES II
Elleanthus graminifolius	CITES II
Encyclia cordigera	CITES II
Guaiacum sanctum	CITES II
Cedrela odorata	CITES III
Dalbergia retusa	UICN/VU
Lonchocarpus minimiflorus	UICN/EN
Lonchocarpus phaseolifolius	UICN/CR
Lonchocarpus phlebophyllus	UICN/EN
Lonchocarpus retiferus	UICN/EN
Pachira quinata	UICN/VU
Terminalia oblonga	UICN/EN
Calyptranthes amarulenta	Endemica/UICN estimada
Hoffmannia oreophila	Endemica
Rondeletia nicaraguensis	Endemica
Opuntia lutea	CITES II
Peniocereus hirschtianus	CITES II
Alsophila firma	CITES II
Barbosella prorepens	CITES II
Elleanthus caricoides	CITES II
Elleanthus hymenophorus	CITES II
Maxillaria mombachoensis	CITES II

[10] Source: IUCN. IUCN Red List of Threatened Species. www.iucnredlist.org. 07 November 2006.
Stevens, W.D., C. Ulloa Ulloa, A. Pool & O.M. Montiel (eds.). 2001. Flora de Nicaragua Vol. I., II, y III Monogr. Syst. Bot. Missouri Bot. Gard. 85.

Guaiacum sanctum	CITES II
Aegiphila panamensis	UICN/VU
Ilex pallida	UICN/VU

G2. BASELINE PROJECTIONS

1. Land Use without Project

For each of the project sites, Paso Pacifico conducted interviews with landowners and neighboring community members to determine historical land use. The historical picture was confirmed by comparing topographical maps based on aerial photographs from the 1980s with information on what is known about the land use history in the area and also current vegetation conditions.

Landowners were also interviewed regarding their intended future land use without the RTF project. Given that landowners are the primary land use decision-makers and have legal authority over their land, the scenarios based on landowner intentions are highly likely. The most plausible land use scenario for five of the sites was cattle ranching and conservation was the most plausible land use scenario for three sites (refer to Table 12).

At sites where landowners expressed intentions to continue with cattle ranching, we believe that the probability that ranching would continue at these sites is greater than 75%. Ranching has been the dominant agricultural activity over the past eighty years in this region of the county. Additionally, local governments[11] and the Ministry of Agriculture (MAG-FOR) have designated these land areas for cattle productions and have prioritized the promotion of the cattle industry within provincial development plans. One must consider that ranching is a cultural activity as much as it is an economic activity, and in many cases would likely continue at many of these properties in the absence of immediate profitability.

Conservation is the plausible land use scenario in the case of farms that are currently established as private protected areas (Project Site #1 and #4) or that had expressed publicly the intention to establish a private protected area (Project Site #6). Landowners who have signed agreements with the governments regarding their intentions to conserve are more likely to follow through with this land use. We believe that the probability for this land use is greater than 80%.

Unforeseen changes to the economics of cattle ranching and financial difficulties for landowners doing conservation could drive landowners to shift their land use to more lucrative activities or to sell their land. Possible shifts to agriculture include the cultivation of commercial crops prevalent in the area, such as rice, beans, melon, and other fruit crops. Forest remnants at farms could also be used for timber or firewood, either due to weak protection of the land or because landowners need additional income. One other alternative scenario is that land areas could be sold to developers or that landowners could shift land use towards urbanization and tourism development. This final alternative scenario, while not mentioned by landowners is the most likely of the project sites #5, #6, and #7 because these sites have landowners who are already associated with tourism and urbanization developments elsewhere.

[11] Rivas 2004. Plan Estratégico Departamental de Desarrollo de Rivas, Versión Validada, November 2004, Rivas, Nicaragua

Table 12. Plausible land use and changes in carbon stocks under baseline scenario or without project.

Project Site	Recent historical Land Use	Plausible Land Use	Increase in Carbon Stocks	Source
1	Conservation	Conservation	Yes	Landowner, MARENA Private Reserve Declaration
2	Cattle Grazing	Cattle Grazing	No	Landowner, neighbors, historical records
3	Cattle Grazing	Cattle Grazing, logging	No	Landowner
4	Cattle Grazing	Cattle Grazing, Tourism	No	Landowner, Ranch foreman, MARENA Private Reserve Land Use Declaration
5	Cattle Grazing	Cattle Grazing	No	Landowner, historical use
6	Conservation, Low-intensity grazing	Conservation with continued grazing	Yes	Landowner, neighbors
7	Cattle Grazing	Cattle Grazing	No	Landowner
8	Cattle Grazing	Cattle Grazing	No	Landowner

Each landowner within the RTF project would not have been able to reforest without either the funding or technical support of Paso Pacifico, or both.

Table 13. Barriers to reforestation at each of the Project Sites.

Site Number	Plausible Land Use Scenario	Possible Alternative Land Uses	Barriers to Reforestation
1	Natural Regeneration from abandonment	Grazing, degradation from firewood extraction, other	Technical and Financial
2	Continued Degradation	Agriculture	Technical
3	Continued Degradation	Agriculture	Technical and Financial
4	Degradation from construction of Hotel Infrastructure and Grazing	Natural Regeneration	Technical and Financial
5	Continued Degradation	Tourism infrastructure	Technical and Financial
6	Natural Regeneration from Abandonment of grazing	Housing structures	Technical
7	Continued Degradation	Tourism infrastructure or housing development	Technical and Financial
8	Continued Degradation	Cattle Grazing	Technical

2. Carbon Stock Exchanges without Project

At the two sites that were already set aside for conservation, the most plausible land use was natural regeneration. This would result in an increase in carbon. At the other sites, grazing, firewood collection, and even logging would have continued. Over time, there would be a further degradation of the site. Therefore, the 0 change scenario is both plausible and even conservative.

Table 14. Projected changes in carbon stocks without project scenario.

Plausible Land Use	Change Above Ground Biomass	Change Below Ground Biomass
Natural Regeneration from abandonment	Increase	Increase
Continued Degradation	Decrease/ 0 Change	Decrease / 0 change
Degradation from construction of Hotel Infrastructure	Decrease / 0 change	Decrease / 0 change

For the two sites where conservation and natural generation would have occurred in the absence of our project, Paso Pacifico calculated an increase of carbon stocks. These sites are #1 Domitila and #6 Las Fincas and are currently dominated by shrubby secondary vegetation or grassland. There are naturally regenerating seedlings but they are dispersed and the areas are dominated by multi-stemmed (from repeated fires) shrubby trees. Therefore, we expect that carbon stocks in these areas to be similar to those at 25 years at the end of the forty year period of this project. We base this projection on relevant research establishing the retarded regeneration of abandoned pasture areas. For the area at Site #1 that is dominated by grassland at which there are very few seed sources for trees, we estimate that carbon stocks would be at year 20 at the end of the forty year period of the project.

Table 15. Projected Net greenhouse gas removal under without project scenario.

Site #	FARM	Preproject (Tonnes CO2/ha)	Area	40 Yr Baseline Scenario GHG sinks (Tonnes CO2/ha)	GHG Removal	Preproject Carbon	Net GHG
6	Las Fincas	129.37	34.547	347	11987.81	4469.345	7518.46
1	Domitila Tacotal	44.45	67.8	347	23526.6	3013.71	20512.9
1	Domitila grassland	10.29	37.32	232.51	8677.273	384.0228	8293.25
						TOTAL	**36324.6**

3. Local Communities without Project

Without the project, rural development would at best follow those plans and projections made by the Nicaraguan government. In particular, the Millenium Develop Goals that address the areas of health and rural infrastructure will likely be implemented. We would expect an increase in economic indicators across the area due to increased tourism. Nevertheless, there will be negative social consequences in association with tourism including out-migration, decrease in land tenure, and increased consumption of consumer goods. Refer to supporting document “Community Study” for further detail on projections with and without project.

4. Biodiversity without Project

Without the project, biodiversity is expected to stay the same as current conditions at the start of the project. At sites #1 and #6, biodiversity may slowly increase in conjunction with the naturally regenerating forest. Without the project, certain wildlife populations will be particularly vulnerable over time and are expected to decrease to the point of possible local extinction. The yellow-naped parrot and the Central American spider monkey are both species that would not be able to survive over time at the current levels of fragmentation and poaching. However, there are many species of flora and fauna that can survive on the margins of the agricultural landscape so long as they have patches of forest for cover and forage. Therefore, it is likely that without the project, biodiversity is not likely to decline precipitously, but would continue a slow process of degradation and local species loss. For further discussion on biodiversity without project scenario refer to biodiversity documents "Key Species Analysis" and "Fragmentation Analysis".

5. Water and Soils without Project

At sites where livestock grazing is expected to continue, soil and water resources are expected to degrade or remain the same into the future without the project. Grazing is known to compact soils and grazing on hillsides can lead to erosion. Additionally, project sites all contribute to the quality of water at important wetland and lake areas. These include a mangrove wetland, freshwater wetlands used by migratory waterfowl, and Lake Nicaragua which is an important source of freshwater for the region. These aquatic habitats would be jeopardized due to contamination of water from grazing livestock, accelerated sedimentation due to upstream erosion, bank erosion due to livestock, and compaction of sensitive riverbeds.

G3. PROJECT DESIGN AND GOALS

1. Scope and Project Goals

The proposed project is located at private properties in the Southwestern Nicaraguan provinces of Granada and Rivas. Properties are within the conservation corridor identified by the Mesoamerican Biological Corridor project and named by Paso Pacifico as the "Paso del Istmo" (Passage of the Isthmus). This land area is composed of a matrix of farmland used for cattle pasture and traditional staple crops and patches of tropical dry on the western slope and tropical moist forests on the eastern slope. The project will use reforestation and other restoration measures to restore 406 hectares of abandoned cattle pasture to native forests over a forty year period. All reforestation will take place on private lands previously dedicated to extensive cattle grazing. Reforestation sites are strategically located throughout the corridor. This project proposes three broad goals that seek to increase carbon storage while protecting biodiversity and supporting sustainable communities. These goals contribute to Paso Pacifico's long-term vision of connecting forest ecosystems to form the *Paso del Istmo* conservation corridor.

Goals

1. Decrease atmospheric greenhouse gases through the restoration of tropical forests.
2. Promote alternative and sustainable livelihoods among rural communities by creating alternative sources of income through reforestation activities, reserve management activities, eco-tourism, and through payments through ecological services
3. Conserve Central America's threatened forest ecosystems and wildlife by restoring currently fragmented and unprotected forests, thereby improving water and other ecosystem services.

RTF project participants include eight different landowners who have voluntarily agreed to participate in this project. All land owners have expressed a strong desire to support the goals of conservation, but have lacked the technical expertise and funding to restore the forest to their lands. Two of the properties are legally declared private reserves. Landowners have expressed contentment that RTF will enable forest restoration and that it will include other eco-tourism and biodiversity conservation efforts. Landowners work in partnership with Paso Pacifico to plant trees and maintain forests over the long term. Paso Pacifico provides financial support to landowners to hire local laborers throughout different phases of reforestation and forest management. Paso Pacifico will also partner with landowners to establish new private reserves at reforestation sites and to develop eco-tourism projects.

Other organizations involved in this project include community associations and farming cooperatives. These participants view the reforestation project as opportunity for increased employment through reforestation activities (tree nurseries, planting) and forest management and through future tourism and conservation activities. School children were also involved in this project, as they assisted in collecting native seeds as part of environmental education curriculum introduced in connection with this project. Other educational institutions such as the Nicaraguan Museum of Entomology, the UNAN-Managua, and the UAM have been involved in baseline studies. Local municipal governments have participated throughout this project by providing oversight and public support. The Nicaraguan Ministry of Environment and the Nicaraguan Ministry of Agriculture-Forestry Institute are participants by registering reforestation areas, providing some of the seedlings used in reforestation, and by aiding in the establishment of new protected areas.

2. Major Activities

Landowner relationships and land areas
First and foremost, Paso Pacifico developed relationships with landowners throughout the corridor area. A relationship of trust and mutual collaboration enabled us to come to long-term agreements and commitments regarding land use. While Paso Pacifico subsidized the cost of the reforestation, landowners contributed their own funding, their land, their workers, and their personal time and energy to make sure that land areas were planted effectively.

Develop nurseries
Working with local community members, Paso Pacifico established three community-run nurseries. One was run by the community association Asociación Pacífico Sur and the other two were run by the landowners at Sites #1 and #6. For all nurseries, community members received training on seed care, germination, and the care of nursery plants. A portion of trees planted across reforestation sites were from commercial nurseries that were selected according to the quality of the plants and the source of the seeds.

Evaluate Current Conditions of Carbon, Communities, and Biodiversity
Prior to planting reforestation areas, sites were visited by consulting biologists, sociologists, and by Paso Pacifico's forester to evaluate current stocks of carbon, and the biodiversity across project areas. Details of this work are available in Section G1 and supporting documents.

Measure Carbon Stocks in Reference forests
Reference forests were identified near reforestation areas. The age of these forest patches was identified based on interviews with long-time local residents, land-use history and based on observations of the areas. Stand ages varied (20-100 years) and forest sites were sampled in both dry and moist tropical zones of the corridor area.

Planting
Trees are planted using simple tools and with low impact planting techniques, including the use of shovels, diggers, and machetes. Tree seedlings are hand carried to planting sites and placed in the ground. Management of seeds, community nurseries, and planting activities is done with the supervision of Nicaraguan foresters and with the consultation of a professional reforestation expert and Paso Pacifico staff who have expertise in forest ecology[12].

[12] Wightman KE. 1999. Good tree nursery practices. Practical guidelines for community nurseries. World Agroforestry Centre (ICRAF), Nairobi, Kenya. 95 pp.

Figure 30. Carrying seedlings to reforestation areas for planting.

To prepare the soil for planting, circular areas are cleared of vegetation surrounding the location where trees are to be planted. Where naturally regenerating seedlings are already present, these seedlings are left intact. Holes for trees are dug to a depth of 20-40 cm depending on the size of the seedling bags.

Figure 31. Community workers digging holes and placing trees in the ground at reforestation site.

Trees will be planted at a 4x4 meter spacing (625/ha) in mixed arrangements decided by the forester and forest ecologist according to the native seedlings that are available for planting and the soil and micro-climate conditions at the reforestation site. Riparian area species are planted nearer to rivers and upland species are planted in well-drained soils. Landowners also play a role in selecting species for their potential value to wildlife, or for ecological properties of interest to landowner goals.

Trees will be managed actively during the first ten years. During year one, if the dry season is intense, manual watering may occur if deemed necessary to protect the plants. Grasses, weeds, and vines will be removed from tree seedlings and at tree bases at least two times during rainy season months during the first three years. Weed removal and trimming will continue after year three as deemed necessary by forest managers. Trees will be thinned as needed to enable continued growth. Naturally regenerating trees will not be removed unless they will compete with plantation trees.

3. Project Location

Maps of project site locations are provided in G1.

4. Project Timeframe

Project accounting will be for a period of forty years. Conservation actions implemented as a part of this project and the private protected areas that will be established are expected to persist well beyond the lifetime of this project. Plantation management will be the most intense during the first ten years. After that period, the focus of management activities will be on the protection of biodiversity resources and basic forest maintenance.

The length of time for project accounting was selected considering two factors. First, primary productivity throughout forest succession is not constant over time. As forest stands mature, productivity tends to slow, particularly during the latter stages of succession. There is not a clear consensus as to when primary productivity levels off, but based on RTF forest biomass surveys of different ages, we observe that above-ground biomass accumulation appears to slow between 30 and 40 years for dry forest and after 40 years for moist forest. We believe the forty years is a period of time long enough to enable the project to benefit from forest productivity, but also short enough for it to be feasible to ensure that project management is effective and that carbon and other project benefits are successfully measured. Second, carbon benefits resulting from this project are expected to be sold to the voluntary carbon market in the United States. Here, emissions reductions targets across individual states are generally set for the dates 2020 and 2050. The RTF carbon benefits will be accounted for by the 2050 targets and can be of interest to buyers who hope to meet reduction targets.

Due to the permanent nature of this conservation-oriented project, carbon stocks will continue to increase after the accounting period. Thus, a forty year accounting period is a conservative measure of RTF carbon benefits.

5. Risks to Climate, Community, and Biodiversity Benefits

Table 16. Identified risks to project and its benefits, and selected methods for mitigation.

RISKS	MITIGATION
Wildfires	Wildfire suppression training, equipping of community volunteer fire brigades, fire breaks maintained, patrols during dry season during first five years, fire management plan with support of USFS
Volcanic Eruption	None, but eruption not likely
Plant diseases from plantation spread to natural forest	Immediate elimination of pests and diseases in plantation areas
Grazing, cattle invasion	Maintenance of fences, monthly patrol of fence areas, conflict mediation with neighbors when necessary
Firewood collection	Direct communication with local communities to explain rules for reforestation areas
Land Sale – transfer of ownership	Contract and landowner agreement changes land title with national registry to reflect conservation purpose of the land area. New owners will be bound to agreement, enforcement with the help of MARENA
Paso Pacifico undergoes organization changes	Design a mechanism in coordination with national Nicaraguan university or MARENA to ensure the transfer of management and oversight, if Paso Pacifico were to leave or change markedly
Squatters – land invasion	Support local communities in job training, employment opportunities, education, and alternative agriculture to reduce conflict in the area..

6. Stakeholder Identification

Project participants and stakeholders can be divided into two major groups. First, there are those who are direct beneficiaries of Return to Forest activities. These include landowners where planting is taking place, and local community member who have been hired as part of the project. The other stakeholders in this project are those who participate less directly in activities specific to RTF, but who either have a stake in the outcomes, will indirectly benefit from the outcomes, or who are participants or stakeholders in other major Paso Pacifico initiatives in the *Paso del Istmo* corridor. All stakeholders that have been identified have been informed of the project and have been asked to participate with varying degrees of involvement. As the project develops and new stakeholders emerge, Paso Pacifico will share the genesis of this project with them and invite their comments or involvement (*i.e.* new relationships with universities who might research project development).

7. Project Transparency

The project design document will be translated into Spanish and both the Spanish and English versions will be made available to all stakeholders. The majority of supporting documents are in Spanish. Project documentation will be made available at four key locations in Nicaragua for stakeholders to have access to them. First, final project design document will be placed at the Nicaragua Sistema de Informacion Ambiental (SINIA) in Managua. This is a clearinghouse library for all environmental information in the country. Secondly, project documents will be available for community members at the Paso Pacifico headquarters. It is organizational policy that these documents will be freely available to the public. Third, project documents will be placed at municipal offices in San Juan del Sur, Cardenas and Nandaime. Finally, all landowners who have partnered with Paso Pacifico to reforest will be receiving full copies of project documentation.

The RTF project will also be shared with the national and regional scientific and forestry community. For example, in 2007, Paso Pacifico presented the RTF project at the Congress of the *Sociedad Mesoamericana para la Biología y Conservació*n, and at the National Forestry Symposium. Such presentations will continue.

Paso Pacifico will receive further oversight through the many researchers who will conduct research at the restoration sites. Researchers from the Nicaragua Agricultural University (UNA), the University Autonoma of Nicaragua (UNAN-Leon), and international researchers from Oxford University, University of Texas – Austin, Northern Arizona University School of Forestry have all expressed an interest in studying the restoration dynamics in reforestation areas, issues of landscape connectivity, and wildlife dispersal. Finally, experienced tropical forestry researchers from the International Institute for Tropical Forestry (US Forest Service) will provide management recommendations, research protocols, and oversight throughout the project.

G4. MANAGEMENT CAPACITY

1. Paso Pacifico Management Experience

Paso Pacifico has assembled a highly qualified team to direct land management activities. Paso Pacifico's director and RTF coordinator has a long history working in Protected Areas management. Recently she served as the National Director of Protected Areas in Nicaragua and was charged with managing the protected lands throughout the entire country. Additionally, Paso Pacifico has a full time forester who has led other reforestation and restoration projects using native species. The Executive Director is a conservation scientist with expertise in forest ecology and disturbance dynamics. In this role, she provides scientific and technical expertise on the project. Refer to CVs in supporting documents for further information on staff experience. It should be mentioned that Paso Pacifico is growing and strengthening as an organization. Over the next year we will be adding full-time positions in plant ecology, turtle conservation, wildlife ecology, GIS-Landscape ecology, and an office manager. As our team grows, so will our capacity to manage these land areas.

Despite the strengths of the Paso Pacifico team, there are experiences and knowledge that we do not yet have. Paso Pacifico will address this in two ways: 1) further training for our staff and 2) partnering with experienced professionals and organizations.

Paso Pacifico has identified training opportunities for our forester in Costa Rica (Finca Experimental Horizontes and CATIE), in Panama and at other reforestation sites where there is experience in restoration of tropical dry and moist forest ecosystems. Paso Pacifico will seek out training workshops and site visits to these and other projects.

Paso Pacifico has a strong partnership with the US Forest Service Institute for Tropical Forestry (IITF). We rely on the input and advice IITF tropical foresters with experience in silviculture and other forest management areas. Additionally, we work closely with the forestry consultant in Nicaragua, Dr. Kevyn Wightman, whose specialty is forest regeneration. She works with landowner partners and provides us with advice and expertise in seed and tree nursery management, as well as plantation management. Additionally, Paso Pacifico will be working with the forestry department from the *Universidad Nacional Autonoma de Nicaragua* – Leon.

2. Management Capacity and Project Scale

The Paso Pacifico staff is appropriate to the RTF project scale. The forester is in charge of coordinating with the foremen and workers at each of the eight farms and ensuring that plantations are maintained. The forester makes technical decisions as to which trees and weeds to clear, leaving instructions with workers at each property. The forester consults with outside experts from IITF, and other organizations when additional management advice is needed. The project coordinator works to develop and maintain landowner relationships and to ensure that the forester and other staff fulfill their duties. If the project were to expand, Paso Pacifico would need to expand its team.

3. Key Technical Skills and Staff

Table 17. Key technical skills required to manage reforestation projects.

SKILL	PASO PACIFICO TEAM
Seed and nursery management	Forester, input from Dr. Kevyn Wightman, experts at national seed bank, and community members with experience in native vegetation
Directing laborers	Forester in partnership with landowners and their employees
Measuring of Pre-project carbon	Otterstrom coordinates methods and data quality. Consulting ecologists and forester collect data
Monitoring of permanent carbon and reference forests	Otterstrom oversees data, forestery and staff plant ecologists
Plantation management, silviculture decision-making	Forester in consultation with experts from IITF, CATIE and others as needed.
Coordination with landowners, assurance of plantation protection and maintenance	Paso Pacifico director in partnership with landowners
Community Monitoring	Consulting sociologist and eventually Paso Pacifico staff, outside researchers
Biodiversity Monitoring	Consulting biologists, Paso Pacifico staff, and outside researchers

4. Financial Status of Organization

Paso Pacifico is a young organization, and as such, has a modest organizational budget. However, the funding base for the organization is growing rapidly. Currently, Paso Pacifico receives funds from private foundations, individual private donors, the US federal government, and other non-profit granting organizations. Components of the RTF project related to tree planting and maintenance have been solely funded by the non-profit Carbonfund.org and landowners. Long-term funding for plantation management is also provided through long-term investments of Carbonfund.org grants with the socially responsible brokerage firm – Progressive Assets Management. In the spring of 2008, Paso Pacifico will conduct its first financial audit. Additionally, financial data is available at the end of the first quarter of each calendar year when the Paso Pacifico Annual Report is presented to the public.

G5. LAND TENURE

1. Private Property and Land Rights

All project sites within the RTF project are legally owned by the party with which relationships have been built and a contract has been made. Legal ownership has been demonstrated with a copy of the land title presented by the owner, and then confirmed by a third party at the National Land Registry. Legal ownership was further verified through interviews with neighboring community members who can attest to the history of land tenure at each site. Neighboring landowners and community members were also able to confirm that the land areas are not under dispute.

All reforestation areas were mapped and the locations of these areas were compared to *catastros* of the properties to ensure that areas considered correspond to the registry. Refer to supporting documents "Landowner Contracts" to see copies of land titles.

Table 18. Legal references to land titles for reforestation sites.

Nombre de la Finca	Tamaño (Mz)	Propietario	Numero de inscripcion	Asiento	Folio	Tomo
Isla Vista		Leo S.A.	27,353	III	103/104	397
Chumbulun	25 Mz	Chris Robert Alan Berry, Agnes Jean Brugger, George Knight y Kathleen L Knight	13295	VI	143	271
La Guacamya	456,604 mts²	Mirna Moncada Fonseca	31,955	I	280/281	335
	26,285.49mts		31,956	I	283/284	335
La Tigra		Pedro Agurcia	27276	III	39/41	278
Nica Dev S,A	454 Mz. con 1254.2 vrs²	Donn Barclay Wilson y Eduardo Jose Caldera	27176		086/087	276
Agroindustria Mecatepio S.A. - Reserva Silvestre Privada Domitila	230 hectáreas	Silvio Mejia Arellano	1174	II	262/278	32
			5838	II	192/219	47
Emporio "M"	26.0	Dr. Fernando Arce Montiel	37545	II	187	410
Emporio "M"	18.99		32249	II	209	397
Emporio "Ch"	30.91		30528	III	92	413
Aguacapolka	71.13		29112	II	266/267	299
Kuyapani	82.1		27603	II	40/281	283/362

2. Voluntary Nature of the Project

RTF is completely voluntarily and all participating landowners were invited by Paso Pacífico to reforest with the project. The project has not developed against anyone's will, as can be demonstrated by the landowner contracts with Paso Pacifico. One of the properties was previously owned by a farming cooperative. This land was sold to the current owner several years prior to the RTF project. Cooperative members all retained medium parcels of land that they continue to farm. These community members have not left the area and have expressed that they sold the land voluntarily.

3. Potential in-migration

The RTF project is not expected to affect local migration patterns. During all phases of the project, local labor will be employed. There is sufficient local labor to meet the needs of the project. While the economic benefits of these jobs are significant, the demand for labor is not considered large enough to attract outside immigrants.

Although there is a low risk of in-migration, Paso Pacifico will work to promptly identify and reduce in-migration risks as they might develop throughout the project. First, land ownership will be clearly communicated to the public. During the first three years of the project, Paso Pacifico will work with landowners to post plainly marked signs indicating the limits of the property and private reserve areas. Signs will also indicate rules for the property (*i.e.* no hunting). Also, by registering properties as nationally declared private protected areas, farms will become listed on websites, protected area brochures and other public places. Second, open communication between local communities, landowners and Paso Pacifico will reduce risks and help forewarn of any problems. Paso Pacifico will ask the person-in-charge at the property to report any signs of in-migration or community-landowner conflict. Paso Pacifico will request similar information from leaders in communities adjacent to properties. Both community leaders and property managers are in frequent contact and communication with Paso Pacifico staff.

Finally, rumors or indications of possible in-migration will be responded to immediately. In these cases, Paso Pacifico will meet with landowners and work with them to identify the best course of action, whether through conflict resolution between the community and landowner or by involving government authorities. In the case of an actual property invasion, the primary government authorities that would be involved would include the Ministry of Environment (they have a mandate to ensure the effective management of protected areas), the local and national police, and the municipal government. Paso Pacifico maintains a collaborative working relationship with both the Ministry of Environment and local municipal governments. Paso Pacifico will begin to work cooperatively with local and national police through future programs aimed at reducing wildlife trafficking. Positive relationships and open communication is a priority for the RTF project and will enable Paso Pacifico to work with the appropriate stakeholders and authorities to resolve any potential in-migration risk.

G6. LEGAL STATUS

1. Compliance with the Laws

Protected Areas Law
Nicaraguan Protected Areas Law allows for the creation of *Reservas Silvestres Privadas*. In order to ensure that project benefits remain into the future, Paso Pacifico will work with landowners to obtain legal private reserve status through the Ministry of Environment, Direction of Protected Areas. To obtain this status, Paso Pacifico must demonstrate that the property protects significant biodiversity resources or will do so in the future as a result of our restoration efforts.

Additionally, the RTF project further strengthens the Protected Areas laws by implementing restoration and conservation in areas that directly influence some of Nicaragua's most important protected areas. There are often management plans for these buffer areas, but in most cases these are not respected by landowners. The national protected areas La Flor Wildlife Refuge and Mombacho Reserve are located near Las Fincas and Domitila project sites respectively, and will directly benefit from the sustainable management of the buffer zones.

Forestry Law
According to Nicaraguan Forestry Law, forest plantations for commercial exploitation are required to register with Departamental-level authorities of the Forestry Institute (INAFOR). Registration is to occur when plantations are one year of age. This law does not directly apply to RTF sites because landowners will not be commercially harvesting tree species from plantation areas. However, Paso Pacifico will register all reforestation sites in late 2008 with INAFOR authorities and will file updates with authorities every five years on the status of the planted areas. Registration cannot be completed until plantations are at least one year old.

Labor Laws
Throughout the RTF project, local labor was used to manage tree nurseries, prepare planting areas, and plant the trees. Laborers were employed temporarily but were paid above than the minimimum wage (80 cordobas/day) and in addition were paid "*prestaciones sociales*" (vacations, aguinaldo) for the period of time they were employed in the form of an additional payment. Refer to supporting document "*Análisis de Codigo Laboral*" and Section CM5 for a discussion of labor laws relevant to this project.

Paso Pacifico's legal status
Paso Pacifico is a US 501(c)3 non-profit corporation registered in the State of California. It is legally registered to operate in Nicaragua towards its mission and within its defined program areas as an international non-governmental organization. It is registered as such with the Ministry of Exterior and as an international NGO reports its annual financial and operational activities to the Nicaraguan government. Equally, in the U.S. Paso Pacifico provides an annual report, conducts an annual financial audit, and files taxes with the Internal Revenue Service of the United States. Paso Pacifico is governed by its by-laws and by the State of California Non-profit Laws.

2. Approval from Appropriate Authorities

The only formal approval required for RTF project activities are agreements between Paso Pacifico and landowners. While no formal approval is required from the National or local authorities, Paso Pacífico has sought out meetings with relevant authorities. At this time, Paso Pacifico does not plan to enter the CDM process. However, if this were to change, Paso Pacifico would work through the appropriate CDM National Authority. The National Authority is aware of the RTF project and has provided his moral support. Officials at various levels at the Ministry of Environment are aware of the RTF project. Paso Pacifico director, Liza Gonzalez also met informally with the new Minister of the Environment in mid-December 2007. A tentative meeting date has been set for early 2008 to discuss Paso Pacifico activities throughout the corridor area, including the RTF project and the need to process requests for six new private protected areas. Additionally, meetings have been held with municipal government leaders to discuss the RTF project and to receive the moral support of the municipalities.

G7. ADAPTIVE MANAGEMENT

1. Management plans and feedback

Paso Pacifico has designed a series of management plans for restoration areas, with a separate plan for each of the reforestation sites. These plans are living documents that will be amended annually. As the forest regenerates, there will be unforeseen variability in factors affecting growth, such as variability in rainfall, soil-site conditions, and disturbance factors. In addition to reforestation areas, the RTF is conducting conservation and research efforts related to biodiversity conservation and rural development. These programs involve either monitoring or recording basic metrics over time.

Through our monitoring programs, we will be able to readily identify changes needed when our management efforts are not producing the intended results. We will then modify our actions to achieve program objectives. Our method is that we implement, we learn, and, if necessary, we adapt.

Table 19. Management actions and monitoring programs that will generate feedback for changing management actions and improving project outcome.

Management Action	Frequency of Monitoring	Variables Monitored	Potential Alternative Actions
Plantation Management	Quarterly, New plan written annually	Seedling mortality, Tree growth, presence of weeds, lianas and competing trees, DBH, canopy width	replacing dead trees, Increased frequency of cleaning, increased watering, strengthening fences
Biodiversity Monitoring – Yellow-Naped Parrot	Monthly	Population, nests, behavior	Increasing sample size
Biodiversity Monitoring – Return to Forest Restoration Areas	Annually, at three permanent plots reforestation sties	Primates, Bats, Birds, beetles, woody vegetation	Increased protection outside of reforestation areas, add new areas to restoration project, increase taxa to be monitored
Community Eco-tourism Projects	Annual project reports	Number of community members trained, number of jobs created, number of tourists received, tourism evaluations	Increased training opportunities, number of tourists trained
Community Sustainable Agriculture Projects	Annual project reports	Number of community members trained, area and species under cultivation, markets accessed and dollar amount in sales	Increased effort to access markets, shift in crops to ones more culturally favored
Education and Outreach	Annually, Educational program plans	Number of children reached, number of field trips, surveys pre and post educational projects	Emphasis on programs and teaching methods that are shown to successful

2. Plan for documenting decisions

All management decisions regarding reforestation areas are documented in written management plans, individualized to each reforestation site. These plans are written annually, and include a plan for monitoring the success of tree seedlings, the presence of outside disturbances (livestock incursions, firewood collections), and for monitoring the natural regeneration that is occurring in combination with the tree seedlings. Management plans are re-written on an annual basis, and are adjusted according to the results of previous management actions and the successes and failures observed through the monitoring program.

Decisions and adaptations to Paso Pacifico's various projects are documented in the following manner:

1) General project proposal or management plan
2) "Plan de Trabajo" or work plan for timeline and specific actions to be taken for implementing management plan
3) Monitoring or measurement of project outcomes, production of maps, data results
4) Progress report documenting successes and failures, and making recommendations for changes (conducted at quarterly for plantations, frequency variable according to project)
5) New plan as needed
6) Final project reports documenting actions taken, adaptations to original proposed plan, and successes and failures at each stage of the project. In the case of reforestation, a synthesized 'final' project report is written every five years throughout the lifetime of the project

3. Adjustments to plans

As a small organization, Paso Pacifico has the flexibility to make needed changes to management actions. Management decisions can be made quickly by Paso Pacifico staff in consultation with the country director and if needed with the Executive Director or international experts in forestry or other relevant fields. This type of agility enables Paso Pacifico to adapt project plans and actions to the challenges and opportunities that arise in the field.

4. Project financial sustainability

This project has secured funding for managing reforestation areas for the lifetime of the project. Nevertheless, funding sources to ensure conservation actions including building and maintaining fences, training and hiring park rangers must also be secured. Paso Pacifico has a legal commitment to landowners to partner with them in the search for funding for these efforts. For several of the project sites, payments for water services is a viable option, particularly within the context of Nicaragua's new Water Law that provides a mechanism for crediting landowners who protect water sources. Additionally, funding has been secured to assist with the cost of park ranger training and reserve signs for several of the reforestation areas during 2008-2009. Paso Pacifico views the following as the most viable sources of funding to assist landowners with the cost of protecting and maintaining reforestation areas:

1) micro-enterprise through small-scale eco-tourism (trails, hiking, horse back riding)
2) payments for eco-system services (particularly through Nicaraguan Water Law)
3) grants from international donors to fund training and equipping of park rangers
4) entrance fees to private reserves, and lodging fees charged to researchers

G8. KNOWLEDGE DISSEMINATION

1. Documentation of Project Lessons Learned

Success, failures and lessons learned through this project will be developed through two major sources: 1) Paso Pacifico project reports and evaluations 2) independent third-party researchers. As clarified in the landowner contract, all lessons-learned and studies developed through this project will be provided to the landowner partner.

Paso Pacifico reports and evaluations
Paso Pacifico will monitor climate, community, and biodiversity variables throughout the lifetime of the project as described elsewhere in this document. This monitoring will provide some information as to the success and failures of the project. Every two years, Paso Pacifico will conduct an evaluation of using methods Strengths, Weaknesses, Opportunities, Threats (SWOT) to consider challenges within the project and lessons learned along the way. Input for these SWOTS will be based on data from these monitoring reports, anecdotal information from landowners and community members, independent research on the project, and based on input from Paso Pacifico staff.

Researchers
Paso Pacifico has invited researchers from universities and research institutions from Nicaragua and around the world to provide input for improved project management and to describe benefits and challenges to the project. As described in other sections of this document, there is already interest and involvement from several researchers. Additionally the International Institute of Tropical Forestry will be providing management expertise as we work to manage plantations for natural regeneration and restoration.

2. Dissemination

Paso Pacifico expects to disseminate lessons learned through various avenues, targeting local communities and landowners and extending to the regional and international community of conservation practitioners.

Table 20. Examples of activities that Paso Pacifico plans to use to disseminate information.

Dissemination Activity	Audience
Presentations to Nicaraguan Universities – UCA, UNAN-Leon, UNA, UNAN-CURN	College Students and professors
Grey Literature publications, Media reports	General Public, Nicaraguan citizens
Academic Journals – Conservation Biology, Restoration Ecology, Mesoamericana	International scientific, forestry, applied conservation and restoration ecology
Presentation at Conferences – SMBC, CATIE conferences, Protected Areas Conference	Central American foresters, biologists, and conservationists
Trainings and workshops aimed at Network of Private Protected Areas (requested by Network)	Private landowners interested in conservation and restoration
School Lessons addressing reforestation benefits	School children in the Paso del Istmo
Community training in seed and nursery management	Interested community members at communities neighboring project sites
Landowner meetings and presentations	Presentations to landowners regarding the advances of project and its outcomes

CL1. NET POSITIVE CLIMATE IMPACTS

1. Estimation of Net Changes in Carbon Stocks

Reference forests
The RTF project is concerned with restoring natural forests. There are two major ecological life zones considered for these restoration efforts, lowland tropical moist forest (1999mm/year precipitation - Cardenas Area) and lowland tropical dry forest (1440mm/year precipitation – San Juan del Sur and Nandaime).

The total area designated for restoration in lowland tropical moist forest is **251.86 Ha**. The total area designated for restoration in lowland tropical dry forest is **153.75 Ha**.

Table 21. Ecological Zone for each of the reforestation sites

Project Site	Farm Name	Area (Ha)	Ecological Zone
1.	Domitila	105.18	Dry Forest
2.	Dr. Arce	165.329	Moist Forest
3.	La Tigra	4.485	Moist Forest
4.	Guacamaya	10.818	Moist Forest
5.	Isla Vista	21.26	Moist Forest
6.	Las Fincas	34.547	Dry Forest
7.	Chumbulum	14.024	Dry Forest
8.	Santa Marta	50	Moist Forest

The reforestation activities here seek to imitate and support natural regeneration as much as possible. By using a diversity of trees and promoting natural regeneration, we expect that over time forest regeneration will be similar to or more rapid than that observed under natural regeneration scenarios. Therefore, in order to project future biomass we looked to proxy or reference forest sites.

Even-aged forest stands near to reforestation sites were located based on interviews of local landowners, aerial maps, and first-hand knowledge of the area. Forest sites were assigned an estimated age based on historical information on changes in land tenure and use, aerial maps, interviews with landowners and local informants, and based on first-hand ecological observations of forest structure and composition. We then mapped each area and randomly located permanent plots within these forest sites, seeking to sample at least ten permanent plots within each age class and ecological zone.

Permanent plots are 20m radius and include a nested sampling design where trees less than 5 cm dbh are measured within 1m radius, trees 5-9.9 cm dbh sampled in 4 m radius, trees 10-19.9 cm dbh measured within 14 m radius, and trees greater than 20 cm dbh measured within a 20 m radius. We then used this data to apply allometric equations[13] for estimating aboveground and belowground biomass.

[13] Brown, S. 1997. Estimating biomass and biomass change in tropical forests: a primer. FAO Forestry Paper B4. FAO – Food and Agricultural Organization of the United Nations. Rome, Italy.

Table 22. Forest layers considered to estimate future carbon stocks at moist and dry forest reforestation areas.

Data variable	Data unit	Value applied	Data Source
Aboveground Tree Biomass	*Tonnes Carbon /Ha*	*Allometric Equation Brown 1997*[14]	*Permanent plots of proxy forests, Based on DBH and forest type*
Belowground Biomass	*Tonnes C/Ha*	*Allometric Equation, Cairns et al. 1997*[15],	*based on AGB*
Seedling Biomass	*Tonnes C/Ha*	*Allometric Equation, Hughes et al. 2006*[16]	*Survey of Forest Proxies and Project Sites, based on trees <5cm dbh*
Dead Wood	*Tonnes C/Ha*	*5% of AGB and BGB*	*Estimate based on Glenday 2006*[17], *Oswalt 200*[18]*7, Vargas et al 2007*[19], *Jaramillo et al.*[20]

Results indicated a different rate of carbon accumulation between the two different ecological zones, with tropical dry forests accumulating biomass early on during the successional process but falling behind tropical moist forests in later years. For proxy forests we observed that carbon stocks increased over time in both forest types, but biomass was highest in tropical moist forest sites at age 40 years. Given the differences in biomass accumulation, we calculate net changes in carbon stocks separately between the two ecological zones.

[14] Brown, S. 1997. Estimating biomass and biomass change in tropical forests: a primer. FAO Forestry Paper B4. FAO – Food and Agricultural Organization of the United Nations. Rome, Italy.
[15] Cairns, M.A., Brown, S., Helmer, E.H. & Baumgardner, G.A. 1997. Root biomass allocation in the world's upland forests. Oecologia 111: 1-11.
[16] Hughes, R.F., Kauffman, J.B., Jaramillo, V. 1999. Biomass, carbon, and nutrient dynamics of secondary forests in humid tropical region of Mexico. Ecology 80:1892-1907.
[17] Glenday, J. 2006. Carbon Storage and emissions offset potential in an East African tropical rainforest. 235: 72-83. Forest Ecology and Management 40:20-27
[18] Oswalt, S.N. and Brandels, T.J. 2007 . Contribution of dead wood to biomass and carbon stocks in the Caribbean: St. John, U.S. Virgin Islands. Biotropica 40:20-27.
[19] Vargas, R., Allen, M., and Allen, E. 2007. Biomass and carbon accumulation in a fire chronosequence of a seasonally tropical dry forest. Global Change Biology 14:1-16.
[20] Jaramillo, VJ, Kauffman, JB, Renteria-Rodriguez, L., Cummings D.L., Ellingson, LJ. 2003. Biomass, carbon, and nitrogen pools in Mexican tropical dry forest landscapes. Ecosystems 6:609-629.

Table 23. Mean Carbon stocks at forest stands in two ecological zones: dry tropical forest and moist tropical forest.

Forest Type	Estimated Stand Age	Mean Carbon Stocks (Tonnes C/Ha)
Dry Tropical Forest	20 years	63.41
Dry Tropical Forest	30 years	125.86
Dry Tropical Forest	40 years	132.58
Dry Tropical Forest	Mature Forest	268
Moist Tropical Forest	20 years	46.16
Moist Tropical Forest	30 years	126.07
Moist Tropical Forest	40 years	172.51
Moist Tropical Forest	Mature Forest	275.39

The RTF project is a 40 year project. Therefore we use the carbon estimates at year forty to estimate the carbon accumulated over the lifetime of the project. Estimates for younger stages of forest will enable us to compare projected growth with actual growth observed over the lifetime of the project to check the accuracy of our projections.

All proxy forest sites have received some degree of disturbance in recent years, primarily through grazing, firewood collection, and wildfires. Therefore, we believe that estimates of carbon pools based on these reference forests are a conservative estimate of the amount of carbon that will accumulate in a protected forest undergoing active restoration.

Pre-project carbon stocks

Nearly all of the project sites had patches of trees within reforestation areas. Even though under the baseline scenario, change in carbon stocks would be zero or negative, we approach this pre-project carbon conservatively by assuming that the biomass already present on the ground from these trees may not be attributed to this reforestation. We therefore subtract the pre-project carbon stocks from any projections of future carbon stocks at reforestation sites. Methods for determining pre-project carbon stocks are described in Section G1.

We made several assumptions regarding baseline conditions across sites:

- At sited with pre-project natural regeneration (Site #1 and #6), continued natural regeneration in absence of project will be slower than with reforestation due to dominance of shrubby species mixed with non-native invasive grasses and weeds.
- At sites where cattle ranching would continue without project, tree cover would remain the same or decline in absence of the project.
- Soil carbon is not expected to greatly increase with project activity thus it is not included in stratification for either baseline or *ex ante* scenarios.
- Shrubby vegetation across project sites is similar to pasture in that it is non-permanent under baseline scenarios and therefore is not included for calculation of baseline GHG sinks, however tree seedlings are included in calculation of baseline GHG.
- Level of disturbance (firewood collection, grazing) in restored forest will be less than that of proxy forest because reforestation areas will be protected in reserves and will receive management and protective measures. Therefore, given their disturbance it is likely that the forest biomass is less than what a protected forest of the same age would have. Therefore, we assume that the carbon pools estimated for ex ante using disturbed forest are conservative.

Table 24. Net Greenhouse gas removal estimated for each reforestation site in moist tropical forest areas. GHG is estimated as Tonnes CO^2 /hectare.

Site #	FARM	Preproject Tonnes CO2/ Ha	Area (Ha)	40 Year Proxy (Tonnes CO2/ha)	Total GHG Sink (Tonnes CO2)	Preproject GHG Pool (Tonnes CO2)	Net GHG (Tonnes CO2)
2	Arce	78.988	165.3	628.96	103985.3278	13059.00705	90926.32
4	Guacamaya	6.4114	10.82	628.96	6804.08928	69.3585252	6734.731
5	Isla Vista	1.16152	21.26	628.96	13371.6896	24.6939152	13347
3	La Tigra	1.73	4.45	628.96	2798.872	7.6985	2791.174
8	Santa Marta	6.4114	50	628.96	31448	320.57	31127.43
						NET GHG Removal	**144926.7**

Table 25. Net Greenhouse gas removal estimated for each reforestation site in dry tropical forest areas. GHG is estimated as Tonnes CO^2 /hectare.

Site #	FARM	Preproject Tonnes CO2/ Ha	Area (Ha)	40 Year Proxy (Tonnes CO2/ha)	Total GHG Sink (Tonnes CO2)	Preproject GHG Pool (Tonnes CO2)	Net GHG (Tonnes CO2)
6	Las Fincas	129.37	34.547	482.5	16668.93	4469.3	12199.58
1	Domitila Tacotal	44.45	67.86	482.5	32742.45	3016.4	29726.07
1	Domitila grassland	10.29	37.32	482.5	18006.9	384.02	17622.88
7	Chumbulum	4.22	14.024	482.5	6766.58	59.181	6707.399
						Net GHG Removal	**66255.93**

2. Other non-CO^2 green-house gases

Non-CO^2 gases are not expected to account for more than 15% of the projects overall GHG impact and therefore are not considered

We are not considering non greenhouse gas emission as significant because of multiple factors. First, we do not plan to use significant quantities of chemical fertilizer for this project. Fertilizers are applied only to where soils are poor. When N_2O emissions for the maximum potential fertilizer use are calculated using IPCC guidelines[21], the total N_2O emissions for the project are .065 metric tons. This is an insignificant proportion of the project's overall GHG impact. This is based on a maximum potential fertilizer estimate of is 200 grams/tree using N-P-K (17-17-17) fertilizer. We believe this is a conservative estimate, because we are not recommending fertilizer use to landowners nd less than 10% of this estimate was used by landowners during the first six months of the RTF project.

[21] IPCC 2006. IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4, Chapter 11, Tier 1 Equations, pg. 11.9)

There is absolutely no burning associated with this project, and project activities will actually work to prevent fires that could emit nitrous oxide. There are no wetland soils being moved or disturbed throughout RTF that could lead to the emission of methane gas. Flooding irrigation is not permitted. There are no soil drainage activities related to this project, the amount of nitrogen-fixing species used in the project activity is minor, so that greenhouse gas emissions from denitrification can be overlooked in the estimation of actual net greenhouse gas removals by sinks. Finally, site preparation does not cause significant long term net decreases of soil carbon stocks or increases of non-CO2 emissions from soil.

Trees will be planted with low density (625 trees per hectare) and will receive a small hole site preparation (*e.g.* 20 x 20 cm in diameter). As a result, the surface area disturbed by site preparation is estimated to be 0.2 - .8% of the total land surface. Therefore the site preparation will not cause significant long-term net emissions from soil carbon.

3. Net Climate impact

Table 26.. Estimated Net Change in greenhouse gases, subtracting possible GHG removal under baseline scenario and due to negative offsite climate impacts as a result of the project.

Total GHG removal through RTF (Tonnes CO2)	**211,182.63**
GHG without project (Tonnes CO2)	36,324.6
Estimated Leakage (Tonnes CO2)*	4291
TOTAL Net Change in GHG due to Project Activities (Tonnes CO2)	**170,567.03**

4. Other considerations – Permanence

Paso Pacifico will address the issue of non-permanence in this project by:

- Establishing new private protected areas at reforestation sites, and supporting landowners in developing and implementing Private Reserve management plans, thereby ensuring development and conservation of carbon pools and associated ecological benefits. Private Reserves are registered with the Nicaraguan Ministry of the Environment.
- Entering into a binding contract with landowners to protect the reforestation areas during the lifetime of the project (Refer to supporting documents "Landowner Contracts"). Land title registries are then officially changed to reflect legal obligation to conserve forest areas over the lifetime of the project.
- Work with other NGOs and Government Institutions to develop legislation that will develop conservation easements or other legislation with enforcement ability.
- Develop partnerships with Nicaraguan Universities and other institutions to provide support to landowners, in the case that Paso Pacifico is unable to care for the land throughout the entire 40 year period.
- Provide financial and other in-kind incentives to landowners to enable reforestation to take place and to encourage good stewardship of reforestation areas
- Train and equip local community members to work as rangers for private protected areas which are reforestation sites. Implement environmental education programs in local communities to promote respect for restoration areas.
- Assist landowners to develop and implement management plans for their properties
- Develop management plans for ensuring the success of reforestation areas and adapt plans as needed

* Explanation of Leakage calculations provided in section CL2.

5. Other considerations – Additionality

This project was conceived in February 2007 and involves legal agreements with the organization that provided financing and with landowners participating in the project. Landowners acknowledge in contracts that reforestation would not have occurred without Paso Pacifico's technical and/or financial support. Reforestation in this project is a result of direct human action. Over time, increases in carbon pools will be aided through management for the purpose of forest restoration.

There are realistic alternatives to reforestation land uses, given the socio-economic conditions of each landowner, the limited technical expertise in the area of reforestation of each land-owner, and the financial limitations.

Nearly all of the landowners would be unable or unwilling to cover reforestation costs with conservation aims. Paso Pacifico is providing the financial incentive to cover reforestation costs (some farms have higher labor costs and could not cover all costs of reforestation using Paso Pacifico's subsidy), supplement cost of management, assure technical input, and reward participating landowners with other incentives (i.e. eco-tourism project development, payments for environmental services). This financial barrier is validated in the formal agreement between Paso Pacifico and the landowner.

All landowners participating in this project appreciate and value biodiversity and carbon stocks found in forests. However, none have the technical expertise to implement a native forest restoration program. No landowners have ever done reforestation projects prior to this one, with the exception of Project Site #6, which started reforestation activities in 2006 outside of this project area, in coordination with Paso Pacifico. No landowner has foresters or forest ecologists on their staff. Some landowners have demonstrated that they have a limited understanding of the current ecological conditions of their farms.

CL2. OFFSITE CLIMATE IMPACTS

1. Estimates of offsite decreases in carbon stocks

Paso Pacifico has identified four potential types of leakage possible within the RTF project, two of which are negative and two are which are positive.

a) Cattle production reduced during RTF project is shifted elsewhere
Cause – removal and sale of cattle in reforestation areas, if there is market demand, potential for these cattle to be produced elsewhere

Effect – Negative, due to continued emissions from cattle grazing.

Mechanism – Activity shifting

The RTF project does not displace landowners and engages them in the new land use activity. Therefore, the risk that for this negative activity-shifting leakage is low[22]. However, in theory, there could be a certain degree of leakage if market demand nationwide pushed cattle production to occur elsewhere. Such leakage would be difficult to track. It is important to note that of the 310 heads of cattle across project sites, 250 were sold by landowners to the slaughterhouse at the start of the RTF project. Landowners either reduced or eliminated cattle production on their farm and expect to replace grazing with other activities including eco-tourism and research in reforestation areas. At one farm, the landowner plans fruit tree production and horse breeding in pasture areas of the farm affected by a reduction in livestock. The remaining sixty head of cattle removed for RTF were moved to other pasture areas owned by the landowners or cattle-owners (pasture was rented to a neighboring rancher at one site). In these cases, no additional land was cleared or new pasture area created.

Given the difficulty in tracking cattle production at a national level and its relation to this project and considering the low risk of leakage due to our direct actions with landowners, we will be mitigating this leakage by withholding 20% of carbon from the market.

b) Increased GHG emissions related to tourism and reforestation activities
Cause – increased emissions from vehicles used during eco-tourism and tree planting activities across project sites.

Effect – Negative

Mechanism – Life Cycle Emissions Shifting

Paso Pacifico has begun recording all use of fossil fuels and other emitting factors related to the RTF project and all other Paso Pacifico activities. This considers emissions through the use of organizational vehicles, air travel, public transportation travel, office energy consumption, and vehicles used during the planting period of the project. Additionally, Paso Pacifico will track tourism activity at private reserves created through this project to identify leakage associated with vehicle and air travel from tourists visiting these private reserves.

[22] Shwarze, R., J.O. Niles, and J. Olander 2002: Understanding and Managing Leakage in forest-based Greenhouse-Gas-Mitigation projects. Philosophical Transactions: Mathematical, Physical and Engineering Sciences 360: 1685-1703

Currently, Paso Pacifico has created an estimate for future emissions in this area and has subtracted them from estimated carbon benefits[23]. The assumption is that Paso Pacifico operations and tourism activity will have increased by year 10, but will not continue to increase in size years 30 through 40. Continual organizational growth is not within Paso Pacifico goals or strategic plan. Details for these estimates are available in supporting document 'Project Emissions - Leakage'.

Table 27. Projected Paso Pacifico Carbon Dioxide Emissions over lifetime of RTF project.

Projected Paso Pacifico Carbon Dioxide Emissions in Metric Tons:	**2007**	**2008-2017**	**2018-2046**
Number of Years:	1	10	29
Number of Employees:	20	20	40
Electricity Use in Office Space:			
kwh / year	3600	3600	10800
tons	2	20	175
Annual Business Travel by Air:			
miles travelled/ year	55,000	35,000	25,000
tons	9.90	63	130.50
Annual Business Travel by Rail:			
miles travelled/ year	500	500	1,500
tons	0.09	0.90	7.83
Annual Truck Mileage (2007 Ford Ranger 4WD, Diesel):			
number of vehicles	1	2	4
est. mpg per vehicle	18	21	18
fuel used (gal of diesel)	443		
miles travelled per year per vehicle	20000	20000	23960
tons emitted per vehicle over time:	11.2	112	389
total tons emitted:	11.2	224	1556
Annual Bus Transportation to Field:			
miles travelled per employee/year	20,000	20,000	25,000
tons	3	34	123.25
Ecotourism:			
Est. Number of Visitors/year:		266	574
Air Travel Estimates:			
Estimated Air Mileage Per Person:		5000	5000
Total Air Mileage		1,330,000	2,870,000
Site Visit Share of Air Mileage (assume 5% of		66,500	143,500
C02 emissions (metric tons):		120	749
Ground Travel Estimates:			
Assumed Visiting Group Size:		2	2
Number of Groups:		133	287
Vehicul Mileage Per Group Per Year:		200	200
Total Visitation Miles:		26600	57400
Tons Emissions:		128	932
Grand Total (Metric Tons):	27	589	3,675
	Total Metric Tons 40 years		**4,291**

[23] Based on World Resources Institute – Greenhouse Gas Protocol 2006

c.) Increase in tree planting of neighboring landowners and communities

Cause – Neighbors and community members observe the process of tree planting and become interested in doing something similar. Excess trees from project and community nurseries are shared among local community members. Paso Pacifico carries out reforestation activities not eligible for carbon credits projects with schools, farming communities and landowners.

Effect – Positive, increase in removal of GHG from atmosphere through biomass

Mechanism – Activity Shifting

The RTF project and other Paso Pacifico activities result in two major activity shifts: i) increase in tree planting due to change in culture, ii) planting of hardwood and fruit trees through other Paso Pacifico projects. Paso Pacifico is not currently accounting for carbon benefits for these shifts in land use activity. Over the last year, we have observed other large landowners take an interest in doing reforestation. Several large landowners have already begun planting trees on their own (approximately 100 ha at two farms). We have observed farmers planting and transplanting trees to their farm. As the awareness of reforestation benefits increases, so does the level of interest and participation in reforestation. Through other Paso Pacifico projects with local people, we have planted hundreds of fruit trees and over 6,000 hardwood species in the Paso del Istmo. In 2008, Paso Pacifico will plant over 50,000 trees as part of a reforestation and educational project where carbon benefits will not be counted. Paso Pacifico will continue to do reforestation and restoration, within and outside of projects that account for carbon benefits. To be conservative, the positive effect of this leakage will not be accounted for within this project.

d) Increase in biomass at project site in forests under increased protection

Cause – By creating new private protected areas at reforestation sites, biomass will increase in the degraded forest fragments already present on the project sites, but outside the boundaries of the plantation areas.

Effect - Positive, increase in removal of GHG from atmosphere through biomass

Mechanism – Ecological[24]

Most of the RTF project sites have degraded forest areas outside of the boundaries planted areas. Paso Pacifico and landowners have made legal agreement to work together to create private protected areas for the forests, including these forest patches. Forest restoration will occur in these areas as a result of RTF activities such as the removal of cattle, the increased protected of the entire area, and through spillover effects from the ecological processes occurring in plantation areas (*i.e*. increased seed dispersal, improved micro-climate conditions). In 2008, Paso Pacifico will conduct biomass and area measurements of degraded forest patches to accurately account for this positive leakage as a result of the RTF project.

[24] Shwarze, R., J.O. Niles, and J. Olander 2002: Understanding and Managing Leakage in forest-based Greenhouse-Gas-Mitigation projects. Philosophical Transactions: Mathematical, Physical and Engineering Sciences 360: 1685-1703

2. Mitigation of offsite negative impacts

Site Selection – We have chosen to reforest and restore land areas in a landscape that has a long history of deforestation and degradation. Currently, only 16% of land maintains forest cover in the municipalities where RTF project is located[25]. By conducting reforestation in an area where deforestation has already occurred, it is less likely that grazing activities will shift into forest areas. This is similar to a reforestation project in Costa Rica where there was little forest outside of the project area to be displaced[26].

Multi-component Project – This project is not limited to reforestation and conservation of reforestation areas. It includes training opportunities for landowners and local communities, employment generation through ecotourism, park management, and research projects, alternative agricultural projects, and fuelwood production through other agro-forestry and non-carbon accounting reforestation activities. This approach helps to reduce leakage by addressing the needs of local people and by giving them sustainable access to resources[27].

Monitoring – Paso Pacifico will be monitoring land use across the Paso del Ismto conservation corridor throughout the lifetime of the project. This monitoring will take place at the landscape level in areas outside of the reforestation sites. In particular, we will track certain indicators of potential leakage[28]including land use (i.e. area of land under grazing), change in forest cover (possibly indicating increased demand for firewood), and diversification of economic activities in communities.

Additionally, we will monitor cattle production across Nicaragua's Southwestern provinces of Granada, Rivas, and Carazo to detect any shifts in cattle production. The primary data source for monitoring production will be the National Agricultural Census, which is a farm-level detailed census of agricultural production in each province carried out every five to eight years. Municipal governments and local communities will be another important source of data on cattle production.

Discounting – Paso Pacifico has calculated to the best of its abilities estimates of future negative leakage and discounted those sources of leakage from emissions reductions estimates. These sources of leakage come from future tourism activities at RTF sites and from other Paso Pacifico operations. Due to potential uncertainties related to calculating leakage, Carbonfund.org (the organization to sell RTF carbon benefits) will be withholding 20% of carbon offsets from sale. This amount is believed to conservatively buffer any leakage, particularly since we will have already discounted estimated leakage from other components of the project. All carbon benefits from the project are tracked through a serial number and the carbon benefits to be withheld are to be set apart in a "lockbox" account area and marked as not available for sale within the company's internal registry and also an external registry. All carbon sales are to be tracked and reported to both an internal and external registry. Third party auditors will audit sale records and registries to verify that the 20% of carbon offsets were withheld from sale. These audit reports will be available to the public on-line.

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[25] Paso Pacifico 2007. Fragmentation Analysis in Paso del Istmo conservation corridor. Technical Report.

[26] Trexler, M., Koshoff, L.H. & Gibbons, R.L. 1999. Forestry and land-use change in the AIJ Pilot Phase: the evolution of issues and methods to address them. In The UN Frameowrk Convention on Climate Change Activities Implemented Jointly Pilot: lessons learned and applications to future market-based mechanisms to reduce GHG emissions (ed. R. Dixon), pp 121-165. Dordrecth: Kluwer.

[27] Shwarze, R., J.O. Niles, and J. Olander 2002. Understanding and Managing Leakage in forest-based Greenhouse-Gas-Mitigation projects. Philosophical Transactions: Mathematical, Physical and Engineering Sciences 360: 1685-1703

[28] Brown, P, Cabarele, B. and Livernash, R. 1997. Carbon counts: estimating climate mitigation in forest projects. Washington,DC: World Resources Institute.

3. Subtracting unmitigated negative offsite climate impacts

Below is the total net effect of the RTF project on carbon (also presented in C1), which is equal to the net increase in onsite carbon stocks minus negative offsite climate impacts (Leakage).

Table 28. Presentation of Total Net change in GHG due to project. Offsite climate impacts are reduced from the total

Total GHG removal through RTF (Tonnes CO2)	**211,182.63**
GHG without project (Tonnes CO2)	36,324.6
Estimated Leakage (Tonnes CO2)	4291
Total Net Change in GHG due to Project Activities minus baseline scenario and minus 'leakge' (Tonnes CO2)	**170,567.03**

CL3. CLIMATE IMPACT MONITORING

1. Monitoring Plan

Paso Pacifico has established permanent monitoring plots at reference forests and also throughout reforestation areas. Plots are permanently marked using steel rebar stakes grounded with cement. Markers of another type would not be long-term because of the high frequency of human foot traffic in the area.

Climate impacts in reforestation areas
Paso Pacifico will monitor the following components of reforestation areas over time:

a) Above-ground biomass: dbh of trees in reforestation areas will be and allometric equations described in Section G1. will be applied to estimate above-ground biomass. When saplings are below 5 cm dbh, then allometric equations for seedlings will be applied. Below-ground biomass will be estimated.
b) Dead wood: Dead-wood will measured starting at year five and with subsequent years to test whether projections of 5% of total aboveground biomass were accurate. Dead-wood will be measured using Brown-transects for measuring downed woody debris.

Monitoring will take place at each of the reforestation sites at five year intervals throughout the lifetime of the project. Repeated monitoring will be conducted within the permanent 15m radius circular plots established throughout the reforestation areas.

Natural Regeneration without Project
At two of the project sites, natural regeneration was expected to continue under the "without project" scenario (Sites #1 and #6). We assumed a slower regeneration process with natural regeneration than with reforestation due to limited seed sources and the dominance of grass and weed cover. Therefore, individual trees within permanent pre-project plots will be permanently marked at these two sites. Additional measurements will include canopy dimensions and canopy height. Remnant trees will be followed to determine if estimated changes in biomass for the without project scenario are in agreement with or a conservative estimate for actual changes in preexisting biomass over time. These measurements will be collected every five years.

Reference forests
Paso Pacifico will return to monitor reference forests every five years. Trees in reference forest plots have been permanently marked with aluminum tags. The centers of these plots also have cement permanent markers. Plots will be visited every five years to monitor growth and forest productivity. Above-ground and below-ground biomass will be estimated within these plots based on dbh measurements for trees and seedlings.

CL4. ADAPTING TO CLIMATE CHANGE AND CLIMATE VARIABILITY

1. Regional climate change and climate variability

Climate change and climate variability will likely impact reforestation areas. While changes in temperature, precipitation and CO2 levels have the potential to impact growth and competition of trees within the reforestation areas, extreme climate such as hurricanes and drought events have the greatest potential for a catastrophic impact on plantation structure and survivorship.

a) Climate Change - There is a high degree of uncertainty regarding climate change impacts in southwestern Nicaragua due to the confluence of various geographic features influencing local weather (*e.g*. coastal mountain range, Lake Nicaragua, Pacific Ocean). Nevertheless, global climate models generally forecast a time-averaged decrease in precipitation across Central America for the latter half of the 21st century[29,30] and an increase in dry extremes throughout the year[31]. Already over the last decade a decrease in precipitation and an increase in temperature of 1° C have been observed[32].

b) Climate Variability – The El Niño-Southern Oscillation (ENSO) and tropical storms and hurricanes are extreme forms of climate variability that may increase in intensity or frequency with future climate change. In Southwestern Nicaragua, ENSO events are known to extend the length of the dry season and increase the temperature[33]. While hurricanes have not historically entered Nicaragua from the Pacific coast, large Caribbean hurricanes and tropical storms can soak the Pacific slope with record rainfall in a short amount of time. Such storms – as was the case during Hurricane Mitch in 1997 – have the potential to cause devastating flooding of coastal areas and rivers and to cause mudslides along deforested hillsides.

2. Minimizing the potential negative impacts

The RTF project helps to mitigate climate change impacts by reversing deforestation trends and by improving watershed and wetland protection. Healthy ecosystems are more resilient to climate variability and climate change impacts. For example, mangroves in Central America are especially vulnerable to rises in sea level[34]. The reforestation at Site #6 Las Fincas helps to mitigate this threat by protecting the upper watershed and thereby improving the quality of water flowing into the Escamequita Mangrove Estuary. Also, by restoring watersheds throughout the *Paso del Istmo* we are reducing the risk of severe flooding, stabilizing river and stream banks to prevent severe erosion, and slowing desiccation of rivers and underground water sources during severe droughts.

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[29] IPCC 2002. IPCC Technical Paper V: Climate Change and Biodiversity. Intergovernmental Panel on Climate Change. Eds. H. Gitay, A. Suarez, D. Dokken, and R. Watson

[30] Ruosteenoja, K., T.R. Carter, K. Jylha and H. Tuormenvirta, 2003: Future climate in world regions: an intercomparison of model-based projects for the new IPCC emission scenarios. The Finnish Environment 644: Finnish Envionment Institute, Helsinki, 83 pp.

[31] IPCC 2007. IPCC Working Group II Report: Impacts, Adaptation, and Vulnerability.

[32] Aguilar E., T.C. Peterson, P. Ramirez Obando, R. Prutos, J.A. Retina, M. Solera, J. Soley, I Gonzalez, and co-authors 2005: Changes in precipitation and termperature extremes in Central America and northern South America. 1961-2003. J. Geophys Res. 110:107

[33] Magaña, V., J.A. Amador, and S. Medina, 1999: The midsummer drought over Central America. Journal of Climate 12:1577-1588.

[34] Kovacs, J.M. 2000: Assessing mangrove use at the local scale. Landscape Urban Plan., 43: 201-208.

Although the RTF project may not be able to stop the impacts of global climate change, we have made specific plans to confront climate change impacts on the RTF project.

Table 29. Actions planned to reduce the impact of climate change and variability on the RTF project.

Climate Change Impact	Potential impact on RTF	Action Taken or to be Taken
Severe droughts during El Ñino Events	Seedling mortality	Planting drought resistant native trees, will water plants if necessary during first 5 years
Severe droughts during El Ñino Events	Wildfires	Fire breaks, patrols during high burn month of April, community brigades and fire training
Increased Temperature and CO2	Increased competition from weeds and grasses	Monthly visits to reforestation areas, manual removal of weeds and grasses until shade has eliminated these invaders
Wind Storms	Tree mortality, downed woody debris	Woody debris will be left in reforestation areas as part of carbon stock, dead tree seedlings will be replaced during the first five years, natural regeneration will be promoted
Heavy Rain Events	Local flooding of plantation areas	Planting native trees that can withstand super saturated soils, improving river banks by planting riparian trees along rivers
Heavy Rain Events	Mudslides	Very few steep areas within project, where there are hills we have planted native trees to stabilize hillsides

CL5. CARBON BENEFITS WITHHELD FROM REGULATORY MARKETS

1. Sale of Carbon Benefits

Future carbon benefits expected to be generated through the RTF project will be sold through the non-profit organization CarbonFund.org. This organization sells carbon credits to private citizens and public corporations through a voluntary and unregulated market. CarbonFund.org will withhold 20% of these carbon credits from sale in the voluntary market. Refer to section CL2 for information on mechanisms for tracking the carbon benefits withheld from markets.

CM1. NET COMMUNITY IMPACTS

1. Net benefits to communities resulting from planned project activities

The Return to Forest project cannot be viewed in isolation from other Paso Pacifico activities that seek to promote sustainable livelihoods in local communities. These other Paso Pacifico projects include capacity building in eco-tourism and field research, job opportunities for local people in reforestation, protected areas management, jobs in field research activities, sustainable agriculture with alternative crops (i.e. cacao, citrus), and environmental education programs. We assume that Paso Pacifico projects that are currently planned or that are underway in these communities contribute to the net community benefit of the RTF project. Detailed projections of net benefits with regard to community well-being are available in supporting document “Community Study, Return to Forest”.

Table 30. Net Positive Benefits to Local Communities Participating in Return to Forest and other Paso Pacifico projects. Increases = ⇧ Positive Change = ✦

Net Positive Impact for communities near to the project	Community	Income	Diversification of Incomve	Distribution of Income	Access to f Service	Access to Production Resources	Agricultural Production	Household Food Security
	Escamequita	⇧	Si		Agua Luz Vivero/ Recolección semilla Educación	Semillas Árboles Abono orgánico	⇧	✦
	Las Parcelas		Si		Educación			
	Carrizal		Si					
	Tortuga		Si		Educación			
	El Acetuno	⇧		✦	Luz Educación Mejora escuela Vivero/ Recolección Semilla Educación	Semillas Árboles Abono orgánico	⇧	✦
	El Carmen – Santa Ana	⇧	Si	✦	Educación Mejora escuela Vivero/ Recolección Semilla	Semillas Árboles Abono Orgánico	⇧	✦
	Pueblo Nuevo	⇧	Si	✦	Educación Mejora escuela Vivero/ Recolección Semilla	Semillas Árboles Abono Orgánico	⇧	✦
	Ostional				Educación			

2. Stakeholder Participation in Project Planning

There are three major stakeholder groups considered within this project. The first and most active are the eight landowners on whose properties reforestation activities have occurred. The second are local communities that have participated in tree nursery, planting, and other Paso Pacifico project activities. Finally, local municipal governments and national agencies (i.e. Ministry of Environment) also have an interest and role in project development. Below is a scheme of participation in project planning.

Table 31. Timeline of initial stakeholder participation in RTF project planning

	Landowners	Community Members	Government
May 2007	Landowners invited to participate in reforestation activities	Landowners in rural community invited to participate in RTF through reforestation, problems with land titles prohibited them from planting trees but participated through nurseries	Ministry of Environment CDM office advised of project plans
June 2007	Preliminary landowner agreements reached, landowner selects areas for planting	Community group Asociacion Pacifico Sur establishes community nursery, with sale of trees designed to profit communities	Municipality of San Juan del Sur notified of project activities
July – September 2007	Landowner consultation and participation during planting activities	Meetings with community leaders at rural community sites explaining project. Community members invited to work as laborers in reforestation activities	Municipality of San Juand el Sur invited to visit reforestation stie
March 2008	Update to landowners through private meetings	Meeting with communities to present project and to award community groups for participation	Presentation

3. Conflict Resolution and Grievances Procedures

The eight landowners participating in this project have the opportunity to address concerns or complaints directly with the project forester, the Paso Pacifico director, or with the Paso Pacifico Executive Director. Landowners have the contact information and are in frequent phone and face-to-face communication with these staff persons.

Similarly, local community members have the opportunity to address concerns to Paso Pacifico staff working with the community members. Community leaders have contact information and phone numbers for relevant Paso Pacifico staff. Community meetings are held in communities where Paso Pacifico has rural development projects in progress. These communities include Escamequita, La Tortuga, Ostional, Pueblo Nuevo, El Carmen, and El Aceituno. Most of these communities have a system of addressing grievances within community organizations.

Nevertheless, landowners and community members must be given the opportunity to express grievances or concerns through a process that will ensure that these are addressed. This is particularly true for the case of local community members, who are more likely to shy away from contacting staff to express the opinions.

The Paso Pacifico Board has determined that the organization must adopt a grievance procedure in early 2008. The Board of Directors will work with Paso Pacifico staff to then be presented this procedure during community meetings so that all will be aware of its options. This procedure will consider the following components:

- Accessible communication by all stakeholders, regardless of economic class.
- Communication access points near to or within local communities.
- Respect for community organizations in place and already established procedures for conflict resolution or grievances within community organization
- Allow for stakeholders to maintain anonymity before Paso Pacifico or before other stakeholders if preferred
- Process for decision-making among Paso Pacifico staff to address grievances
- Documentation of grievances made and the form in which these were addressed documented
- Option for Paso Pacifico to assist communities in addressing grievances with third parties, particularly with respect to the participation of other government organization

CM2. OFFSITE COMMUNITY IMPACTS

1. Potential Negative Impacts

The primary potential negative impact of this project is that job opportunities previously available through extensive cattle ranching will no longer be available to community members. These jobs are both temporary and permanent employment in tending to cattle, herding cattle before sale, and managing pasture (generally through annual burns).

Another potential impact is the cultural effects of tourism on local communities. Project sites #1 and #6 are already conducting tourism activities and local communities are involved in tourism at these sites. Under the baseline scenario, communities near these two farms would have already been influenced by tourism, though eco-tourism could increase as a result of improvements to habitat. Project sites #2 and #3 do not plan to introduce eco-tourism to their farms. Project Site #4, #5, #7, and #8, all plan to increase eco-tourism activities over time, but only site #4 is planning to create lodging at the project site. It is important to note that tourism is on the rise in Nicaragua, independent of the Return to Forest Initiative. Therefore, Paso Pacifico believes that it within the possibilities, that eco-tourism at reforestation sites is preferable to other tourism alternative that might have developed at the sites in the absence of the project and the guidance of Paso Pacifico.

One final potential impact on communities is the influence of volunteers and researchers. Researchers and volunteers collaborating with Paso Pacifico come from Managua and around the world. They can bring in new ideas and attitudes, new commercial goods, and will develop relationships with local people. These new things have the potential to have either a positive or negative impact on the communities.

2. Mitigation of Negative Impacts

The impact of job loss in the area of extensive cattle ranching will be mitigated by job training and job creation in the areas of private reserve management, alternative agriculture (citrus crops, cacao, hibiscus and other), research (field assistants), and eco-tourism. Extensive livestock grazing has a low intensity of labor. We expect that the jobs created through activities promoted by Paso Pacifico to be equal or greater than those jobs lost. Paso Pacifico will deliberately seek to train and employ former ranching employees. This is beneficial for all because local employees generally have very good first-hand knowledge of forests. Paso Pacifico has already begun job training at several project sites.

The socio-cultural impacts of tourism activities will be mitigated by Paso Pacifico working in partnership with landowners at RTF sites to develop eco-tourism projects. Sustainable tourism will take into account cultural traditions and beliefs. Additionally, Paso Pacifico will work to promote the reliance on local labor, and will partner with international eco-tourism companies that promote sustainable tourism (*i.e.* partnership with Mesoamerican Eco-tourism Alliance already underway). Finally Paso Pacifico staff will develop a protocol and list of rules for Paso Pacifico volunteers and researchers working within Paso Pacifico communities. Rules will be agreed upon by volunteers before beginning any research or volunteer work. This protocol will consider respect for local community's practices and beliefs, abstention from drugs and alcohol, etc.

4. Net Social and Economic Effects

Table 32. Net impact of offsite impacts against RTF project benefits

Potential Impact	Community Benefits	Net Impact
5 full time jobs in cattle ranching lost	Job training and creation in eco-tourism, alternative agriculture, and reserve management	Positive, more jobs created than lost, diversification of labor force
10 temporary labor jobs in cattle ranching lost	Temporary jobs created in reforestation, plantation management, and research and field assistant jobs	Positive, more jobs created, news skills learned in the area of biodiversity conservation
Change in culture due to increased tourism	Economic benefits from tourism jobs, shift in values towards wildlife and biodiversity conservation	If tourism is implemented using sustainable models, net positive impact for conservation and economic development of community
Change in culture and values due to increased number of researchers and visitors	Increased jobs, shift in values towards wildlife conservation	Neutral

CM3. COMMUNITY IMPACT MONITORING

Paso Pacifico already has ongoing community monitoring established through the RTF project and through other ongoing capacity building and rural sustainable development projects (i.e. agriculture, eco-tourism). We have identified factors to be monitored throughout the lifetime of the RTF project. These indicators may change and be expanded upon. Specifically, we will likely increase monitoring for indicators related to natural resource use in local communities.

Table 33. Variables to be measured to assess community impact throughout the lifetime of the project.

Livelihood Factors	Indicators Measured	Monitoring Frequency
Education	Literacy Rate	2 years
Education	School Attendance Rates	Annually
Education	School Matriculation Rates	Annually
Education	Participation Rate in Paso Pacifico Capacity Building Activities	Ongoing
Health	% Households with latrines	2 years
Health	% Households with potable water	2 years
Health	Garbage management status in communities	Annually
Health	Access to health centers (distance and days open)	Annually
Economic	Unemployment Rate	2 years
Economic	Participation in different sectors of Employment	2 years
Economic	Land Use – Farm level studies and maps	2 years
Economic	Diversification and Income generated through agricultural activities	2 years
Economic	Savings rates and type of savings	2 years
Economic	Land Tenure (incl. legal titles)	2 years
Economic	Remittances	2 years
Demographics	Household, location, composition and size	2 years
Demographics	Immigration and out migration	Annually
Well-being	Participation and membership in community organization	Ongoing
Well-being	Gender participation in community organizations and Paso Pacifico project	Ongoing
Well-being	Local crime rates	Annually
Well-being	Attitudes and perceptions of wildlife, biodiversity, and conservation	2 years
Well-being	Perceptions in changes of community and household well-being	2 years

CM4. CAPACITY BUILDING

The RTF project and other Paso Pacifico activities include many capacity building opportunities. These training activities are designed to increase the skills of local community members.

1. Training to accommodate the need of communities

The RTF project needs community members to have skills in the areas of nursery management, tree planting, and seed germination. Workers in tree nurseries and at plantation sites have received various types of courses and instructions in this area. However, capacity building programs cover other areas that address community needs. Capacity building activities have been carried out in the areas of agriculture, tourism, environmental awareness, biodiversity research, and organizational development.

2. Targeted to a wide audience

While the participation in capacity building activities varies according the specific goals, most activities include an invitation extended to all community members, regardless of economic status or social position. The schools and community leaders are our principle means for extending invitations. There are school-age children representing the majority of households in the community. We have seen women and men from a diversity of households participate in field trips to nature reserves, agricultural training, and educational courses.

Figure 32. Left: Diverse participation from community members in educational activities, including youth and adult men and women. Right: Some community members will be trained in biodiversity monitoring techniques

3. Targeted to women

Women are invited to participate in nearly all Paso Pacifico capacity building activities. Additionally, we have developed activities in the area of household gardens and fruit production, specifically aimed at women in the communities. We are designing future projects related to income-generation in the areas of tourism and agro-forestry, especially to increase income among women.

Figure 33. Women participate actively in the RTF project and in other Paso Pacifico capacity-building opportunities.

4. Increase community participation in project implementation

Community participation is promoted through a series of direct consultations to community members and organizations. Before Paso Pacifico identifies a project, it assesses the community needs and checks to see how they might compliment Paso Pacifico conservation goals. In many cases, Paso Pacifico also directly asks community members what types of projects they would like to see in their communities. Such was the case in on-going agro-forestry and community-based eco-tourism projects underway in six communities near RTF sites.

Table 34. Recent Paso Pacifico capacity building activities from 2007 as an example of diverse participation to meet community needs.

Capacity Building Activity	Purpose	Community Involvement
Training in agro-forestry management, fruit trees distributed	Diversify crops and sources of income	El Aceituno, El Carmen, Pueblo Nuevo
Training in fruit trees and home gardens	Diversify crops and sources of income	12 women, El Aceituno, El Carmen, Pueblo Nuevo
Training in organic fertilizers and tree grafting	Improve sustainability of crops	18 men and women from three communities
Field Trip to Mombacho Reserve	Increase appreciation for tourism potential with conservation	22 women and men from 4 communities
Revolving fund management	Establish association micro-credit program	Asociacion Pacifico Sur
Organizational Capacity training sessions	Help community association better understand roles and structure in organization	Asociacon Pacifico Sur
Environmental Education Program	Year-long program in environmental curricula	110 children from Schools in Aceituno, El Carmen, Pueblo Nuevo
Training in hibiscus trees cultivation	Alternative income source for women	8 women from El Aceituno
Nursery establishment training	Establish community nurseries for RTF project	El Aceituno, El Carmen, Escamequita
Sea Turtle Awareness Training	Improve appreciation for sea turtles	90 families from Tortuga, Ostional, Escamequita
Training to work on Parrot, Vegetation, and Primate Studies	Increase local capacity to work in biodiversity monitoring	8 young community members trained to assist field biologists

CM5. BEST PRACTICES IN COMMUNITY INVOLVEMENT

1. Project Activities compatible with local customs

Local people in the RTF area traditionally participate in agricultural activities (ranching and farming). Reforestation and plantation management are consistent with this agricultural culture. Additionally, other large plantation projects are located near some of the project sites and community member have already been working in reforestation activities for several years. Reforestation activities have followed the culturally accepted practice of a 5 hour work day (6 a.m. – 11 a.m.) for rural field labor activities. Sunday is considered a family day and reforestation activities are withheld on this day.

2. Local Stakeholders fill jobs and local women are included

Jobs related to reforestation activities were filled by community members from eight different local communities. All labor was recruited either directly from farm workers already at the farm or from neighboring communities. Women were equally recruited alongside men and filled important positions caring for and watering trees before and after planting, and placing trees carefully in the soil. Women and youth were expected to work to the best of their abilities but were not expected to realize the same amount of work as adult men.

3. Project informs workers of their rights

The RTF project will begin informing workers of their primary rights when a new worker begins working for Paso Pacifico. This information will be verbally communicated and provided to workers through a printed brochure. Landowner partners will also been asked to do the same for their own workers. Landowners will be provided with a summary of labor laws relevant to operations of their farms and will be required to be in compliance in order to continue as participants in the project. Additionally, Paso Pacifico will hold at least one community workshop over the next year explaining worker rights to local communities. An analysis of worker rights is available in the supporting document "*Analisis de Codigo Laboral*". Specifics of the Nicaraguan Labor Code include[35]:

- Field workers should work 8 hour work days, for a maximum of 48 hours in a week. Any extra hours are subject to compensation
- Equal rights for men and women to obtain work
- 37 cordobas minimum wage for 8 hour work day in the field, and 18 cordobas a day for food (Paso Pacifico paid between 80-100 cordobas for 5 hour day which included wage and benefits, payments directly from landowner varied but were within legal limits)
- Minimum Age for work is 14 years of age with permission from parents

4. Worker safety

Paso Pacifico will establish a worker safety plan for each farm in coordination with property owners. Additionally, RTF sites will be equipped with basic first aid kits by this date. In these plans, risks to safety will be identified (*e.g.* machetes, snakes), and the procedures for the use of a first aid kit will be defined. Paso Pacifico will also coordinate with local health centers and international doctors affiliated with our organization to prepare first aid training workshops to be imparted across local communities and to RTF workers. These workshops will take place in late 2008 and early 2009.

[35] Refer to 'Labor Code Analysis' in supporting documents and Ley 185 Codigo Laboral de Nicaragua, 1996.

B1. NET POSITIVE BIODIVERSITY IMPACTS

1. Net Positive Biodiversity Impacts

Biodiversity across the Paso del Istmo corridor is threatened by habitat fragmentation and degradation. The RTF project is an important step towards reducing this threat to biodiversity because it will reverse habitat degradation at reforestation sites, and slow degradation in neighboring areas. New private protected areas will be established at reforestation sites. Thus, this project will significantly increase the area of land in western Nicaragua under protection.

Table 35. Net biodiversity benefits projected with project scenario. Net effect is consistently positive for biodiversity conservation. Biodiversity monitoring will establish quantitatively the extent to which this is the case.

Without Project Scenario	With Project Scenario	Net Effect
Spider Monkey populations stay the same or decrease due to increased degradation of habitat	Spider monkey populations increase with increased habitat connectivity and quality	**Positive**
Yellow-naped parrots populations decline or go locally extinct with further habitat degradation	Habitat quality improved by planting *Javillo* and other native trees, and increased protection through new protected areas	**Positive**
Threatened hardwood tree populations continue to decline	Threatened tree populations increase due to reforestation with species of conservation concern	**Positive**
Pasture continues to dominate reforestation site. Although valuable, this habitat type is common	Forest habitat areas replace pasture, endangered tropical dry forests increase in cover	**Positive**
Project Sites continue unprotected from hunting, firewood extraction, and wildfires	Project sites become established “Private Protected Areas” and contribute to protecting wildlife and forests in Nicaragua	**Positive**

Fragmentation analysis (refer to supporting document *Análisis de Fragmentación*) demonstrates that forest fragmentation is particularly severe throughout the corridor area. While reforestation efforts will only contribute to restoring a small portion of this landscape, we observe that this contribution is important for returning forest cover. This is particularly true in the Cardenas municipality where reforestation sites are near to forest areas and represent a very real opportunity to increase landscape connectivity and effective habitat area. Without the project, landscape fragmentation is expected to stay the same or worsen.

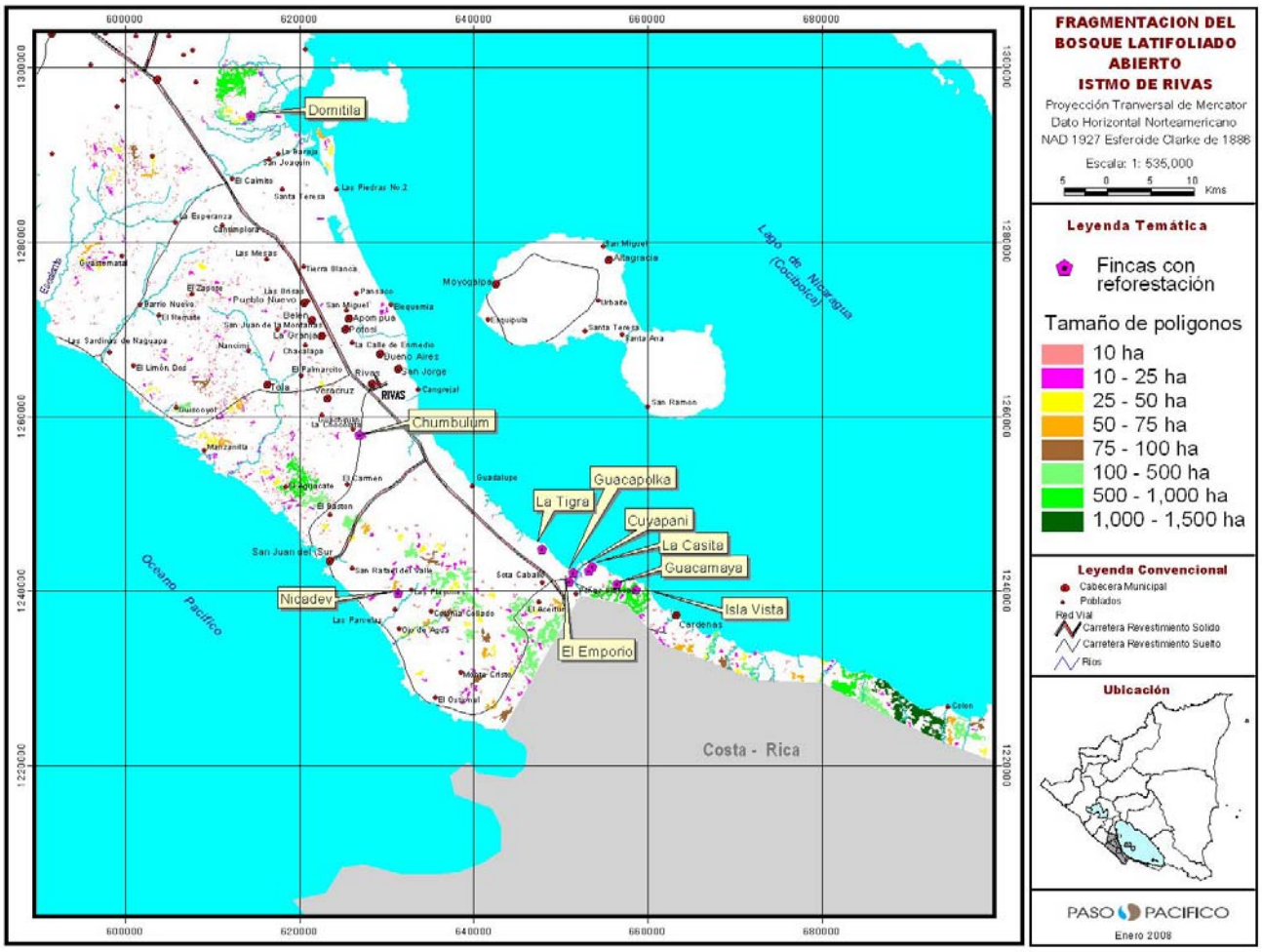

Figure 34. Open forest patches in the Paso del Istmo corridor. Locations of reforestation sites are tagged with farm names. Reforestation areas make an important contribution to fragmented landscape.

2. Possible adverse effects of non-native species

No non-native species were used within this project. Native species were collected from a local seed source or from a seed source with elevation and climate similar to reforestation sites. Seeds and seedlings were checked to ensure that they were free of disease before planting.

3. Identify IUCN Red List Threatened Species possibly within project boundaries

Threatened species on the IUCN Red List or listed within CITES are provided in Section G1.of this project document.

4. Identify all species to be used by the project

Species used for reforestation in the RTF project are defined in section B4 and in supporting documents. There are no known invasive species to be planted under this reforestation effort.

5. No use of GMOs within the project

No genetically modified organisms have been used to generate carbon credits.

B2. OFFSITE BIODIVERSITY IMPACTS

1. Potential negative offsite biodiversity impacts

While the RTF is not expected to contribute to any extreme negative offsite biodiversity impacts, we consider two possible offsite impacts.

First, local community members will have increased job opportunities as a result of this project. As a result, we expect their patterns of consumption to increase. This could lead in turn to an increase in garbage in local communities. This garbage is dominated by plastics and is prone to being burned or dumped in local rivers. While the causality between RTF and this offsite impact will be difficult to measure, Paso Pacifico must work to address this threat.

Secondly, project sites will be established as private protected areas and local people will eventually be hired to patrol these areas to protect the forests from poachers and arsonists (oftentimes people using fire to harvest honey or iguanas). However, it is likely that if hunters are no longer able to hunt in these forests that they will go elsewhere. Therefore, the threat to wildlife from hunting and the threat to forests from fire will be shifted to an offsite area. Once again, the link between these offsite impacts and the RTF project will be difficult to monitor. However, these threats must be addressed both within and outside of RTF project sites.

2. Mitigation Plans

Increasing education and creating viable options for waste management will reduce the threat of the first offsite impact. Paso Pacifico has been working with three local communities to promote proper garbage disposal. In 2008, three additional communities will be added to the program. Additionally, Paso Pacifico has begun conversations with the Cardenas and San Juan del Sur municipalities regarding options for local waste disposal sites. At some sites, landowners are helping to provide waste bins. Paso Pacifico will also coordinate with a local non-profit organization (Fundación A. Jean Brugger) that is working to establish a local recycling program.

Promoting conservation across the landscape will decrease the likelihood that hunting activities will be shifted to offsite areas. Hunters will not be allowed access to private farms and lands where landowners are looking to protect their wildlife. Paso Pacifico is working to gain landowner and community buy-in to support wildlife conservation efforts across the corridor landscape. We will achieve this by promoting forms of alternative livelihoods (eco-tourism and alternative agriculture), establishing private protected areas elsewhere in the conservation corridor, and by raising awareness of the ecosystem services provided by forests and forest wildlife. Also, wildfire threats to offsite project areas will be addressed by working with local communities to train and equip volunteer fire brigades. Paso Pacifico plans to help establish community fire brigades in 2008 and 2009.

3. Unmitigated offsite biodiversity impacts versus positive impacts within project boundaries

Table 36. Comparison of unmitigated of offsite biodiversity impacts against positive biodiversity impacts

Unmitigated	Positive Impact within Boundary	Net Effect
While mitigation measures may improve waste management across local communities, a portion of garbage generated through increased consumption will be difficult to manage because of individual human behaviors	Rivers and streams within project sites will be free and clear of garbage, natural habitat will be restored across project sites	Positive, the benefit of having a restored and protected forest outweigh the negative impact of some individuals who poorly manage their garbage
Despite mitigation efforts, some poachers will likely continue to threaten natural areas because individual human behaviors vary	Protection for wildlife and forests within project boundaries	Positive, while offsite impacts may continue to occur, having eight protected areas is arguably better for conservation than no protected areas. Wildlife can seek refuge at project sites.

B3. BIODIVERSITY IMPACT MONITORING

1. Plan for Biodiversity Monitoring

Biodiversity will be monitoring within four major areas:
a) USFS-IITF Paso del Istmo Restoration long-term biodiversity monitoring. This long-term monitoring program will be established with the technical and financial support of the US Forest Service with funds through the USAID. Permanent monitoring sites will be at the set up across forest fragments and reforestation areas to follow changes in biodiversity over time. The final methodology and taxa are still being determined, but a draft of the project is available in supporting documents of biodiversity. This project is funded for the first two years with the possibility of continued funding into the future.

b) Repeated Sampling of Pre-project census. Prior to reforestation, project sites are nearby forest areas were sampled for biodiversity for taxa of trees, butterflies, beetles, herps, primates, and birds. Every five years, Paso Pacifico will repeat the same pre-project sampling across sites. Refer to supporting biodiversity documents for further information on this biodiversity monitoring protocol.

c) Paso Pacifico Conservation Science Program. Currently Paso Pacifico has research programs that consider yellow-naped parrots and primates in the corridor area. This includes the participation of a pos-doc and a doctoral student. Over the period of this project, research projects in the corridor will increase as will our understanding of biodiversity change in relation to the RTF project. Refer to supporting documents on project reports and discussions of Paso Pacifico conservation activities.

d) Water and stream monitoring.
In order to assess project impacts on water resources, a program of stream monitoring will be established across sites. First we will map the principle streams at project sites and select streams for monitoring based on how likely they are to be influenced reforestation impacts. We will regularly measure physical, chemical, and biological characteristics to determine the health of within rivers and streams. Monitoring will begin in 2008.

Table 37. Water variables to be measured during stream monitoring

Characteristics	Variable	Frequency
Physical	Flow (cubic feet per second)	Quarterly, set dates
Physical	Turbidity	Quarterly, set dates
Physical	Temperature	Quarterly, set dates
Chemical	pH	Quarterly, set dates
Chemical	Dissolved Oxygen	Quarterly, set dates
Chemical	Conductivity	Quarterly, set dates
Chemical	Phosphate (PO4), Nitrate: (NO3-), Ammonia: (NH3)	Quarterly, set dates
Biological	Total Coliform, E.coli, and Enterococcus	Annually
Biological	Biosurvey – Aquatic insects and invertebrates	Every two years

B4. NATIVE SPECIES USE

Paso Pacifico has chosen to use solely native species for the RTF Project. Species distributions[36] and first-hand knowledge of natural forests were used to determine distribution of native trees, and only those trees that are found in forests of the Paso del Istmo were used. Additionally, tree seedlings were selected from local tree nurseries (local seed sources) or from nurseries using seeds of trees from similar elevations and climate regimes. During planting, the RTF forester selectively placed tree species according to micro-site conditions and according to best available information about micro-climatic requirements of each species. For example, tree species primarily found in riparian forests were placed at or near rivers and streams. A total of 69 different species were planted. However, 90% of the trees planted consisted of 22 different species.

Table 38. The twenty-two tree species most frequently planted throughout reforestation areas.

	Top 22 Species Planted
1	*Couroupita nicaraguensis*[37]
2	*Dalbergia retusa*[38]
3	*Tabebuia chrysantha*
4	*Hura crepitans*
5	*Inga vera*
6	*Albizia niopoides*
7	*Chrysophyllum cainito L.*
8	*Enterolobium cyclocarpum*
9	*Caesalpinia violaceae*
10	*Hymenea courbaril*
11	*Cordia alliodora*
12	*Anacardium excelsum*
13	*Cedrela odorata*[39]
14	*Bombacopsis quinata*
15	*Espondias mombin*
16	*Albizia saman*
17	*Swietenia humilis*[40]
18	*Calycophyllum candidissimum*
19	*Simarouba glauca*
20	*Albizia guachapele*
21	*Manilkara chicle*
22	*Tabebuia rosea*

[36] Arboles de Nicaragua 1993, Juan Bautista Salas Estrada, Instituto Nicaraguense de Recursos Naturales.
[37] Endemic
[38] IUCN/VU
[39] Listed CITES I
[40] Listed CITES II

B5. WATER AND SOIL RESOURCE ENHANCEMENT

1. Project Activities that enhance water and soil resources

Restoring ecological processes, including soil and hydrological processes, is a major goal within restoration ecology. These processes are slowly recovered over time as a result of reforestation with native species and promoting natural regeneration. Project activities that will contribute to improved soil and water resources include: removing cattle, maintaining partial weed cover during early years of reforestation to protect from soil erosion, planting a diversity of species leading to a diverse soil microbial communities, establishing protected areas at reforestation sites, planting trees along contours, planting native drought-tolerant tree species, and allowing natural litterfall and woody debris to accumulate on soil surface.

2. Comparison to Baseline

Soil and Water monitoring

We will monitor changes to water resources by monitoring important streams across reforestation sites as described in Section B3 Biodiversity Impact Monitoring.

Table 39. Effects and mechanism by which reforestation activities are likely to improve water and soil resources.

Resource	Reforestation Effect	Mechanism	Result
Water	Return of lower pre-disturbance levels of stream flow	Rapid regeneration in tropics[41]	Positive, more consistent flow, reduced peak flow
Water	Return of forest cover and trees that capture moisture, slow filtration	Potential for Improved Filtration[42]	Positive, enhanced low flow, reduced peak flow
Water	Increase in low flow	Diminished dry season water flows due to increased rainy season run-off and decrease in soil recharge capacity. Would be exacerbated if RTF were to have used fast growing species (i.e. teak, , eucalyptus)[43]	Positive, particularly due to use of native species that consume less water than plantation species
Soil	Reduction in soil erosion and sediment yield	Degraded pasture has increased soil erosion.	Positive, reduced erosion
Soil	Recovery of soil microbial community	Increase in quantity and quality of litterfall, increased soil humidity[44]	Positive, increased quality storage of soil carbon and nutrients[45]
Soil	Retention of nutrients	Reduction of wildfires associated with hunting and grazing	Positive, decrease in volatilized nutrients

[41] Brown, S. and Lugo, A.E. 1990. Tropical secondary forests. Journal of Tropical Ecology 6:1-32.
[42] Bruinjzeel, L.A. Hydrological functions of tropical forests: not seeing the forest for the trees. Agriculture, Ecosytems, and Environment 104: 185:228.
[43] Negi et al. 1998 in Bruinjzeel, L.A. Hydrological functions of tropical forests: not seeing the forest for the trees
[44] H. Zheng 1, Z. Y. Ouyang 1, X. K. Wang 1, H. Miao 1, T. Q. Zhao 1, T. B. Pen. 2005. How different reforestation methods affect red soil properties in Southern China. Land Degradation and Development 16:387-396.
[45] Whendee L. Silver, Lara M. Kueppers, Ariel E. Lugo, Rebecca Ostertag1, and Virginia Matzek1 2004. Carbon sequestration and plant community dynamics following reforestation of tropical pasture. Ecological Applications 14: 1115–1127