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ASOCIACIÓN PARA LA INVESTIGACIÓN
Y DESARROLLO INTEGRAL

FOREST CARBON PROJECTS IN PERÚ

AIDER experience to mitigate climate change

Percy Recavarren Estares

Lima, 2015

AFFORESTATION | REFORESTATION | FOREST MANAGEMENT | FOREST PROTECTION

AIDER

Association for the Investigation and Integral Development – AIDER, for its acronym in Spanish, is a Peruvian Non-Governmental Organization without lucrative purposes, since 1986 focuses its efforts in environmental conservation and sustainable development.

Accordingly, AIDER has as work lines: I) Sustainable forest management, governance and forest certification, II) Management of protected natural areas, III) Ecosystem services, and IV) Investigation.

Considering that ecosystem services directly influence in life maintenance, generating welfare for local populations, AIDER worked since 1992 in forest management with landscape focus, both in the dry forest in the north region of Peru, as in tropical rain forest in the Peruvian Amazon. In this frame, in this publication are presented AIDER experiences in development and implementation of forest carbon projects that has been developing since 2004 as an adicionality to forest management, which has placed AIDER as a leader in the development and implementation of this type of projects, the same that has contributed with technical inputs and experiences to other similar proposals in a regional and national level.

AIDER has completed 28 years of institutional life, reaffirming its commitment with populations which live in and of the forest, contributing to improve their quality of life in harmony with conservation and through this sustainable proposals that rely both in applied research, as in political action and knowledge recovery.

Principales reconocimientos

Premio por la Paz 2009
Biocomercio 2009
Premio Ecuatorial 2006
Premio 2006 por el Desarrollo Sostenible
Premio CAMBIE 2005 a la Conservación Ambiental
Modelo de financiamiento ambiental 2015

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FOREWORD

We know the Association for Research and Integral Development - AIDER for the forest projects that we have funded and in which has participated, witnessing the work done with professionalism and quality. We also know that for several years has been conducting forest carbon projects in different parts of Peru, covering actions of afforestation, reforestation, protection, management and conservation of forests, which are the experiences that will be shared in this publication.

As the International Tropical Timber Organization (ITTO) an intergovernmental organization that's promotes the conservation and management, sustainable use and trade of tropical forest resources, these issues are of great interest to us, we also like to highlight that AIDER has successfully involved in this effort, local people, providing opportunities and improving the capacity of communities, both rural and native and settlers, farmers and small businesses.

In this context, ITTO is very pleased to present this publication "Forest Carbon Projects in Peru. *Alternative to mitigate climate change and increase economic benefits in forestry* ", prepared by a team of professionals AIDER, led by Mr. Percy Recavarren Estares.; in which we get to know the various experiences in forest management, and share results, contributions, achievements and challenges encountered in their development.

We trust that the AIDER experience, systematized in this publication, allow other organizations enrich thefrom the lessons learned and at the medium and long term joint effort will help to improve conservation and management of the forests of Peru.

Lima, March 2015

John Leigh
Project manager
ITTO

ACRONYMS LIST

A/R	Afforestation/Reforestation
RCA	Regional Conservation Area
AFOLU	Agriculture, silviculture and other land use
AIDER	Asociación para la Investigación y Desarrollo Integral (Association for Research and Integrated Development)
NPA	Natural Protected Area
B/C	Benefit/Cost
CATIE	Tropical Agricultural Research and Higher Education Center
PC	Peasant Community
CCB	Climate, Community and Biodiversity
CC.NN.	Native Communities
CDC	Conservation Data Centre
CI	Conservation International
CIFOR	Centre of International Forest Research
CO_2	Carbon dioxide
CO_2-e	Carbon dioxide equivalent
CVIS	South Interoceanic corridor
DRC	Diameter at root- collar
DHB	Diameter at breast height
PRD	Participatory Rapid Diagnosis
FAO	Food and Agriculture Organization – United Nations
FONAM	National Environment Fund
FONDAM	Fund of the Americas
FSC	Forest Stewardship Council
GHG	Greenhouse Gases
GIZ	Deustsche Gesellschaft Fûr Internationale Zusammenarbeit
GNGGI	Greenhouse Gases Inventory
GORE	Regional Government
GS	Gold Standard
ICAA	Andean Amazon Conservation Initiative
INEI	National Institute of Statistics and Information
INTA	National Agricultural Technology Institute
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
CDM	Clean Development Mechanism
MDL –EB	Clean Development Mechanism – Executive Board
MEF	Ministry of Economy and Finance
MFS	Sustainable Forest Management
MINAM	Ministry of Environment
N	Nitrogen
N_2O	Nitrous oxide
ITTO	International Tropical Timber Organization

ACRONYMS LIST

OSINFOR	Monitoring Agency for Forest Resources and Wildlife
GDP	Gross Domestic Product
ADP	Area Development Program
PDD	Project Design Document
WAP	Working Age Population
PK	Kyoto protocol
PGMF	General Forest Management Plan
PNBS	Bahuaja Sonene National Park
UNDP	United Nations Development Program
SOP	Standard Operating Procedure
PROFONANPE	National Fund for Protected Natural Areas
RAE	Spanish Royal Academy (Real Academia Española)
REDD	Reducing Emissions from Deforestation and Degradation
REDD+	Reducing Emissions from Deforestation and forest Degradation
RNA	Assisted Natural Regeneration
RNTAMB	Tambopata National Reserve
R-PP	Readiness Plan Proposal
SNIP	Public Investment National System
SERNANP	National Service of Protected Natural Areas
SINANPE	Protected Natural Areas System
MIRR	Modified Internal Rate of Return
TREES	Tambopata Reserve Society - UK
UNALM	National Agrarian University La Molina
VAN/NPV	Net Present Value
VCS	Voluntary Carbon Standard
VCU	Verified Carbon Unit
VER	Verified Emission Reduction
WVA	World Vision Australia
WVP	World Vision Peru
WWF	World Wide Fund
ZA	Buffer area
ZEE	Ecological – Economic zoning

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EXECUTIVE SUMMARY

In the present publication, AIDER explains its experience in forest management projects as an alternative to climate change mitigation and to increase the economic benefits of the forests in our country. Issues such as afforestation, reforestation, management, conservation and forest protection are comprised, as well as improve the capacities of the communities, both native and peasant, for the sustainability of forests and communities.

Peru is a mega diverse country with a large extension of forests, which give a great economic potential to develop. This can be appreciated in the variety of types of forests that can be found throughout the territory, in which AIDER, along with national agencies and international organizations, has proposed and developed several forest carbon projects. These projects involve forest species for carbon sequestration and/or storage as a complement of other activities like forest management, protection of natural areas (PNA), afforestation and reforestation, in the forestry CDM and REDD+ projects categories, mainly for obtaining carbon credits due to forest plantations, forest management and protection.

AIDER, through this publication, shares the results, achievements and challenges of the following experiences:

- **Afforestation experience**
  - ✓ "Agro-silvo-pastoral practices oriented towards the carbon market" in Cusco region.

- **Reforestation experiences**
  - ✓ "Reforestation, sustainable production and carbon sequestration in the dry forests of José Ignacio Távara – Piura."
  - ✓ "Reforestation in degraded lands for the purposes of timber production and carbon sale – Ucayali."
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    - ✓ "Feasibility assessment of forest carbon projects in "Pomac Forest Historical Sanctuary"

Besides, sharing projects and experiences, contributions to forest management and to climate change mitigation projects, the stage of development and the results of the mentioned projects and the lessons learned throughout this experience, are also presented.

FOREST MANAGEMENT AND CLIMATE CHANGE

Forest Management and Climate Change

Percy Recavarren Estares

A. Peru and its forests

Tropical forests are particularly important at local and regional scales for the multiple ecosystem services they provide. Mainly, tropical forests modulate the flow of rivers, keeping base flow in the dry season and reducing flooding in the period of high rainfall. Tropical forest ecosystems function as a giant sponge that slowly discharge groundwater throughout the dry season and absorb large amounts of water during the rainy season. Without tropical forests, floods and droughts would be exacerbating. The cover of tropical forests also protects fragile and incredibly erosive soils from the ntensity of tropical storms and heavy rains (Hartshorn, 2014).

Peru, because of the natural wealth it possesses in its tropical forests, is positioned in a privileged place in the world; with an area of 128,521,560[1] hectares, it is the third largest country in South America and the twentieth largest in the world[2]. It also has 76,419,818[3] hectares of natural forests, which places it second in South America after Brazil, and ninth worldwide. According to the major land use soils classification, 80.14% of the territory is suitable for forestry and land protection, while only 5.92% is suitable for crops and 13.94% is suitable for pastures and livestock (Schwartz, 2004). These figures indicate that Peru is a forest country with great economic potential to develop, revealed with the existence and distribution of the different types of forests, most of which are located in the Amazon region (high and low jungle forests) as detailed in Table 1.

Table 1. Types of forests in Peru

Types of forests	Surface(ha)	Percentage
Low jungle forests	53,432,618	73%
High jungle forests	15,736,030	21%
Dry forests of the north coast	3,235,012	4%
Andean forests	385,005	1%
Dry forests of the Marañón	372,915	1%
Occidental Montane forests of the north	133,378	0%
Total	**73,294,958**	**100%**

Source: MINAM (2011)

1 INEI (2014)
2 MINAM (2014)
3 PROCLIM (2000)

These types of forests are seen mainly as a supply source of timber and firewood, leaving behind other benefits they have and all the potential they might provide as an ecosystem. Forests provide ecosystem services as producers and regulators of water flow, biodiversity conservation, capture and storage carbon, oxygen production and scenic beauty, which benefit people directly and others indirectly. All these goods and services the forests provide and offer occur in the 73.3[4] million hectares, which represent 57.03% of the Peruvian territory.

Forest management in the country is based on the conservation thereof, understanding "the maintenance of the populations and diversity of forest ecosystems under natural conditions or with human intervention[5]" as the definition of forest conservation, and under this concept, forest management in Peru is applied by two conservation strategies, (i) the protection of forests through the System of Protected Natural Areas (SINANPE) and (ii) the management of forests by forest concessions, permits and authorizations for timber and non-timber products.

- Protected Natural Areas (PNA) – altogether constitute a fundamental part of the natural heritage of Peru, preserve representative samples of the unique national biodiversity - their most important objective - and are of enormous importance for the ecosystem services they provide[6]. These areas represent 21,759,058 hectares protected under the SINANPE, which represent 16.93% of Peru's territory. There are 76 National Administration Protected Areas (13 National Parks, 9 National Sanctuaries, 4 Historic Sanctuaries, 15 National Reserves, 3 Wildlife Refuges, 2 Scenic Reserves, 10 Communal Reserves, 6 Protected Forests, 2 Game Reserves and 12 Reserved Areas); and 90 Regional and Private Administration Areas (16 Regional Conservation Areas and 74 Private Conservation Areas[7]). The management and/or monitoring of these 166 PNA are in charge of the National Service of Protected Natural Areas (SERNANP), a specialized public technical organism ascribed to the Ministry of Environment (MINAM).

- Management of forests in Peru is an activity regulated by authorization certificates which are forest concessions, permits and authorizations. Forest concessions are given for timber products, non-timber products, wildlife and afforestation/reforestation purposes in permanent production forests, which are areas designated by the Peruvian state according to law[8]. Forest permits and authorizations occur in native and peasant communities, as well as in private properties, and are managed through various modalities according to extraction volumes and involved areas. Table 2 details the different types of forest concessions in Peru.

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[4] MINAM (2011)

[5] AGROFORESTAL SAN REMO (2014)

[6] SERNANP (2014)

[7] SERNANP (2014a)

[8] Ley 29763

Table 2. Types of access to forest resources: forest concessions

Timber forest concessions
Concessions granted through public contest
Concessions granted through adequacy and contract extension
Forest concessions for non-timber products
Conservation concessions
Ecotourism concessions
Concessions for other forest products (Brazil nuts)
Concessions for other forest products (Rubber)
Other concessions
Wildlife management concessions
Afforestation and reforestation concessions

MINAM (2000) mentions that the forest resource has a huge and valuable potential, which, if exploited properly, can represent a great contribution to socio-economic development. However, this resource has not been given importance in terms of administration, management and protection; on the contrary, as is happening throughout the tropical and subtropical region in recent decades, natural forests have suffered an accelerated destruction by slashing and burning, primarily for shifting agriculture. These processes have led to the loss of great part of the humid tropical primary forest in the Peruvian Amazon, considerably decreasing its extent and transforming it into areas of agricultural crops, pastures, secondary forests, infrastructure and no-vegetation areas (degraded areas). Deforestation on the Peruvian amazon for the years: 1985, 1995 y 2000 can be seen in table 3.

Table 3. Deforestation on the Peruvian amazon for: 1985, 1995 y 2000

Year	Deforestation (ha)	Loss of forest area regarding its original extent (%)
1985	5,642,447	7.4
1990	6,948,237	9.1
2000	7,172,554	9.4

Source: INEI 2014

A forest area which should have more attention is the tropical dry forest, which includes large areas of the Tumbes, Piura, Lambayeque and northern La Libertad regions, occupying an area of 3,230,263 hectares. These forests have fragile ecosystems due to low rainfall; to the fact that they are of great value for nearby populations as it provides them with timber products (construction, fences, handicrafts, wood and coal), non-timber products (fruits, medicinal plants, beekeeping), forage (pasture, food for goats, sheep, cattle and horses) and ecosystem services (protection of soil, microclimate, water regulation, carbon sequestration and storage)[9]; and because of the great diversity of flora and fauna they shelter. These

[9] Otivo (2008)

factors make them of international interest by being cataloged as: unique ecosystem of our country, Tumbes endemism area, species irradiation center, rated as outstanding for biological distinctiveness, endangered ecosystem and high conservation priority. These forests have been and are under a strong anthropic pressure, reason why they have been reduced by the loss thereof as shown in Table 4.

Table 4. Deforestation on the Tropical dry forests for the years: 1990, 2000 y 2010

Year	Deforestation (ha)	Loss of forest area regarding its original extent (%)
1990	184,830	5.7
2000	308,330	9.5
2010	601,275	18.6

Adapted from: Hildebrando (2011)

Besides deforestation, illegal logging for charcoal production is another activity that is damaging the tropical dry forest as its impact cannot be measured because it is done selectively and gradually, reducing productivity of forests and turning them into grasslands (low in goods and services) or non-vegetation areas.

B. Forest legislation

The promotion of forest management and utilization is given by the Peruvian forest legislation, which began in July of 1963 with the Law Decree No. 14552, creating the Forestry and Game Service as a public law intern body, attached to the Ministry of Agriculture. Its objective was "the protection, conservation, development and rational utilization of forests and forest lands in the nation, as well as wildlife". With this law, it was intended to classify the forests and forest lands in the country in: Forest Reserves and National Forests, the same that were managed under supervision of the Forestry and Game Service. It was also established that "Nation or private property over the forests and forest lands must be informed to the Forestry and Game Service to ensure their use and conservation", as for the award of forest harvesting contracts for natural and legal people in forests owned by the Nation.

Law Decree N® 21147 was the first to be conceptualized as Forest Law and wildlife, the same that was enacted June of 1975. It defined forests as "natural plant communities in which timber species predominate in certain areas of land, as well as plantations", and classified them into natural or cultivated according to their origin. For natural forests, they were classified as: National Forests, free availability forests, protection forests and conservation units. From this classification, National forests (direct and exclusive use of the state) and free availability forests (could be used by any person duly authorized by the State) were declared fit for permanent timber production, other forest products and wildlife. This decree authorized the use of timber forest resource through logging contracts in areas up to 100,000 hectares, the same that required prior submission of a technical and economic feasibility study; when the area was greater than 50,000 hectare, it would be done Supreme Decree.

On July of 2000, by Law Decree No. 27308, Forests and Wildlife law was approved, which aimed to regulate, moderate and oversee the sustainable use and conservation of forest and wildlife resources of the country. On April of 2001 the Regulation of the Forestry and Wildlife Law was approved by Supreme Decree No. 014-2001-AG. Forest management could be given in 7 zoning categories, as shown in table 5.

Table 5. Forest zoning according to Law Nº27308

Forest zoning	Classes
Production forests	- Permanent production forests - Reserved production forests
Future production forests	- Forest plantations - Secondary forests - Forest recovery areas
Protection forests	
Protection areas	
Native and Peasant community forests	
Local forests	
Protected Natural Areas	

Source: Forests and Wildlife Law No. 27308

An importat aspect imposed by this law is the forest management plan, which is a dynamic and flexible tool for management and control of the forest management operations. It must be elaborated by a forestry engineer and/or legal entity specialist registered in the State, establishing guidelines for its formulation. Likewise, the use of forest resources is subject to utilization payments per unit area, specie, volume, size or other parameters.

Regarding the management and use of forest resources, the law establishes that it is done through authorization certificates, which are concession contracts, permits, authorizations and others, whose objective is the sustainable use and conservation of forest and wildlife resources, as well as ecosystem services provided by the forest.

Forest concessions are granted in two ways: (i) for timber products and (ii) for non- timber products, which are detailed in table 6.

In the case of forests on private lands, secondary forests and forest plantations, authorization certificates are given by forest permits and authorizations.

- The authorizations are authorization certificates of administrative nature, whereby the forest and wildlife authority entitles the holder to: make sustainable use of the dry forests of the coast; establish forest species in nurseries for propagation, commercialization and preservation, or cultural purposes; for the management and use of wildlife in animal breeding, zoos, rescue centers and temporary custody centers; change agricultural major land use areas in the jungle; and forest and wildlife resource extraction with scientific-cultural research purposes.

Table 6: Characteristics of forest concessions according to Law Nº 27308

Forest concession	Description
Timber forest concessions	Public auction concessions: logging units ranging from 10,000 to 40,000 hectares, granted for up to 40 renewable years
	Public contest concessions: logging units ranging from 5,000 to 10,000 hectares, granted for 40 renewable years, to small and medium businessmen, individually or organized in associations or other type of organizations
Forest concessions for non- timber products	Concessions for other forest products
	Ecotourism, conservation and ecosystem services concessions

- Forest permits are also administrative in nature, whereby the forest and wildlife authority grants the rights for forest harvesting with commercial or industrial purposes on private lands, secondary forests, forest plantations, and local forests, in which permits for the use of forest products are given to private lands and native and peasant communities[10].

On June 26 of 2008, the Law Decree No. 1090 was given, in which the power to legislate on various matters related to the implementation of the Peru – United States Trade Promotion Agreement, was entrusted to the executive power. With this power, a Forests and Wildlife law was passed, the same that was made without regarding the transparency, participatory and consensus principles established by the Peruvian law. Consequently, it had many detractors as it contravened forest heritage and the rights of indigenous communities, and arouse social conflicts, and through protests it was repealed in June 2009.

On July 21 of 2011, Forestry and Wildlife Law No. 29763 was enacted, being its regulation still in development, it is not yet in effect (November 2014).

In 2009, the civil society promoted payment for ecosystem services (PES) projects under the REDD and REDD+ mechanism that were being developed in PNA, forest concessions and native communities. These initiatives managed to concretize on 2012, under international standards and international voluntary markets by generating carbon credits due to avoided deforestation and carbon sequestration. The initiatives pushed the State to regulate these services, for which the National Service of Protected Natural Areas (SERNANP) endorsed the presidential resolution 26-2014-SERNANP on January of 2014. In said resolution, the

[10] OSINFOR (2014)

General Directive Nº001-2014-SERNANP was approved, which regulates the marketing of the rights generated by conservation projects of natural ecosystems in national administration Protected Natural Areas. With these rights, management contract executors in national administration PNA are authorized to market carbon certificates as a management strategy of the PNA. For timber forest concessions, these are covered by state[11] contracts, authorizing them to use ecosystem services by adding a complementary management plan within their general forest management plan. For other modalities such as concessions for non-timber products, conservation, ecotourism, private land and native communities, Law No. 30215 Law of Payment Mechanisms for Ecosystem Services, was enacted on June 11 of 2014, which is not yet regulated for its application (November 2014).

C. Forest management and climate change

Tropical forests are a renewable natural resource of global importance; they contain a wonderful biodiversity that provides a variety of goods and services. Many of these forests are protected by the State under the National System of Protected Natural Areas (SINANPE), especially those with a high conservation value; other forests are arranged in permanent production forests, future production forests and secondary forests, the ones that have to develop activities that generate economic and environmental benefits to ensure their existence. One of the activities that man must be careful with to ensure the permanence of the forest, is the change of forest land use, where primary forest areas become areas with agricultural crops, palm oil, pastures, fallow land, infrastructure and bare soil due to mining, the same that become the connectors and/or drivers of future deforestation.

Sustainable forest management is a particularly difficult challenge due to several factors: the great biodiversity and ecological complexity of most tropical forests, the limited scientific knowledge in how to handle bio-diverse forests, vast areas of defenseless forests, the long term (decades) waiting period for a possible return on investment, and unattractive incentives to invest in tropical forests (Hartshorn, 2014). An alternative to ensure the permanence of forest resources is to develop forest management activities where the forest is not seen as a synonym of logging, but as an integrated ecosystem that provides a wide range of goods and services in a sustainable way for the benefit of people at the local, national and global levels.

Furthermore, climate change is anticipated to have an effect on the distribution of types of forests and tree species, forest productivity, land and soil conditions, structure of the stands, and also cause changes in natural disturbance regimes such as the incidence, severity and impact of fires, invasion of non-native species, insects, diseases, floods and droughts, extreme temperatures, landslides and storms[12].

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[11] Law Nº 27308

[12] FAO (N.D.)

In the same way, there are also the populations settled in the forests that depend on goods and services thereof for a living, as is the case of native, riparian and settler communities as well as surrounding populations. This is a more sensitive aspect for which strategies and forest management activities that include social, economic and cultural aspects to ensure forest sustainability are to be developed. These technical, climatic and social factors increase challenges regarding the design, planning and implementation of forest management proposals that take the forest as an integrated ecosystem, where the expectations of everyone involved in this activity are satisfied. For this, it is essential for the strategies to be implemented, to aim at the development of multipurpose management plans, the same that should involve several actors, since these require a high degree of scientific and technological knowledge in the development management proposals that are sustainable over time.

An aspect to consider in tropical forest management is climate change; although it was just a myth decades ago, today it is a reality that cannot be overlooked. FAO - forests and climate change - mentioned that this change could alter the growth of the trees, the frequency and intensity of fires and the incidence of forest pests, and that it could also increase damage to forests by extreme weather conditions such as droughts, floods and storms, leading to face great challenges in forest management. In the face of climate change, the forestry sector has two answers to develop, climate change mitigation and adaptation, which, in the case of forests, are measures that interact directly, since mitigation is to reduce its potential impacts and adaptation to face its causes.

Mitigation strategies include reducing emissions from deforestation, reducing emissions from forest degradation, enhancing the role of forests as carbon sinks, and the replacement of products such as fossil fuels with wood for energy production, and materials whose manufacture involves high emissions of greenhouse gases with wooden products. On the other hand, adaptation includes interventions aimed at reducing the vulnerability of forests and populations dependent on them facing climate change (FAO, ND.). These mitigation strategies become projects that seek to receive the economic incentive for contributing with climate change mitigation, and this mechanism is developed by the transaction unit that is the carbon credit.

Carbon credits are issued when there is a reduction in greenhouse gas (GHG) emissions or carbon dioxide equivalent (CO2-e) sequestration, where a ton of CO2-e corresponds to a carbon credit, which can be placed on the national or international voluntary market.

D. Forest carbon projects

Forests are important in climate change mitigation and adaptation, so it is logical to analyze the links between these strategies and identify the opportunities to improve both their outcomes[13]. The forest sector in Peru has made progress in developing proposals that

[13] CIFOR (2014)

contribute to climate change mitigation, projects that are also called "forest carbon projects" as they involve forest species carbon sequestration and/or storage, in addition to other activities such as:

- Forest management of timber and non-timber products.
- Forest protection in national, regional and private administration PNA.
- Reforestation for recovery of land and/or timber production.
- Afforestation for production of wood.

Within all sectors (Forestry and land use, renewable energies, clean and efficient stoves, methane, energy efficiency and fuel and gas substitution) in which work is done in order to mitigate climate change, there are the AFOLU projects, which contemplate activities in agriculture, forestry and other land uses. The AFOLU projects lead to the reduction or capture emissions of GHG through key interventions, which are:

- Afforestation and reforestation projects (ARR).
- Projects to reduce emissions from deforestation and forest degradation (REDD+).
- Improved forest management Projects (IFM).

Other non-forest categories:

- Agricultural Land Management (ALM).
- Peat recovery and conservation (PRC).

It is important to emphasize that forest carbon projects are a strategy to increase the value of the proposed forestry activities; reason why it is not socially, technically or economically feasible to do projects just for the carbon component, since this is just a complement to the main activity.

Climate change mitigation projects that are taking place in Peru are framed in sequestering CO_2-e from the atmosphere through forest plantations and storing it in the structure of trees; another method is to keep carbon stored in the primary forest for the duration of the commitment period of the project, generating carbon credits for the ecosystem service generated, as can be seen in figure 1.

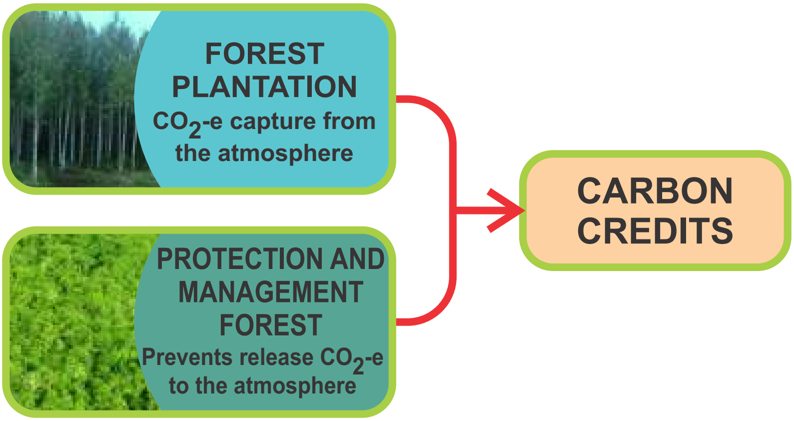


Figure 1. Carbon credit generation in forest carbon projects

These projects, by mitigating climate change and generating social, economic and environmental co-benefits for local communities, turn into conservation and human development projects, laying a solid foundation for sustainability. These have to undergo several processes: pre-feasibility study (reflected in the PIN – Project Idea Note), design, validation and implementation, in order to concretize the verified carbon credit emissions. A summary of the processes by which these projects have to go through can be seen in figure 2.

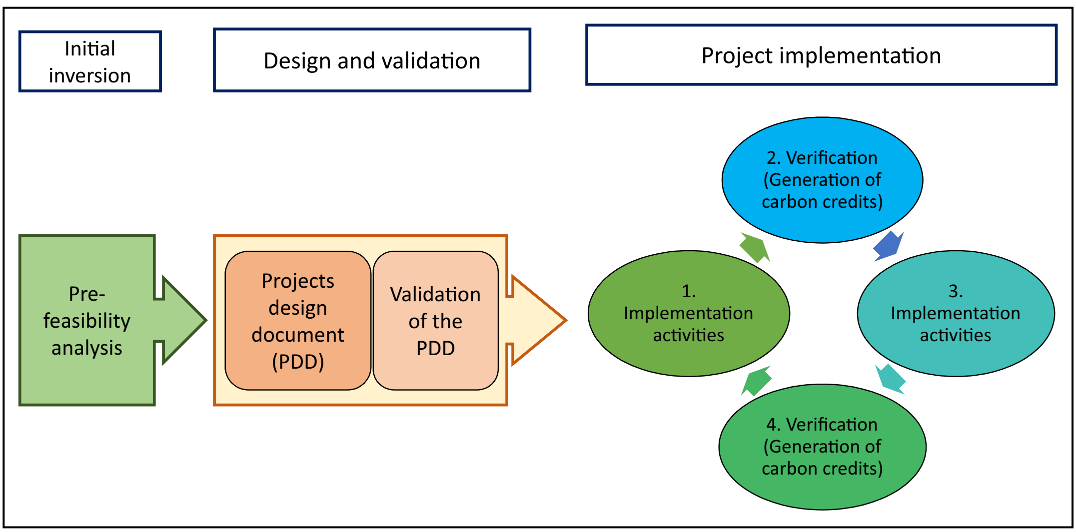


Figure 2. Management process of a climate change mitigation forest project

- **Carbon sequestration projects**

  These forest carbon projects, known as "carbon sequestration", present a theory based on increasing carbon content of a defined area through reforestation and/or afforestation (forest plantations), in which the objective is to change from a low carbon content scenario (grasslands, degraded areas and bare soil) to another of a high carbon content scenario, as shown in figure 3.

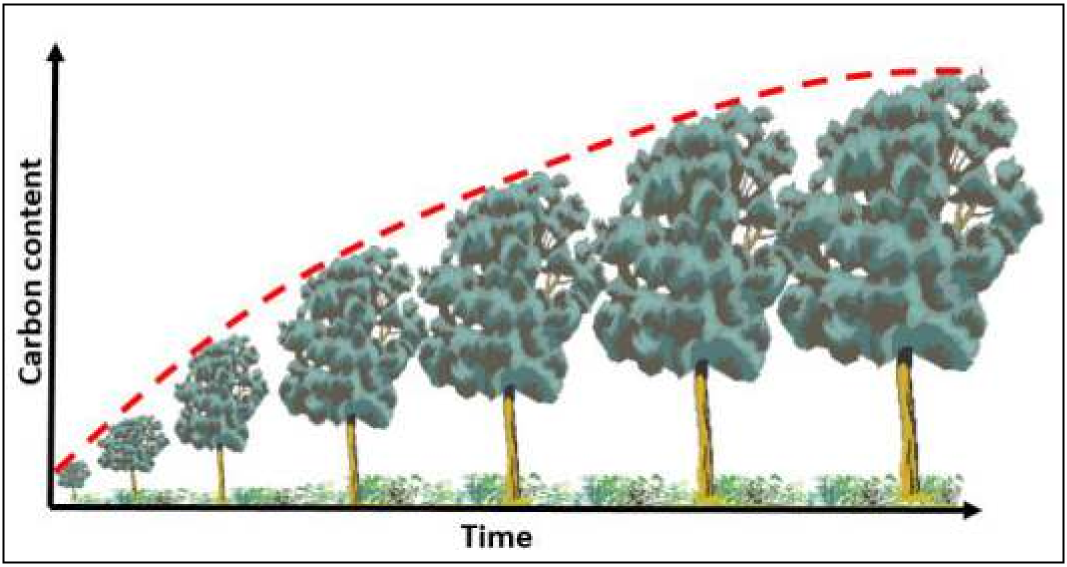


Figure 3. Change in carbon content through time

Carbon sequestration varies according to the species used and the growth of the plantation. Such projects were created to be developed in a regulated marked through the Kyoto Protocol Clean Development Mechanism (CDM), where eligible forest activities are afforestation and reforestation (forestry CDM). The disadvantage of this type of project is that it only represents 1% compared to all other sectors working with CDM[14] and that the credits generated are non-permanent, which means that they are treated as temporary credits (the duration of the plantation) that must be replaced before they expire for permanent credits[15]. These factors have made it difficult for forestry CDM to take off, being relegated in the way.

As an alternative to forestry CDM the voluntary market was developed, where carbon sequestration projects (afforestation and reforestation) have developed favorably.

[14] Bio-carbon fund

[15] Permanent credits from other sectors of CDM such as renewable energies, energetic efficiency, fuel substitution, among others.

Currently, carbon sequestration projects are in the design phase of the project and some others have achieved their validation, verification and marketing of carbon credits.

- **Reduction of emissions from deforestation and forest degradation**

Another option for mitigating climate change is to keep carbon stored in the forests for the period assumed by the project (from 20 to 100 years[16]). This will be achieved by implementing strategies to avoid deforestation and forest degradation, with which GHG emissions are to be reduced; this type of project is known as REDD.

For the implementation of such projects, the definition of "forest" and the 2 "D’s" from REDD (deforestation and forest degradation) must be known, which are:

<u>Forest</u>

Peru has adopted the definition of forest as "land with a tree crown cover of more than 30% of the area and a minimum area of 0.5 hectares, in which trees should be able to reach a minimum height of 5 m at maturity in situ[17]". This definition characterizes the tropical rainforest; however, the same definition is used for the dry forests and highland forests. Currently, there is a proposal under discussion to define dry forest that was prepared by the civil society organization (REDD Group Peru) to release to the State for its approval. In figure 4 the parameters that define forest in Peru are shown.

Figure 4. Forest definition parameters for Perú

<u>Deforestation</u>

According to the RAE, deforestation is the "action and consequence of deforesting" and deforesting is "to remove forest plants from an area"; or as defined by the IPCC (2007), deforestation is the "conversion of a forest area into a non-forest area". These definitions that contain the same meaning should be subject to the definition of forest adopted by Peru. In figures 5 and 6 deforestation can be seen graphically.

[16] VCS (2014)

[17] FONAM (2006)

Figure 5. Forest scenario

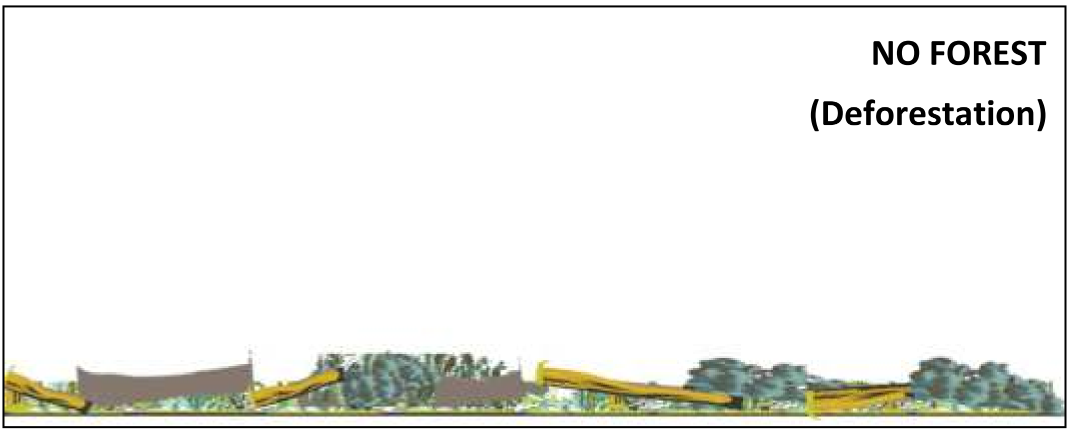


Figure 6. Deforested scenario

<u>Forest degradation</u>

Simula (2009) defines forest degradation as the reduced capacity of a forest to provide goods and services. Forest degradation is due to anthropogenic causes and mainly due to selective logging for timber extraction and charcoal production. In the following figures, how forest degradation takes place can be seen graphically; figure 7 shows a scenario of a non-intervened forest, which as a result of selective logging in several periods, gradually loses its potential to provide goods and services, as can be seen in figures 8 and 9; the latter still representing a forest, but with a significant decrease in its provision of goods and services (an affected service is the reduction of carbon stored in the forest).

Figure 7. Non-intervened forest

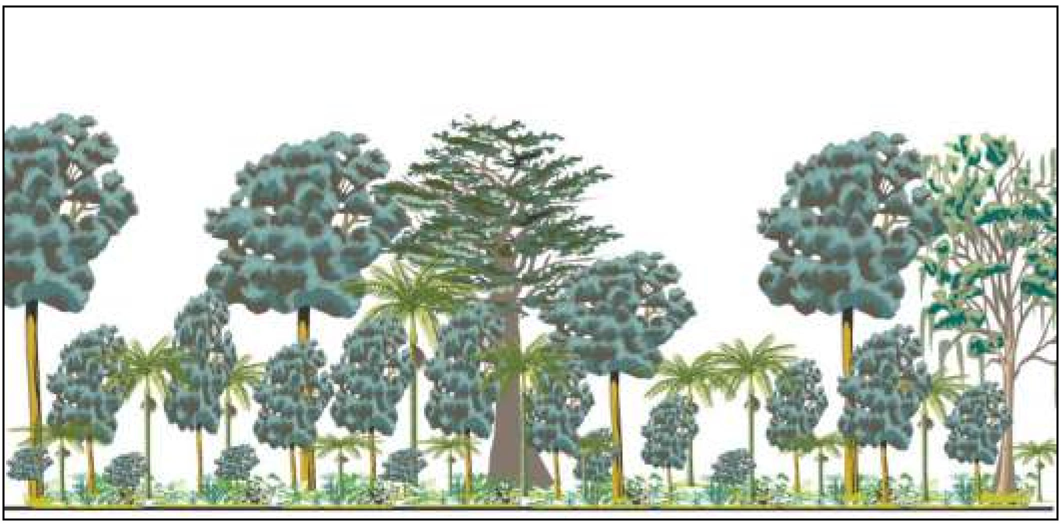


Figure 8. Intervened forest

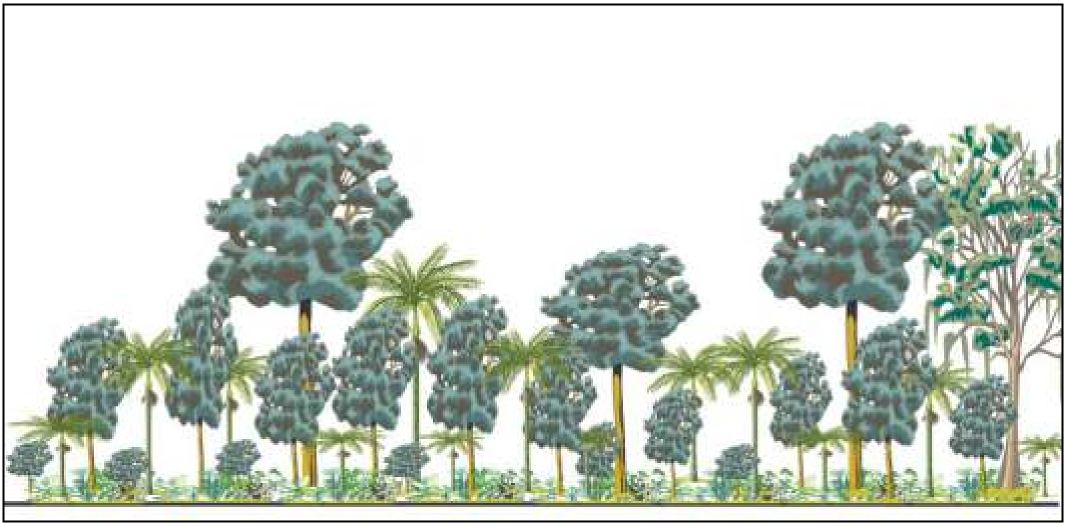


Figure 9. Intervened forest (several years)

This "avoided deforestation" mechanism has over 2 decades of work, as mentioned by Hamilton et al. (2008) being quoted by Zambrano-Barragán and Cordero (2008), for which avoided deforestation projects have been financed since before 1990. These types of projects were known as RED projects (Reducing emissions from avoided deforestation). Also in the Context of the United Nations Climate Change Convention (UNFCCC), during the meeting in Bali in late 2007, reducing emissions from deforestation and forest degradation (REDD) was recognized as a mitigation mechanism to climate change for the post-Kyoto regime[18]. These REDD+ projects had many detractors because they showed REDD clearly as a protection mechanism of forests with high carbon contents and subjected to pressure, leaving aside the people who live within or near them and that depend on them. Therefore, a more compatible mechanism with socio-economic activities carried out in the forest was developed, which is now known as REDD+. It includes other eligible activities such as carbon storage, which is an eligible activity for REDD+ as it aims to maintain carbon stored in areas with high conservation value and under threat of deforestation, focusing the work in Protected Natural Areas, Regional Conservation Areas and Private Conservation Areas. This can be seen graphically in figure 10.

- ✓ Sustainable management of forests, this activity is based on sustainable forest management as a strategy for their conservation, relying technically on the utilization and natural regeneration of the forest. It is developed in forests belonging to native and peasant communities, granted as forest concessions and in private lands that are under management (see figure 11).

[18] Zambrano¯Barragán y Cordero (2008)

- ✓ Increase in carbon content, this method aims to improve the productive capacity of forests (goods and services) and increase carbon content; it can be developed in PNA, forests of native and peasant communities, forest concessions and private lands that have had anthropic extractive intervention and that still maintain their forest condition (see figure 12).

These activities encourage the active participation of forest users by promoting their conservation. Currently, REDD + projects are not part of the regulated market, instead they follow their initial conception of implementing and developing for the voluntary market, looking to be a part of the regulated market in the near future.

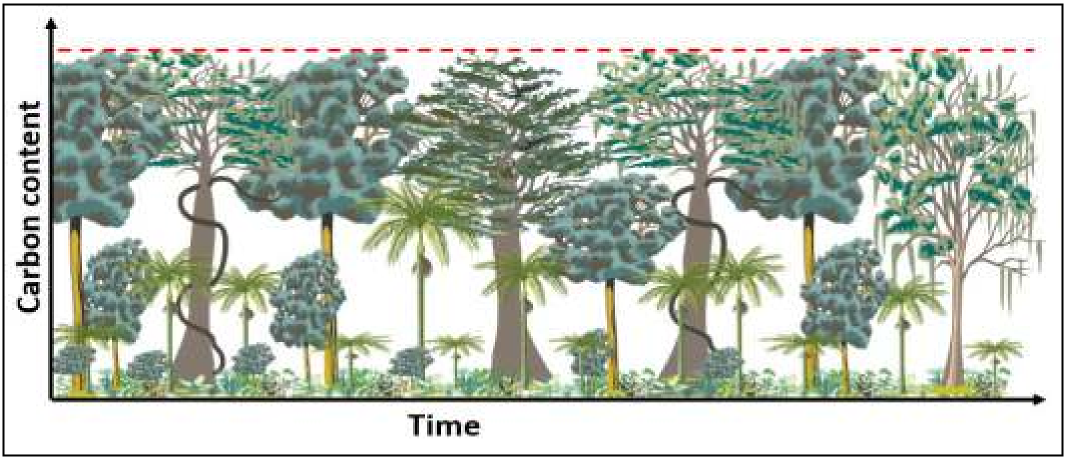


Figure 10. Carbon storage eligible activity

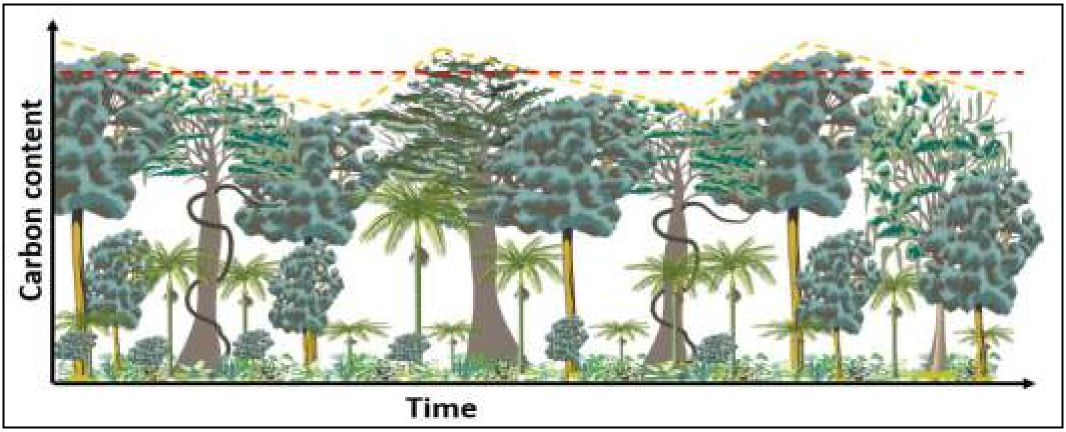


Figure 11. Sustainable forest management eligible activity

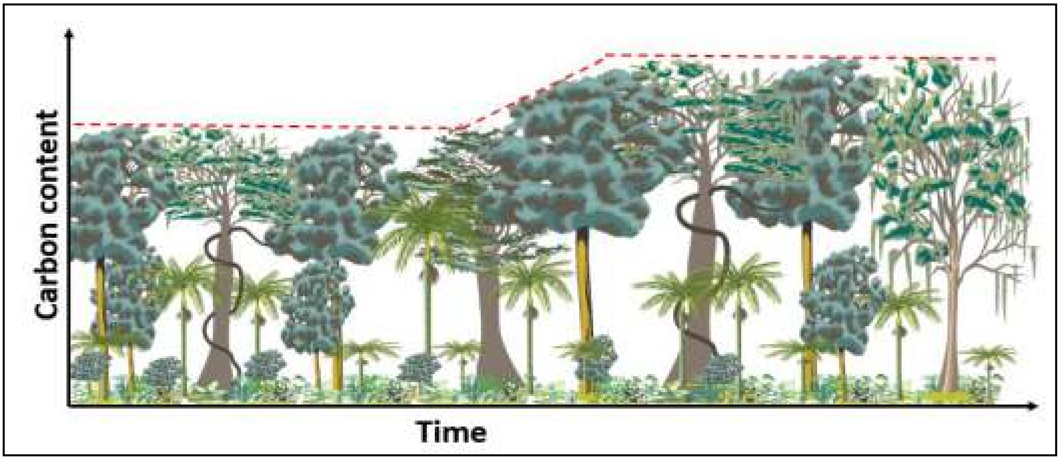


Figure 12. Increase in carbon content (storage) eligible activity

Climate change mitigation has had most development in the forestry sector in Peru, there are many projects and initiatives that have achieved concrete results, translated into carbon credits for carbon sequestration or storage.

E. Standards to apply to forest carbon projects

The voluntary carbon market has developed multiple standards that seek to give legitimacy and credibility to carbon credits issued; the existing methodologies are:

VCS (Verified Carbon Standard), is a group of social institutions: The Climate Group, International Emissions Trading Association (IETA) and the World Economic Forum and World Business Council for Sustainable Development (WBCSD). VCS begun operating in March 2006 in order to provide uniformity to the voluntary market and credibility to the voluntary emission reduction certificates, being currently the leading standard with the following objectives:

- Standardize and provide transparency and credibility to the voluntary carbon market.
- Increase the confidence of businesses, buyers and governments in voluntary reductions.
- Create a unit of voluntary emissions reduction that is credible and marketable: VCU (Voluntary Carbon Unit).
- Draw additional funding for projects that reduce emissions.
- Encourage innovation in mitigation technologies.
- Provide a transparent system that prevents the double use of credits. This is accomplished by creating VCS Records and a central database for projects, which is open to the public.

The GS (Gold Standard) is a standard with 10 years in the market and it focuses on land use change projects, such as forestry, energy efficiency, renewable energies, waste management and pipelines[19].

CAR (Climate Action Reserve)[20] is a standard that promotes measures to reduce GHG, ensuring the environmental integrity and financial benefits of emission reduction projects. It also establishes high quality standards for carbon offset projects, oversees independent third party verification bodies, issues carbon credits generated from such projects, and monitors credit transactions over time in a transparent system accessible to the public.

CAR begun as the Climate Action Registry of California, created by the State of California on 2001 to address climate change through voluntary input of data and public information of the emissions.

Climate, Community, and Biodiversity Standards (CCB), are a set of criteria for evaluating mitigation projects and their co-benefits. The standards are handled by the CCBA (Climate Community and Biodiversity Alliance), an international consortium of NGOs. The CCB does not generate tradable certificates, but is applied in conjunction with a carbon standard as CDM or VCS. CCBA requires the projects to be validated and verified by independent auditors to show that they do not only reduce GHG emissions but also generate co-benefits for the community and biodiversity. [21]

American Carbon Registry Standard (ACRS) is a nonprofit organization that serves as a record of pre-compliance and voluntary reporting of emissions. Their standards, methodologies and protocols are based on the ISO 14064. ACR also accepts CDM methodologies and some of VCS. The projects must be verified by an accredited third party before the ACRS[22].

Carbco Platinum Carbon Standard, released in 2009 for forestry projects, is a standard that searches for projects to meet certain transparency and sustainability requirements, protecting biodiversity and forests, contributing to local development and providing forest and meteorological information to help conservation and increase the understanding of the climate change phenomenon. The standard seeks to meet the requirements of the VCS and provides new elements such as public availability of cameras and satellites to demonstrate the compliance. Currently, under this standard, there are projects developed in Africa, Brazil and Southeast Asia. [23]

[19] Gold Standard
[20] Climate Action Reserve
[21] Finanzas Carbono
[22] Finanzas Carbono
[23] Finanzas Carbono

ISO 14064/65 Standards are part of the family of ISO standards (International Organization for Standardization). Launched in 2006 and 2007, ISO 14064/14065 quantify, report and verify GHG emissions. [24]

Panda Standard is the first voluntary standard created specifically for the Chinese market. Created by CBEEX (China Beijing Environment Exchange) and BlueNext, this standard was made public during the Conference of the Parties in Copenhagen in December of 2009. China has pledged to voluntarily reduce its emissions by 40-45% for the period 2005 - 2020, creating the standard for achieving said target and ensuring market infrastructure to create a robust Asian market of VERs. On the first stage, the standard focused on rural areas, with the development of methodologies for the forestry and agricultural sectors. All projects certified under this standard must be located in China. [25]

Plan Vivo, is a program designed for projects related to payments for ecosystem services in areas of community forest management and agroforestry. The program aims to build capacities, achieve carbon benefits on the long term, diversify livelihoods and protect biodiversity. There are seven projects registered in Mexico, Uganda, Mozambique, Tanzania, Nicaragua, Bolivia and Malawi, and projects that are being prepared for Cameroon, Ethiopia, Mexico, Kenya, Nepal and Tanzania. Plan Vivo keeps a list of the projects on its website and enter the issued credits (Plan Vivo Certificates) in the Markit Environmental Registry. [26]

SOCIALCARBON Standard, is a certification program created by the Brazilian NGO "Ecological Institute". The standard books the co-benefits for the communities generated by the projects, which must be verified by a carbon accounting standard such as VCS. The registry of projects has been managed by Markit since 2008. The standard measures the degree of sustainability of the projects in six areas: social, human, financial, natural, carbon and biodiversity. [27]

F. Neutralization and emissions compensation

Every productive activity performed by man generates greenhouse gases (GHGs), where the main and most abundant is carbon dioxide (CO_2) and on a lesser extent there is methane (CH_4), nitrous oxide (N_2O) and fluorinated gases. The main sources of emissions attributable to man are derived from the supply and use of fossil fuels (oil, coal and natural gas), generating 84% of the global emissions; also, 80% of the global emissions are CO_2.

[24] Finanzas Carbono
[25] Finanzas Carbono
[26] Finanzas Carbono
[27] Finanzas Carbono

Another important source of CO_2 emissions is deforestation, and other sources are: animal husbandry and rice cultivation that emit CH_4, the use of fertilizers that increase nitrous oxide emissions, and the removal, treatment of garbage and human waste.

These emissions, as of the industrial revolution have increased the levels of GHGs concentrated in the atmosphere, causing the greenhouse phenomenon on Earth to be altered and consequently to a gradual increase in temperature - which according to various reports is between 0.5 and 2 °C - an increase that is causing many economic, social and environmental problems worldwide.

As climate change and its effects have been scientifically proven, society has taken measures to mitigate it. The main action is focused on reducing or offsetting emissions from companies, industries and other institutions, the same that in their environmental policy commit to neutralize the emissions generated with their production activities.

The process of neutralizing emissions follows the dynamic shown in figure 13.

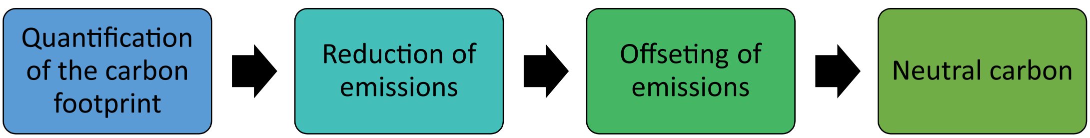


Figure 13. Neutralization process

Figure 13 shows as first step the carbon footprint quantification of the company, industry or institution, which has to be certified by an accredited company; by said quantification, emissions are known by source and productive process. The second step is the reduction of emissions by the identification of the sources that can be reduced without affecting the production process (being more efficient with resource and energy use). The third step is the offsetting of emissions that cannot be reduced in the second step; in this step, the company, industry or institution must buy carbon credits to offset the remaining emissions. In the fourth and last step, the certifying entity of the process issues the certificate and indicates the evaluated production process as carbon neutral.

The offsetting process generally directed to specific events or activities, where becoming carbon neutral does not justify the time and cost. The offsetting process is a cut of the neutralization process (figure 14), and consists in defining the time and space boundaries of the event or activity, the quantification of emissions and the offsetting of the quantified emissions by purchasing carbon credits.

Figure 14. Offsetting process

G. Funding

The financing of forest carbon projects aim at early initiatives in the voluntary market, is accomplished by three modalities:

- International cooperation
- Investment funds
- Individual Investment

In the case of forest carbon projects under the REDD+ mechanism, Angelsen (2013) mentions that currently REDD+ funding comes from several sources - public, private, national and international - and various mechanisms (such as taxes, carbon markets and credit auctioning). Public sector funding is defined as revenue generated through a controlled mechanism by a public entity; while private sector funding bypasses the public sector. It also mentions that two thirds of all REDD+ activities that receive international support are funded through bilateral programs and projects of the country; the rest comes from multilateral sources. Here preparation programs are included and to a lesser extent, support policies and pilot projects of payment based on results.

On the other hand, the Peruvian government has been preparing the implementation of REDD+. Che Piu & Mentón (2013) mention that there no specific fund that manages REDD financial resources; however, in the Readiness Plan Proposal (R-PP), the possibility of having a fund to administer and coordinate financial resources from all sources (national and international), has been considered. This would not be a separate fund, but it would be articulated to climate change adaptation and mitigation funds, in charge of the MEF. However, the institutions that manage the existing environmental funds (PROFONANPE, FONAM, FONDAM, etc.) are expected to manage financial resources that arrive for REDD. In fact, FONAM administers the financial resources of the project "Strengthening of technical, scientific and institutional capabilities on the implementation of a REDD program in Peru" and the project "Support in the implementation of REDD+ in Peru". Additionally, there is the debt swap managing experience with the United States for forest conservation, as in the case of the Tropical Forest Conservation Fund by FONDAM and the Agreement on the Conservation of Tropical Forests by PROFONANPE.

H. Market

Forest carbon projects in Peru have been developed for the voluntary market, where they have several commercial transactions; Rojas (2011) mentions that the voluntary market[28] has had an exponential growth in recent years, as the processes of registration and credit issuance are more agile and present less obstacles. The national approval of the host country is not usually requested, and the validation and verification process is dependent on the standard used. However, approval criteria are similar to CDM projects and seek to ensure that the reductions are real, long-term and comply with all environmental standards without any double counting. Thus, the voluntary markets offer:

- Increased potential to implement small projects with high benefits for local communities, in low-income countries.
- Less bureaucratic procedures and lower transaction costs.
- Increased flexibility, allowing the inclusion of different types of projects.
- Extra Funding for cooperation projects.
- Clean technologies for the poor and better energy services.
- Most demanding voluntary schemes allow assessing aspects beyond climate change.

In the voluntary market there are different sectors generating credits for offsetting and neutralizing GHG emissions, which are also known as "offset credits". These sectors[29] are:

- Energy
- Industrial Processes and use of products
- Agriculture, Forestry and Other Land Uses (AFOLU)
- Waste
- Other

Sectors that issue offset credits do this as a complement within their activities in order to improve their income and as a financial thrust strategy. This credits generated in the market are demanded for: offset emissions or support a climate change mitigation initiative, as a part of the social and environmental responsibility policy of industry and enterprise. This makes the decision of purchasing offset credits be related to the implementation of the policy or institutional strategy. The demand of credits based on the offset credit purchase motivation can be seen in table 7.

[28] This chapter focuses in the voluntary market
[29] IPCC 2006 – AFOLU GEI inventories

Table 7: Buyer's motivation for participating in the market, until 2013

Buyer's motivation for participating in the market	Participation (%)
Offset resale	32.0
Mission driven by climate; to battle climate change	20.0
Social corporate responsibility	19.0
Showing climatic leadership in the industry, politics	14.0
Involve the clients/clients for offsetting emissions	10.0
Encourage the offer of the practice change chain, sustainability	2.0
Other	3.0

Adapted from: Ecosystem Market Place (2014)

Moreover, due to the working environmental policies of companies and industries of countries and regions, different social and environmental responsibility working strategies are applied, the same that contributes with to climate change mitigation and brings benefits to the population. This working scheme has made regions in the world have different levels of offset credits demands based on their objectives, as shown in table 8. Europe and North America are the regions that demand most offset credit in the voluntary market.

Table 8. Traded volume and purchase Price in the market, until 2013

Region	Volume bought (Thousands of tons)	Purchase price (Thousands of USD)	Purchase Price (%)
Europe	28	254	52.0
North America	9	78	36.0
Australia	3	30	4.0
Asia	1	9.7	7.0
Latin America	0.4	4.1	1.0
Europe (Not European Union)	0.2	1.3	0.2
Africa	0.1	1.3	0.1

Adapted from: Ecosystem Market Place (2014)

The offset credit market increases its demand and the value thereof due to the co-benefits generated for biodiversity conservation and improvement of the living conditions of the populations involved, which makes buyers be attracted to the particularities of each type of project, where this preference reveals the projects that have the highest demand according to their type, as shown in table 9.

Table 9 shows that REDD+ is the type of project that has the greatest demand in the voluntary market, as each offset credit helps prevent the loss and alteration of natural forests, the same that have a great social and environmental importance due to the co-benefits they offer. Another type of project that has a large share is afforestation and reforestation (forest plantations), whose demand is lower than REDD+ because they emitting few credits at the start and increase progressively as the plantations develop, where projects are of 20 years and more.

Table 9. Percentage participation in the market by Type of Project, until 2013

Type of project	Participation (%)
REDD+/avoided emissions	38
Clean stoves	24
Wind	7
Afforestation/reforestation	4
Water filtration	4
Residual heat recovery	4
Methane from landfills	3
Hydroelectric Energy production	2
Large Hydroelectric plants	2
N_2O/Nitrous oxide	2
Improvement in forest management	2
Change in fuel	1
Biomass	1
Efficiency	1
Biogas	1
Geothermic	1
Agro-silviculture	1
Grasslands	<1
Methane from livestock	<1
Other	1

Adapted from: Ecosystem Market Place (2014)

Forest carbon projects, in order to quantify their CO2-e sequestration or avoided emissions, as well their co-benefits, are governed according to international standards and certifications attributed to such type of projects. The application of a standard or certification is often directed according to the consumer market or region in particular. Many standards and certifications have been developed worldwide; many have managed to consolidate but others have been relegated in time. Table 10 shows the participation or application of the most accepted methodologies according to the offset credit market, some of which are complementary to one another in order to emphasize the co-benefits of each project.

Table 10. Market participation by standard and certification

Standards / certifications	Participation (%)
Only VCS	29
VCS+CCB standards	16
VCS + Social Carbon	2
Internal/Owner	21
Gold Standard VERs	15
Gold Standard CERs	<1
CERs/ERUs	7
CAR	5
CCB + "other" standards	1
ACR	1
No standard	1
Plan vivo	<1
VER+	<1
Other	2

Adapted from: Ecosystem Market Place (2014)

There are different types of projects that generate offset credits in the market, the same that, according to the activity they perform, may have a greater or lesser acceptation. In figure 15, forestry and land use projects in the voluntary market are shown, forest carbon projects represent the greater demand.

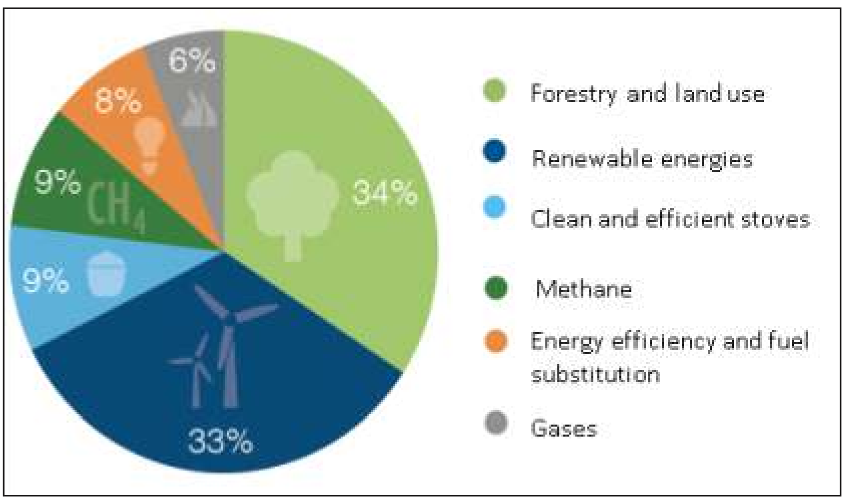


Figure 15. Market by voluntary carbon offset projects category, year 2012

Figure 16 shows the demand for offset credits from 2008 to 2013, where a downward trend was recorded; however, on the same chart, predictions from surveys from 2013 and 2014 projecting a demand greater than the historical trend can be seen, which is encouraging for forest carbon projects.

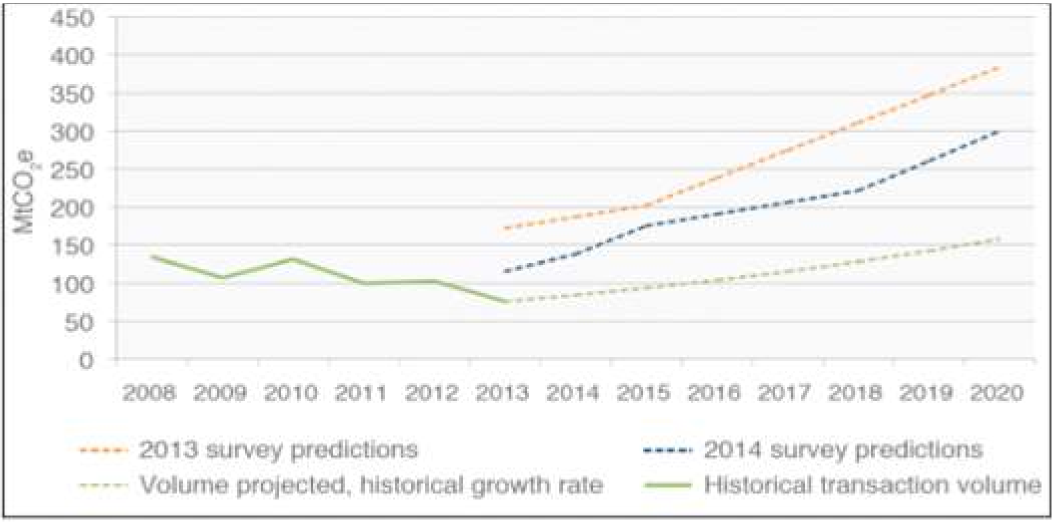


Figure 16: Market projections, historical data and predictions of the supliers

I. Forests and climate change mitigation activities

The lines of action that are part of forest carbon projects, which have been described above, lead them to be classified as follows:

- Afforestation
- Reforestation
- Forest management
- Forest protection

For these four lines of action, AIDER has implemented various development, conservation and research projects in several areas of Peru, which are described in this publication, in order to share the results, achievements and challenges of each experience :

A) Afforestation experience, with the Project “Agro-silvo-pastoral practices oriented towards the carbon market” in Cusco region.

B) Reforestation experiences, with the following projects: “Reforestation, sustainable production and carbon sequestration in the dry forests of José Ignacio Távara – Piura”, “Reforestation in degraded lands for the purposes of timber production and carbon sale – Ucayali”, and “Recovery of degraded areas as a result of mining in Madre de Dios.”

C) **Forest Management with REDD+ Experiences,** with the following projects: "REDD+ Project "Evio Kuiñaji Ese'Eja Cuana to mitigate climate change, Madre de Dios – Peru", "REDD+ Project "Forest management to reduce deforestation and forest degradation in Shipibo Conibo and Cacataibo indigenous communities in Ucayali region" working along with 7 native communities, and "Assisted natural regeneration in tropical dry forests".

D) **Experiences in forest protection with REDD+,** with the following projects: "REDD+ project "Reducing deforestation and forest degradation in tropical dry forests located in Piura and Lambayeque", "REDD+ Project "Reduction of deforestation and degradation in Tambopata National Reserve and Bahuaja Sonene National Park in the scope of the Madre de Dios region – Peru", and "Feasibility assessment of forest carbon projects in "Pomac Forest Historical Sanctuary".

In addition to these projects and experiences, AIDER has been implementing forest projects that contribute to forest management and climate change mitigation. Figure 17 shows the location map of AIDER's forest carbon experiences.

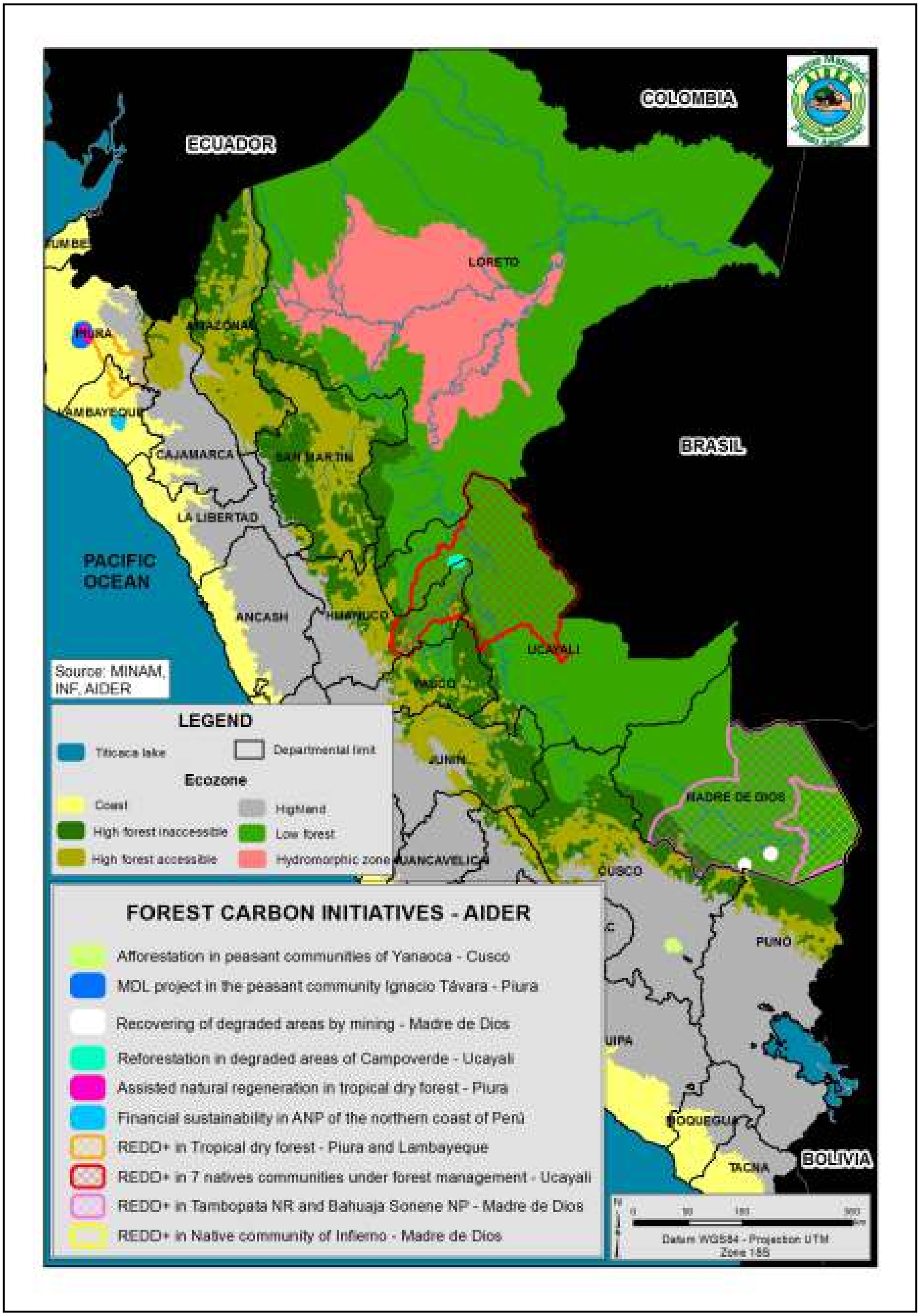
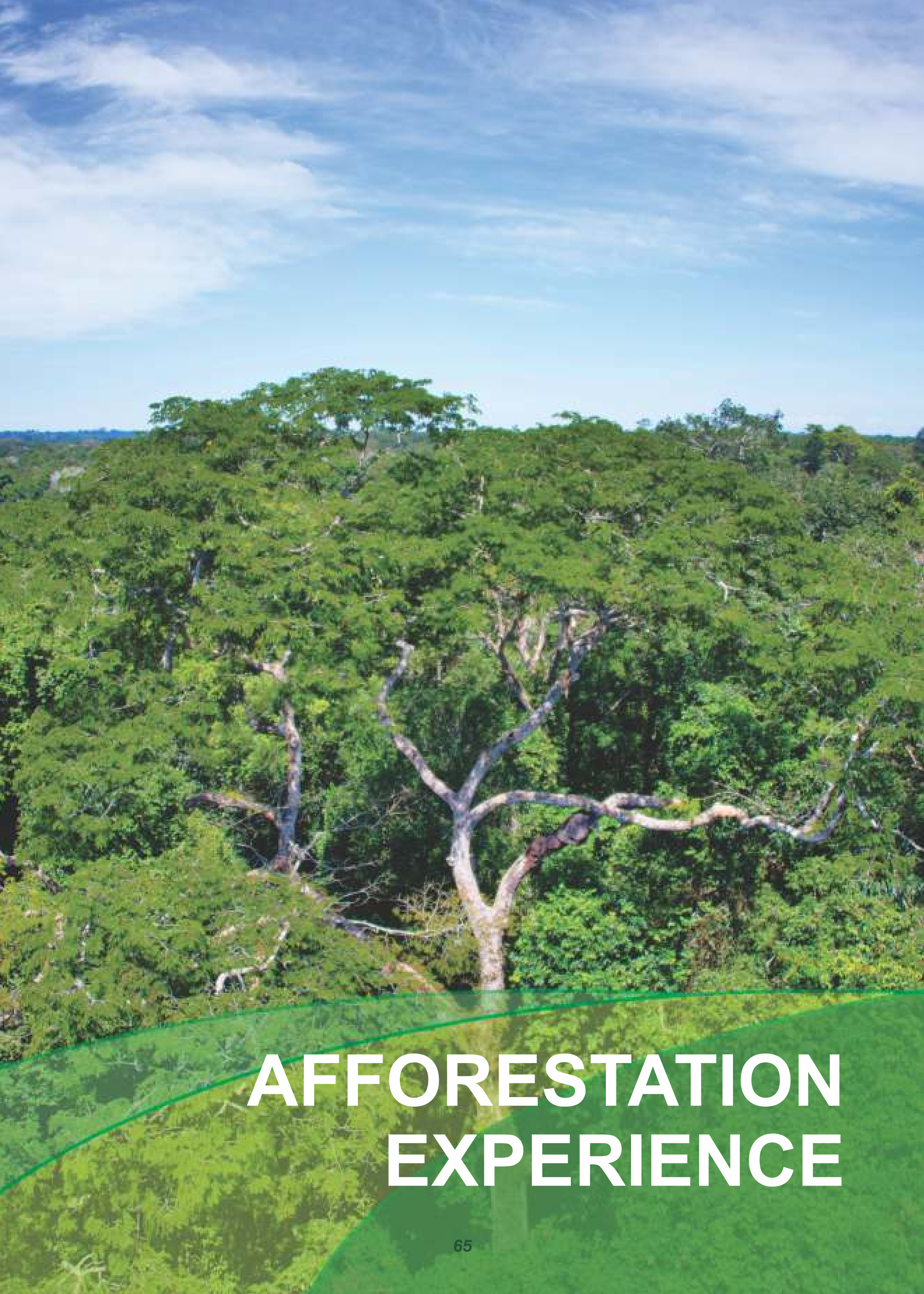


Figure 17. Location map of AIDER's forest carbon experiences[30]

30 MIANM (2014) http://geoservidor.minam.gob.pe/geoservidor/maps.aspx

DEVELOPMENT OF THE CARBON FOREST EXPERIENCES



AFFORESTATION EXPERIENCE

Project "Agro-silvo-pastoral practices oriented towards the carbon market"

Percy Recavarren Estares and Miriam Delgado Obando

SUMMARY

The project "Agro-silvo-pastoral practices oriented towards the carbon market" was developed and implemented by World Vision Peru (WVP). The beneficiaries of this project are six peasant communities in the Yanaoca district, Canas province, Cusco region. The project total area of intervention comprises of 418 hectares, in which afforestation is being carried out. The main objective of the project is to provide an income for the communities through timber sales and carbon credits, as well as to generate environmental and social co-benefits.

For this project, the selected tree species were pine, eucalyptus and queuña. This selection was made taking into account the climatic and edaphic conditions of the area and the objective of the afforestation – to generate more income to the population. With no Allometric equations to estimate the growth in height and diameter at breast height (DBH) in the biophysical conditions of the plantation area, they were developed for each of the species. With the generated equations we could make projections of growth in height and DAP, as well as fixing CO2-e of the same until the turn of the year use 25. In the case of timber product is obtained in the first thinning, at year 9, a volume of 4,458.6 m3 (r) between pine and eucalyptus wood second income is the second thinning at year 17 with a volume of 12,063.9 m3 (r) and the end is with crop planting in the year 25, with a volume of 49,829.3 m3 (r) and carbon fixation 81,145.4 tCO2-e.

In order to assess the ecosystem services of the forest plantation and to be able to commercialize the generated carbon credits, World Vision Peru hired AIDER to formulate the Project Design Document (PDD) under the method established by Gold Standard (GS).

I. Location and characteristics of the communities

The project "agro-silvo-pastoral practices oriented towards the carbon market" has been implemented in six peasant communities: Jilayhua, Ccolliri, Pongoña, Kaskani, Hanccoyo y Hampatura, located in Yanaoca district, Canas province, Cusco region. The land use rights of the six communities comprise a total extension of 11,031 hectares, as shown in figure 1.

Figure 1. Location map of the six peasant communities

1.1. Biophysical characteristics

A) Climate, temperature y precipitation

The Yanaoca district is located at an altitude of 3,910 meters above sea level, the climate of the district is cold and with rainfall in well-defined periods throughout the year. Regarding temperature, the average varies from 5 to 8ºC, while the minimum reaches values from -3 to -20 ºC.[31]

B) Hydrography

The Carañahui and Totorani rivers represent the hydrographic network, as well as springs – water fountains – that are commonly called “manantes” or “puquios” (in quechua)[32].

C) Ecology

The scope of the Project comprises 3 life zones according to the ecological map of Peru (INRENA, 1994):

- Subtropical Montane moist forest.
- Subtropical Montane moist forest transition to paramo
- Subalpine Subtropical wet forest

D) Flora

The evaluation of the vegetation allowed to identify 31 families, 59 genera and 76 species, plus 12 unidentified taxa. The most diverse families were Poaceae with 9 genera and 14 species and Asteraceae with 11 genus and 13 species. The vegetation is mostly herbaceous, with the exception of 4 semi-shrubby to shrubby species: *Lupinus* sp. (Fabaceae), *Margyricarpus pinnatus* (Rosaceae), *Tetraglochin strictum* (Rosaceae) and *Ageratina sternbergiana* (Asteraceae). Individual tree species: Qqeuña or Queuña - *Polylepis cf. racemosa* (Rosaceae), C'olle - *Buddleja coriacea* (Scrophulariaceae) [33]. The flora found in the area of the communities are shown in figure 2.

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[31] CTAR Cusco *et al.* (2002)
[32] World Vision Peru and KUNTUR. 2013.
[33] World Vision Peru (2014)

Figure 2. Flora found in the area of the community

E) Wildlife

The wild animals that can be found in the six peasant communities are: fox, deer, skunk, squirrel, mouse, wild guinea pig, wild rabbit, kestrel, dove, caqqe, leqqe, eagl", alqamari, leqencho, huamán, qellohuayto, peqpe, owl, choseq, bat, taparaco, pichitranca, chiuchico, chihuanco, heron, cuculí, cullco, partridge, pesaqa, parakeets, snake, toad, frog, sucayllu, trout, suche, silverside and lizard among others that appear sporadically, according to villagers.

Note that many of these wild animals are in danger of extinction such as the Ph'isaq, disappearing due to indiscriminate hunting by the villagers of the area[34].

1.2. Social characteristics

The population of Yanaoca district was of 14 510 residents by 2010 and it had an annual growth rate of 1.58% (see Table 1). The human development index (HDI) of the UNDP was 0.5, which reflects a low level of socio-economic development (World Vision, 2006).

The working age population (WAP) compromises of 50.1% dedicated to farming, 25.4% to studying and 12.2% are housewives. These three activities account for 87.7% of the WAP and 12.3% remaining is dedicated to trade, handicrafts, construction, and the exercise of several other professions.

[34] Wolrd Vision Peru and KUNTUR. 2013.

Table 1. Total population for Yanaoca district

Year	1993	2000	2005	2010
Population (inhabitants)	9,923	11,680	11,997	14,510

Source: World Vision 2006, with data from INEI – DIRESA Cusco

The child and adolescent total population from 01 through 19 years of age represents 52.2% and the population from 19 through 60 years of age represents 47.7%, showing that child and youth population is greater than half of the total population; however, there is a drastic decrease in the number of people over the past 20 years, demonstrating there is a considerable migration of young people in the search for better living conditions.

For example, young people from 15 to 20 years of age in Kaskani community temporarily migrate to Arequipa, Puerto Maldonado and Quillabamba, where they offer unskilled manual labor from December to April, period in which the highest rates of migration happen. Meanwhile, in Pongoña community, the migration rate is a concern, as most of the young people migrate in the search of employment, mainly during the months of January, April, June, July and December. (World Vision Peru, 2006).

98.3% of the families in Yanaoca district, live in rural areas, only 6.1% live in urban areas. (World Vision Peru, 2006).

As of 2006, World Vision Peru (WVP) has been working in Canas province in Cusco with the “Development Program for the Canas are” known as PDA for its initials in Spanish; in this program, family and community are actively integrated in projects aimed towards the encouragement of a culture that protects and promotes childhood. The area of intervention in Canas province comprises the districts of Quehue and Yanaoca, in which the project is currently being implemented. Thanks to this work, WVP has managed to position itself within the communities that are part of the project, thus creating a commitment from their side.

Figure 3. Social work with the representatives of the six peasant communities.

1.3. Economic characteristics

Productive economic activities in Canas province are mainly based on livestock, even though the weather conditions are not very favorable for the development of natural pastures and the associated crops are not abundant. Second comes farming, being commercial and craft activities developed in a small scale and complementary way (World Vision Peru, 2006). Communal areas are divided according to the ecological tiers for production: typically, the lower and middle zones are for growing basic crops, and upland areas are intended for growing potatoes and for extensive grazing of animals.

Livestock is extensive and mainly supported by natural pastures; it provides the highest percentage of income for the sustenance of the families in Yanaoca. It should be noted that all families are engaged in both livestock and agriculture simultaneously in a complementary way, being agriculture very limited due to the lack of water and affected by the fragmentation of agricultural land. Also, the complementarity of agriculture becomes relative as the altitude increases (World Vision Peru, 2006).

II. **Problematic**

Most Andean highlands families in Peru are dedicated exclusively to agriculture and livestock for their nourishment and livelihood; men are primarily involved in farming the land while women are mainly occupied in animal rearing. According to INEI, the monthly income of the families in Yanaoca district is 57 dollars[35]. Low family income is one of the factors influencing on the children nutritional condition (54.4% of them suffer from chronic child malnutrition) and the poor educational attainment (only 73.4% of children between 12 and 13 years have completed elementary school[36]).

Farmer's increased needs for better education, health, housing and energy have generated in them a greater need for monetary liquidity. This has led them to increase their excess production to be sold in the markets and thus increase the pressure on the soil. In addition, local climate change is affecting the activities performed by the population increasingly, causing a shortage in water supply for drinking and for irrigation, and producing increasingly phenomena that affect the health of the people, the animals and the production of crops and pastures.

All this is generated by the lack of alternative economic activities in the communities, which is leading them into poverty and socio-economic backwardness.

III. Design of the project

3.1. Conceptualization and pre-feasibility study of the project

Prior to the development of the "Agro-silvo-pastoral practices oriented towards the carbon market" project, World Vision Peru (WVP) conducted a feasibility study developed over a three year period (2009-2011) in four rural communities in three districts. The three year period allowed the compilation of information from different agencies for its subsequent evaluation, making use of the relationship between the socio-economic realities of the Andean highland communities in Peru with the requirements of the CarbonFix standard. This information has served as basis for the design of the project being implemented to date.

Figure 4. Participatory workshops of the six peasant communities

[35] INEI (2007)
[36] INEI (2007)

3.2. Design

To address the problems of the Andean highlands families in our country, especially the ones in the project area, forest plantations come to be an alternative for improving their income (with the sale of timber and manual labor). Likewise, revenue will be achieved from the sale of the carbon credits that will be offered in voluntary markets, and environmental and social co-benefits can be foreseen with the forest plantations. Under this context and financed by World Vision Australia (WVA), World Vision Peru developed the project "Agro-silvo-pastoral practices oriented towards the carbon market" to implement the scheme of payments for ecosystem services (PES). The project was established to work with the CarbonFix standard due to the experience that WVA has in other countries, where it has been implementing projects in which beneficiary communities have earned an income from the sale of the carbon credits. While WVA has experience in this subject, its staff in Peru doesn't have the knowledge of the specialists in Australia, so it was decided to rely on an institution that handles forest carbon subject in Peru; this way, AIDER was contacted, company that was hired by World Vision Peru to document all the requirements set by the CarbonFix standard. AIDER has over nine years working around the subject of forest carbon. The combined work between AIDER and the communities in the gathering of information for the documentation of the standard is shown in figure 5.

Figure 5. Gathering information with the peasant communities

3.3. Participants

The participants of the project are: World Vision Peru, under the advice of WVA specialists, AIDER and the 650 families of the 6 peasant communities.

Figure 6. Project participants

Table 2. Participants involved in the project

Participants	Roles/commitments	Benefits
Peasant communities	In charge of the installation, maintenance, protection and silvicultural management of the forest plantation. Communities, as owners of the carbon credits, will be the ones making the decisions related to its marketing, under the advice of World Vision Australia.	Economic income and environmental and social co-benefits
World Vision Peru and Australia (Project implementers)	WVP and WVA will provide technical advice and help in the fundraising for the maintenance of the early years of the forest plantation and sale of the carbon credits in the voluntary carbon markets.	Continue working with the peasant communities for their own benefit, fulfilling their institutional strategic mission
Asociation for Investigation and Integral Development - AIDER (Technical adviser on forest carbon)	Development of the Project Design Document (PDD), under the Gold Standard.	Fulfillment of their institutional strategic mission

3.4. Project Design Document elaboration

AIDER was hired to develop the project design document (PDD) in order to obtain the carbon credits as a product from carbon sequestration CO_2-e of the plantation. The development of the PDD started with the CarbonFix standard, and during the process it was merged with the Gold Standard, having had to adjust the requirements. The PDD was developed with Gold Standard (GS) version 0.9, published in August 2013.

The requirements set out in the Gold Standard (GS) for a project that is in an initial certification process include three major sections: sustainability, additionality and methodology; these three sections comprehend social and environmental issues, legal rights, monitoring, baseline and CO_2 sequestration, among others. The determination of the limits of the project is part of the requirements of the GS; the limits were established according to the following:

The Project limits are the following:

- **Limits of the project area** are the 6 peasant communities with land use rights: Jilayhua, Ccolliri, Pongoña, Kaskani, Hanccoyo and Hampatura; which comprise a total area of 11,031.0 hectares in which afforestation will be held.

- **Limits of the eligible plantation area** are the areas designated by the 6 peasant communities for the activities of the project to be carried out. With the eligibility

  criteria established by the standard, the most suitable for the plantation were analyzed. Being clear on the eligibility criteria, the eligible planting area was delimited by constructing a series of units (taken as sectors) for both the biophysical and forest diagnosis. Subsequently, the spatial domain over the area was delimited, prior to an analysis and field work. All of this was visually digitalized until the eligible areas for the plantation were obtained. The visual digitalization process was developed as follows:

  - ✓ The units (project areas) were defined by overlapping basic political and administrative boundaries, contour lines, populated areas, roads and hydrography map layers. This was done using ArcGIS 9.3.1. allowing a better characterization of the terrain.

  - ✓ Once the base information was obtained, the “bing aerial layer” – which has orthophotographs of the area and a resolution of 1 meter per pixel - was loaded, making the delimitation of the eligible areas for the plantation much easier.

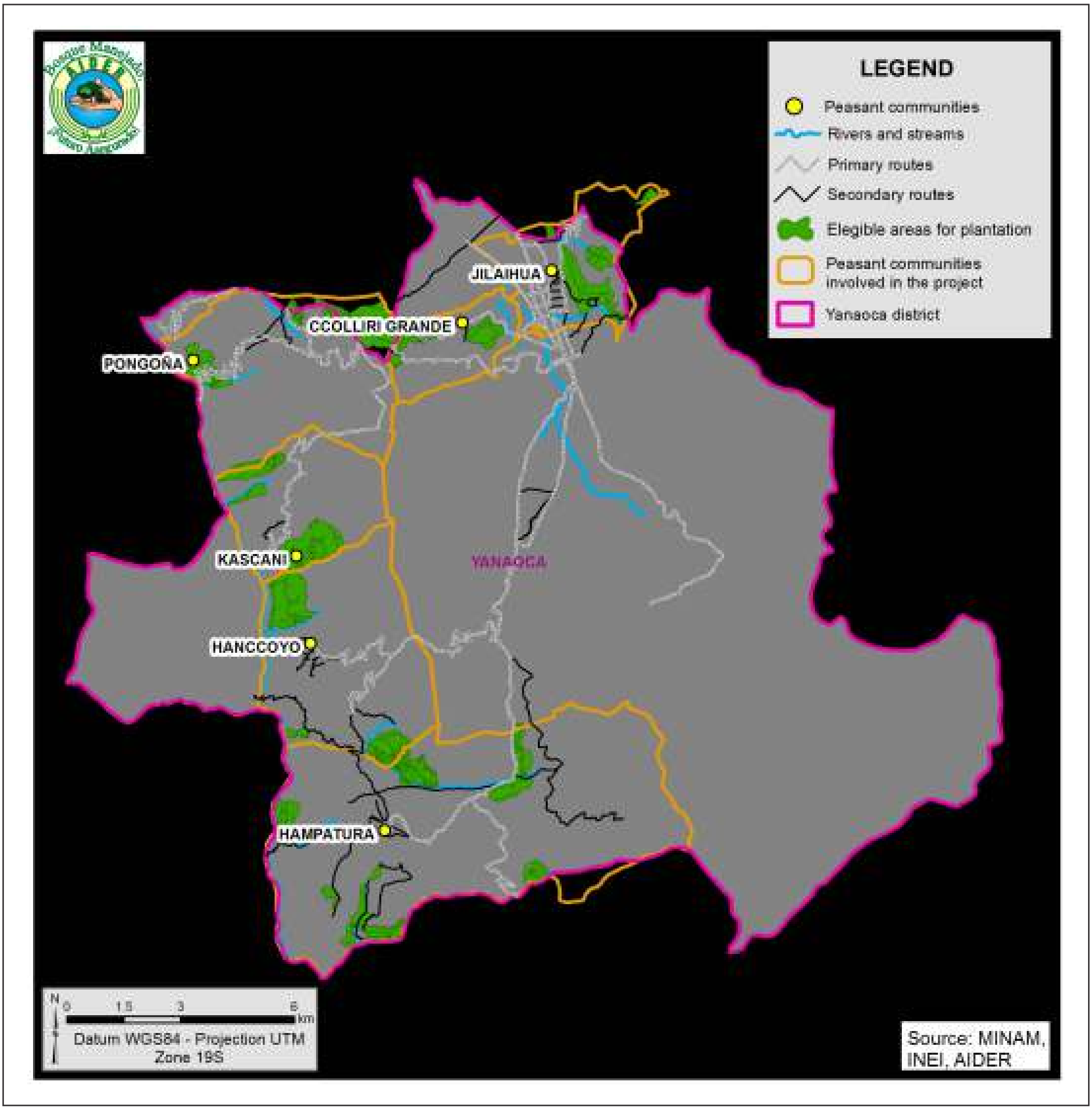

Figure 7. Map showing the limits of the project

IV. Timber production and carbon sequestration

4.1. Selection of species

The selected species for the forest plantation were pine (*Pinus radiata*), eucalyptus (*Eucalyptus globulus*) and queuña (*Polylepis* sp.). This selection was made according to two major factors: site quality (climate, soil, topography and competition) and the objective of the afforestation (timber production and CO_2 sequestration). References of successful experiences made in our country with these species in areas of similar characteristics to the ones of the project added to the decision.

Figure 8. Installed nursery of pine

4.2. Growth models

Growth models were developed due to the lack of information to estimate the DBH and height growth for the selected species. It was decided to develop allometric equations with primary information that took in the biophysical characteristics of the areas surrounding the plantation area. Plantations of pine, eucalyptus and queuña were identified in areas near the project area, and tree growth variables: DBH (cm), total height (m), commercial height (m) and age of the plantation, were registered on the field for 132 trees. With the collected information, growth curves were obtained, resulting in allometric equations to project the DBH and height growth for the selected species.

Figure 9. Measurement and collection of information of pine trees in a 12 year old plantation for the growth model.

Figure 10. Measurement and collection of information of pine trees in a 17 year old plantation for the growth model.

A) Growth model to estimate DBH and height of *Eucalyptus globulus*

Data was collected from 50 trees of eucalyptus for DBH (cm), total and commercial height (m) and age. For this specie, trees between 5 and 28 years were sampled. With this information, growth models for DBH and height were developed, resulting in the allometric equations presented below:

- DBH growth: allometric equation to estimate the DBH growth of eucalyptus (*Eucalyptus globulus)*.

$$\mathbf{DBH = 2.005*T^{0.875}}$$

Where:

DBH : Diameter at breast height (cm)

T : Age (years)

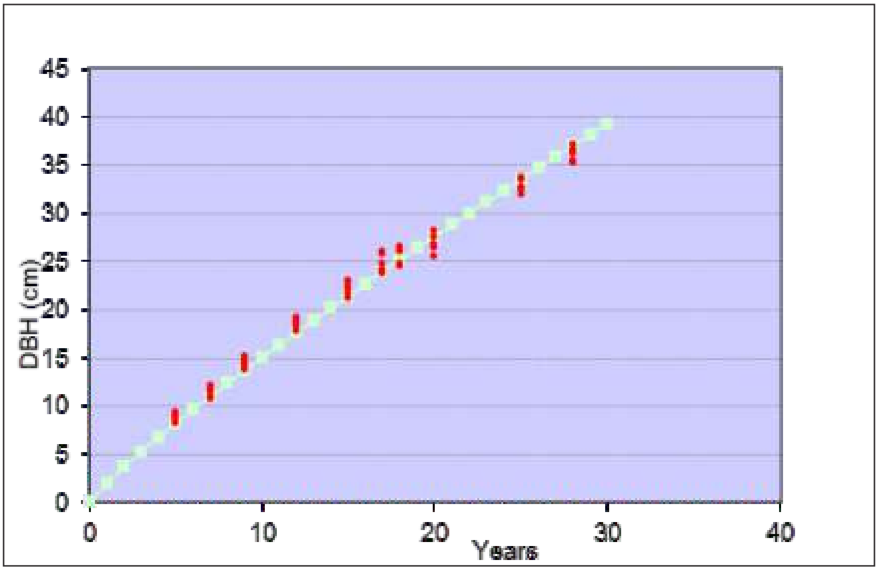

Figure 11. Graph showing a DBH growth model for eucalyptus (*Eucalyptus globulus)*

- Height growth: allometric equation to estimate the height growth of eucalyptus (*Eucalyptus globulus)*.

$$\mathbf{H = 31.15 * (1 - exp(-0.125 * T))^{1.825}}$$

Where:

H : Total height (m)

T : Age (years)

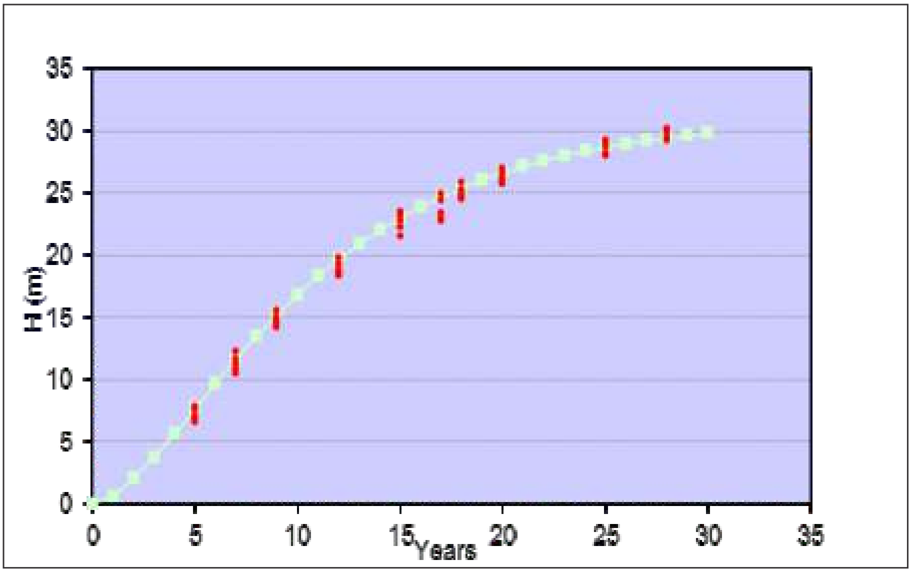

Figure 12. Graph showing a height growth model for the specie eucalyptus (*Eucalyptus globulus)*

B) Growth model to estimate DBH and height of pine *(Pinus radiata)*

As with eucalyptus, data was collected from 46 trees of pine for DBH (cm), total and commercial height (m) and age. Trees between 5 and 22 years were sampled. With this information, growth models for DBH and height were developed, resulting in the allometric equations presented below:

- DBH growth: allometric equation to estimate the DBH growth of pine (*Pinus radiata).*

$$\mathbf{DBH = 1.515 * T^{0.965}}$$

Where:

DBH : Diameter at breast height (cm)

T : Age (years)

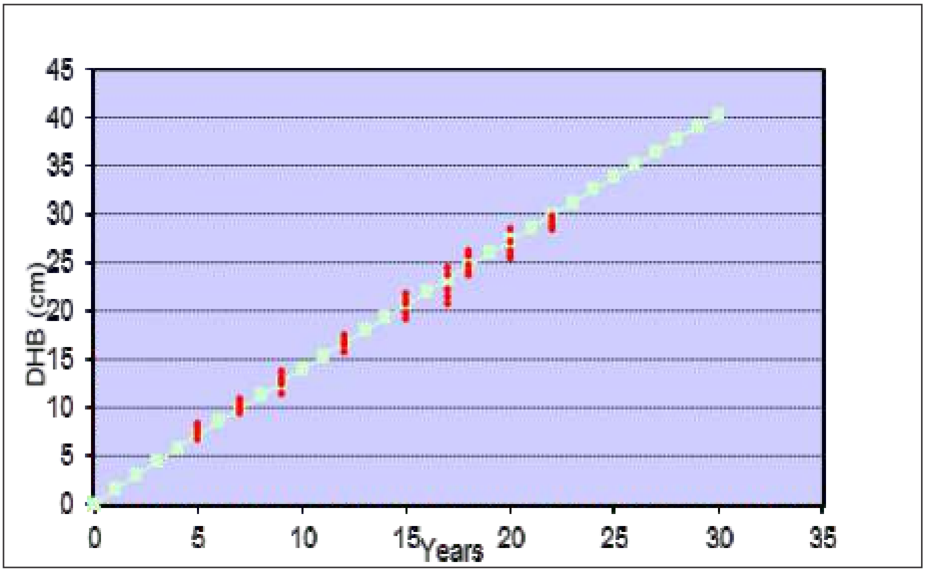

Figure 13. Graph showing a DBH growth model for pine (*Pinus radiata)*

- Height growth: allometric equation to estimate the height growth of pine (*Pinus radiata).*

$$H = 23.52 * (1 - \exp(- 0.099 * T))^{1.415}$$

Where:

H : Total height (m)

T : Age (years)

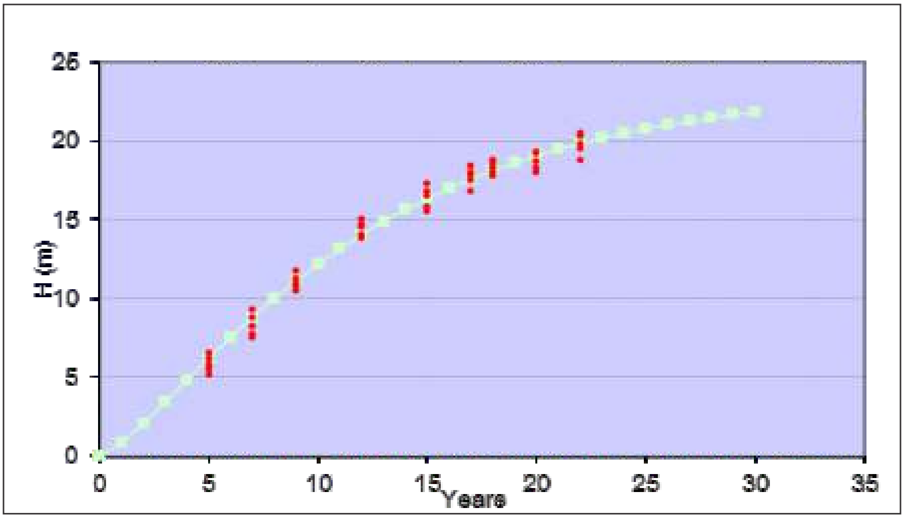

Figure 14. Graph showing a height growth model for pine (*Pinus radiata)*

C) Growth model to estimate DBH and height of queuña (*Polylepis* sp.)

As with the two other species, data was collected from 35 trees of queuña for DBH (cm), total and commercial height (m) and age. Trees between 5 and 20 years were sampled. With this information, growth models for DBH and height were developed, resulting in the allometric equations presented below:

- DBH growth: allometric equation to estimate the DBH growth of *queuña (Polylepis* sp.).

$$\mathbf{DBH = 1.734 * T^{0.712}}$$

Where:

DBH : Diameter at breast height (cm)
T : Age (years)

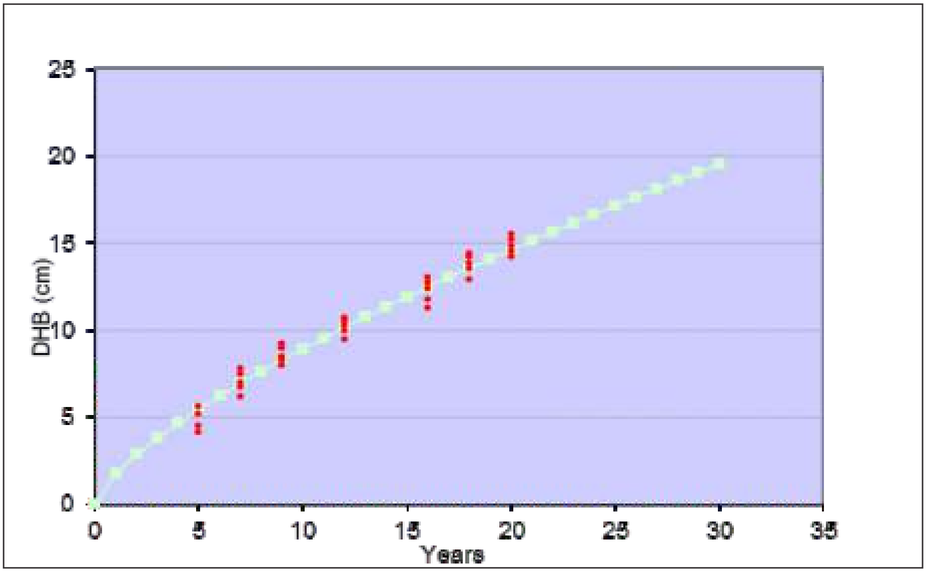

Figure 15. Graph showing a DBH growth model for queuña (*Polylepis* sp.)

- Height growth: allometric equation to estimate the height growth of queuña (*Polylepis* sp.).

$$\mathbf{H = 7 * (1 - exp(- 0.095 * T))1.2}$$

Where:

H: Total height (m)
T: Age (years)

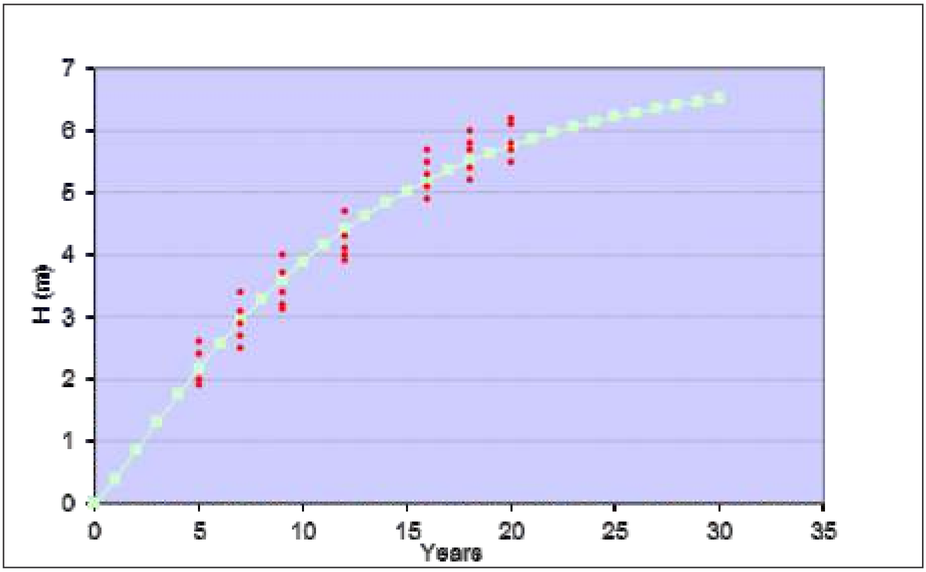

Figure 16. Graph showing a height growth model queuña (*Polylepis* sp.)

4.3. Projected growth and timber production

A) Projected growth

Projected growth in DBH and height for pine, eucalyptus and queuña was estimated using the allometric equations generated with the growth models. Table 3 shows the projected growth for the three species.

Figure 17. Pine growth evaluation

Table 3. Growth projections for the selected tree species

Years	DBH growth (cm)			Total height growth (m)		
	Pine	Eucalyptus	Queuña	Pine	Eucalyptus	Queuña
2	3	4	3	2	2	1
3	4	5	4	3	4	1
4	6	7	5	5	6	2
5	7	8	5	6	8	2
6	9	10	6	8	10	3
7	10	11	7	9	12	3
8	11	12	8	10	13	3
9	13	14	8	11	15	4
10	14	15	9	12	17	4
11	15	16	10	13	18	4
12	17	18	10	14	20	4
13	18	19	11	15	21	5
14	19	20	11	16	22	5
15	21	21	12	16	23	5
16	22	23	12	17	24	5
17	23	24	13	18	25	5
18	25	25	14	18	25	6
19	26	26	14	19	26	6
20	27	28	15	19	27	6
21	29	29	15	19	27	6
22	30	30	16	20	28	6
23	31	31	16	20	28	6
24	33	32	17	20	28	6
25	34	34	17	21	29	6
26	35	35	18	21	29	6

B) Timber production

The forest plantation will produce timber by two thinnings and a final harvest. The first timber production will be seen on year 9 - first thinning - with an intensity of 40% of the total standing trees; the second one will be seen on year 17 - second thinning - with an intensity of 35%; and the final harvest will be on year 25 and will represent the remaining 25 % of the trees. Only pine and eucalyptus will be harvested as they already have an established demand on the market. The timber volume to be harvested from the 418 hectares of the forest plantation can be seen in table 4.

Table 4. Timber volume to be harvested

Specie	Timber volume to be harvested (m^3)		
	First thinning	Second thinning	Final harvest
Pinus radiata	4,081.2	11,119.0	46,353.0
Eucalyptus globulus	377.5	944.9	3,476.3
Total	**4,458.6**	**12,063.9**	**49,829.3**

4.4. Quantification of the pre-existing carbon in the plantation area

Carbon in the project area was quantified in order to develop the project baseline. According to the GS methodology requirements, the biomass of the trees and other vegetation present in the eligible area of the plantation before the afforestation must be estimated. With the eligible area of the plantation in vector format (shape file), the referential limits were contrasted with a visual analysis, and roads (primary and secondary), streams, rocky areas, and agricultural fields, among others, were defined. This was done using high-resolution satellite images, "Bing maps" from Microsoft Corporation and ArcGIS 9.3.1. The analysis and digitalization established that the eligible plantation area contemplated an extension of 1198 hectares.

In order to estimate the existing carbon content in the eligible area prior to the afforestation, a carbon inventory was carried out. For the location of the evaluation plots, a systematic random design was applied. 31 plots were systematically distributed randomly throughout the eligible area of the plantation and were subsequently evaluated. The sample plots were of 1 m^2 divided into 4 areas of 50 x 50 cm (as seen in figures 18 and 19)[37]. A destructive sampling of all the existing biomass (grassland vegetation) on the sample plots was done. The evaluated reservoirs of carbon were: aerial and underground storage. The average carbon content of each reservoir was measured in t/ha and tCO_2-e / ha. Table 5 shows the average quantification of carbon and CO_2-e in the area of the plantation and table 6 shows the total tCO_2-e in the area before the afforestation.

[37] [37] Winrock International (2007)

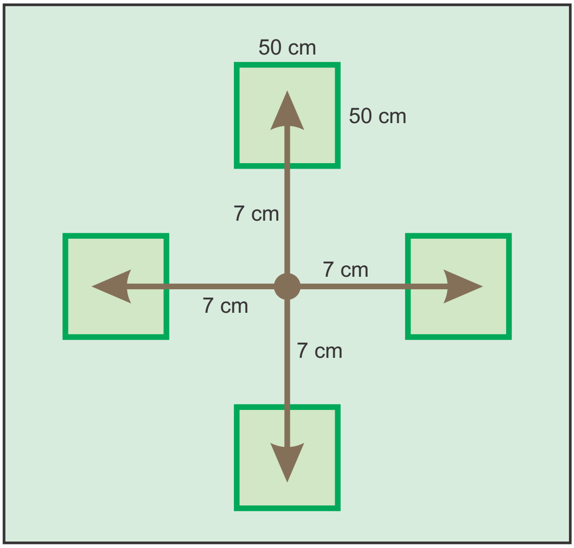

Figure 18. Size and shape of the evaluation plot

Figure 19. Materials for the sample collection

Table 5. Average carbon and CO2-e (t/ha) stored by aerial and underground biomass

Vegetation type	Aerial storage (tC/ha)	Aerial storage (tCO_2-e/ha)	Underground storage (tC/ha)	Underground storage (tCO_2-e/ha)	Total (tC/ha)
Grassland	0.8	3.1	0.3	1.2	1.6

Table 6. Total tCO_2-e in the project area before the afforestation

Vegetation type	Surface area (ha)	Average tCO_2-e/ha	Total tCO_2-e
Grassland	418	4.3	1,792.1

Figure 20. Collection of information for the evaluation plots

4.5. Projected CO_2-e sequestration by the forest plantation

The projected CO_2-e sequestration was performed based on one hectare of pine, eucalyptus and queuña. The final harvest was projected to be every 25 years.

The sequestration per year by the selected species in tCO2-e/ha can be appreciated in figures 21, 22 and 23. As can be seen that eucalyptus is the specie that has the highest sequestration of CO_2-e/ha per year.

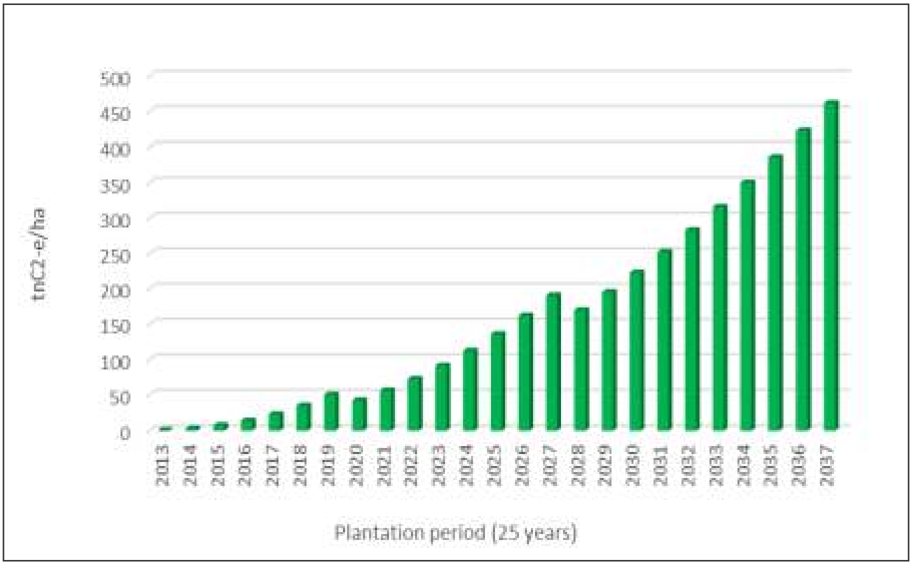

Figure 21. Graph showing the CO_2-e sequestration of pine

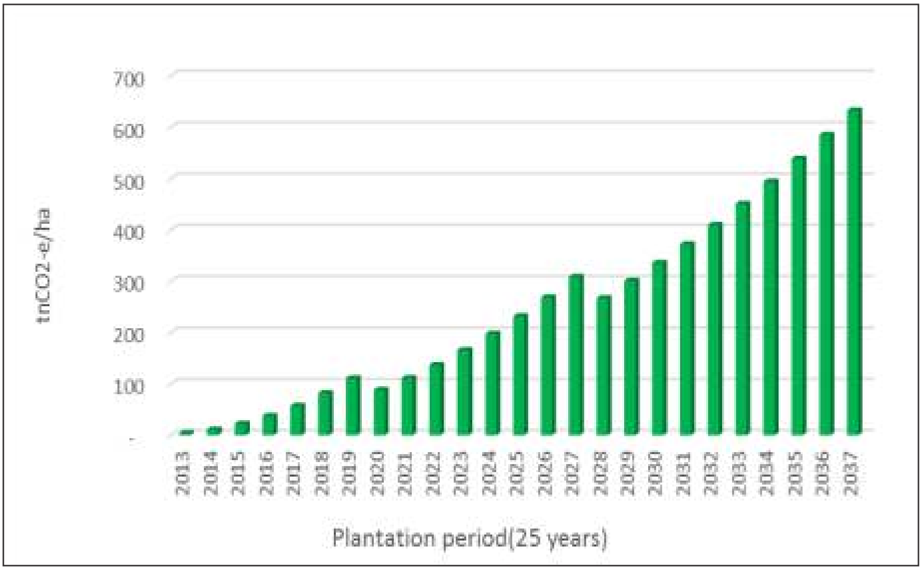

Figure 22. Graph showing the CO_2-e sequestration of eucalyptus

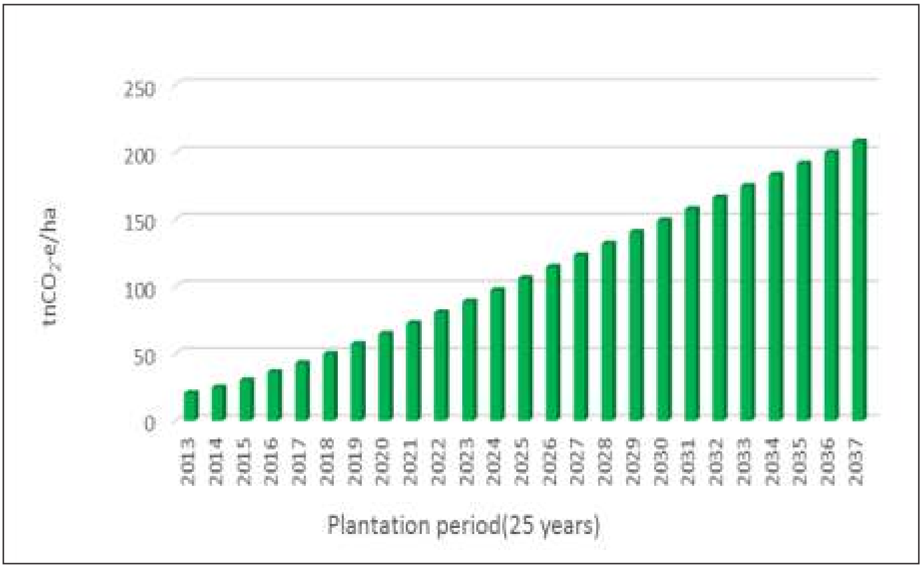

Figure 23. Graph showing the CO_2-e sequestration of queuña

V. Project management

For a proper project management, several documents that will help with its development were especially prepared. The main documents are the General Forest Management Plan (GFMP) and the statute of the forest management committee.

The GFMP is a management document which scheduling and the activites to be developed during the afforestation. The main activities are: maintenance, management and harvest of the plantation. The statute of the Forest Management Committee was prepared according to its conformation, consisting of six members, one from each peasant community, which facilitates the communication between communities regarding the activities performed. The roles and responsibilities of the committee are specified in its statute, being the responsible authority of forest management in the communities

Management documents were developed in collaboration with the communities involved in the project and the technical team of World Vision Peru.

VI. Project monitoring

The monitoring of the project has been developed according to the requirement of the Gold Standard, which establishes parameters to keep track of items such as: natural resources (flora and fauna) and the plantation area, among others, that may be adversely affected due to the project activities, and that were identified in the evaluation performed to determine the impacts of the project, some of which are more vulnerable than others. In this case, the parameters to be monitored will be areas with a high conservation value and the eligible areas of the plantation. Monitoring is the responsibility of the forest management committee of the project.

Permanent plots will also be established in order to monitor the height and diameter growth of the selected species. Five plots will be installed on the fifth year of the plantation, making a total of fifteen plots installed.

The purpose of this afforestation is timber production, therefore it should be given a proper silvicultural management so that the quality of the timber obtained is appropriate and the one that is expected.

Figure 24. Forest plantations monitoring

VII. Project results

7.1. Economic results

- More manual labor jobs available, WVP and the six peasant communities established an agreement on the roles and responsibilities for the activities to be performed on the plantation, for which the communities agreed to provide unpaid manual labor for their implementation (installation, management and harvest) and WVP agreed to provide them with the necessary technical assistance, supplies and materials. With the agreement established, 418 hectares were afforested.
  The distribution of the benefits will be established by themselves according to their needs. The total number of wages that would be obtained with the afforestation of the 1,198 hectares is 105,424. The revenues for timber sale wil be distributed between the communities, as part on their economical benefit.

- According to the cash flow, the income from the sale of timber and carbon has been calculated for the 1,198 hectares. The sale of the carbon credits will begin as of year 6 of the plantation. In the case of timber, the log volumes to be obtained are: 12,184.8 m^3 (r) with the first thinning at year 9, a volume of 32,238.5 m^3(r) with the second thinning at year 17, and 131,197.5 m^3(r) with the final harvest at year 25, The economic analysis of the project is specified in table 7, having applied a discount rate of 9% corresponding tor public investment projects.

  The project "Agro-silvo-pastoral practices oriented towards the carbon market" is beneficial as all current flows generate a positive NPV, and it is also profitable for the communities as it is more expensive to stop the project as it has an internal rate of return of 15%, which is higher than the discount rate of the SNIP. Finally, the Benefit/Cost ratio shows that the project generates revenue more than 4 times greater its value for every sol that is used.

Table 7. Economic analysis of the project

Discount rate	9%
Net Present Value - NPV	S/. 205,370.22
Internal Rate of Return - IRR	15%
Benefit/Cost	1.61

7.2. Social results

Among the social benefits we have:

- Commitment from the communities for the maintenance and management of the forest plantation.
- Strengthenin the communal organization and forest management committee.

- Better quality of life of the benefited communities.

7.3. Environmental results

Among the environmental benefits we have:

- 415 hectares of pine, eucalyptus and queuña have been established.
- The existing vegetation of the six peasant communities in Yanaoca has been determined.
- High conservation value areas have been identified in the six peasant communities in Yanaoca.

VIII. Lessons learned

- Get the communities to incorporate afforestation of their land into the communal plans, idea that is not within their cultural conception of the Andean highlands landscape.
- Make the communities comprehend the whole subject of the voluntary carbon markets and the carbon credits, considering that the native language of the communities is "quechua" and at the beginning, transmitting the information was a bit difficult.
- Generate the allometric equations for the selected species: pine, eucalyptus and queuña with information gathered in surrounding areas.
- Have adequate staff since the beginning of the project (social, forester, etc.)
- The staff have to be trained with all the issues to be worked while the project implementation, with the objective to disseminate a correct message to the population with whom will work.

IX. Further actions

- Practice on silvicultural treatments (pruning, thinning and harvesting of the plantation) and compliance with what is established in the management plan of the plantation.
- Validation of the project to enter a voluntary carbon market and be able to generate income with the sale of the carbon credits.
- Accomplish the afforestation of the 1,198 eligible hectares for the plantation.
- Identify the threats to the forest plantation such as fires, grazing and work on the threats.
- World Vision Peru's commitment to search for funding for a good technical assistance in the management of the plantation.

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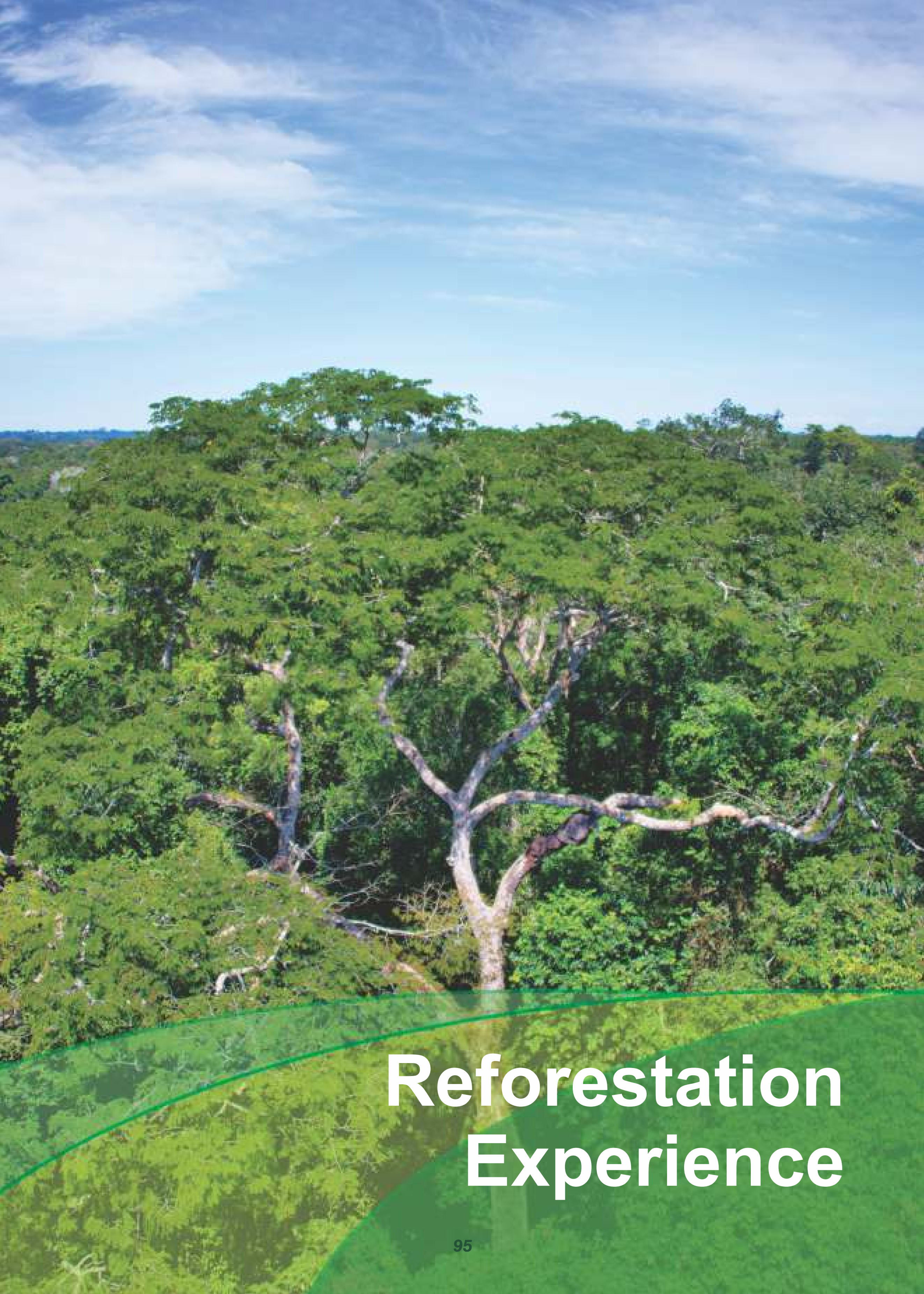

Reforestation Experience

Reforestation, sustainable production and carbon sequestration in the dry forests of José Ignacio Távara – Piura

Mario Palomares De Los Santos and Sylvia Mayta D´Ugard

Summary

The objective of the project "Reforestation, sustainable production and carbon sequestration in the dry forests of José Ignacio Távara – Piura" was to reforest 8,980.5 ha of land qualified as non-forest to the community, generating co-benefits to improve the quality of life of the local people, increasing their profits with the selling of extra algarroba's fruits production, as well as the trade of sequestrated carbon credits from plantations.

With this experience allometric equations were generated to quantify carbon from native shrub species as faique (*Acacia huarango*) and overo (*Cordia lutea*); as well as growth equations for algarrobo (*Prosopis pallida*) and zapote (*Capparis scabrida*), which is an important contribution to forestry in this type of forest.

The result of the project was its validation and registration into the global convention on climate change under the CDM (Clean Development Mechanism) forestry projects. An important issue to highlight from this type of CDM forestry projects is that they are not competitive with energy CDM projects, given that the former generate temporary credits (credits that are valid during the life of the project). In addition CDM forestry projects do not value the co-benefits generated by this kind of initiative. This project stalled in its validation and registration stage; however it has much to contribute as an experience to develop similar projects in either the regulated or voluntary market.

I. Location and characteristics of the communities

The Peasant Community "Jose Ignacio Távara Pasapera" is located in Chulucanas District, Morropón Province, Piura Region. It was officially recognized by the Peruvian Government in 1986, which allocated for them 52 269 hectares of land.

Figure 1. Location map of the community

1.1. .Biophysical characteristics

A) Climate

The climate is warm and dry, characterized by its proximity to the equator line. In this area is common to have rainfall seasons in alternated years, generally during the first four months of the year, from January to April with periods of 8-month of dry season. The annual rainfall varies from 150 to 250 mm[38]. However, every certain number of years, there are very intense rainfall seasons, caused by El Niño phenomenon.

The annual mean temperature is 24ºC. February and March present the highest values, specifically between 13:00 and 15:00 h, heating until 37 ºC. During June until August, the minimum values reach 15ºC.

B) Hydrology

The area of the project is located in the middle of the Piura river basin. This basin, which includes the Provinces of Piura, Morropón, Huancabamba Ayabaca and Paita, with a total area of 12,216 km^2, has its origins at 3600 meters above sea level, in the eastern Andes in Huarmaca River, Huancabamba Province, and it ends at Virrilá estuary, near Sechura town.

There is a lack of water in many areas of tropical dry forest. Due to the scarcity of surface water supply, the provision is based on groundwater through communal wells or boreholes, which provide families of this vital liquid for human consumption.

Although the area of the project belongs to the Piura River basin, the nearest part of the River to the project area is 15 km. This makes it very difficult to consider the river as a water source.

C) Geology, lay of the land, soil and topography

The area of the project is located on wind plains formed by aeolian deposits appeared during the recent Quaternary (Cenozoic). They are associated with undulating areas (low, medium and stabilized high dunes) with a geological formation based on aeolian sands. Some of these plains have alluvial influence.

The topography varies from flat to slightly undulating with slopes of 2 to 5%, associated to dune hills. It includes plain-concave areas or Vegas, which are like small alluvial formations that cut the wind plain.

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[38] AIDER. (2009)

The Forest Management Plan developed by AIDER to the Peasant Community José Ignacio Távara Pasapera indicates that the soils are sandy loam, deep, somewhat excessively drained and good infiltration capacity. They have low organic matter content and the pH value ranges from 6.1 to 6.8.

According to the Peruvian Land Use map, the project area is totally clasififed as protection lands, with grazing, agricultural of low quality aptitude, limitated by the environmental conditions and the temporal presence of pastures.

D) Description of the ecosystem

The entire area of the project is located in the Biogeographic Province of Tropical Dry Forest and, taking into account the classification of Holdridge life zones[39], classified as Tropical desert scrub (md-T), and their characteristics are shown in table 1 below.

Table 1. Description of the life zone in the area of the project

Life Zone	Annual Mean Bio-temperature (°C)		Annual Rainfall (mm)		Humidity Provinces
	Max	Min	Max	Min	
Tropical desert scrub (md-T)	24.6	22.4	222.2	122.6	Arid

Tropical dry forests are composed of fragile ecosystems in arid areas which suffer long periods of drought, being heated by high temperatures; with tree, shrub and herbaceous vegetation adapted to water stress. These ecosystems include a high diversity of wildlife, usually composed of birds, small reptiles and mammals, and low diversity of plant species.

- **Vegetation**

The tropical dry forest of Peasant Community José Ignacio Távara Pasapera is characterized by a low diversity of flora, well-adapted to water stress species with an average height lower than 10 m at maturity and a distribution of savannah with a canopy cover of below 30%.

The tree species are usually evergreen and thorny, as it is algarrobo (*Prosopis pallida*), zapote (*Capparis scabrida*) and faique (*Acacia macracantha*), as dominant species. Other species of tropical dry forest as palo verde (*Parkinsonia aculeata*) are present in low numbers.

During the rainy season some herbaceous species and grasses of temporal behavior appear forming a temporary meadow associated to the forest. Among

[39] Holdridge (1982), quoted by AIDER (2009)

these species are: bejuco de ganado (*Ipomea crassifolia*), hierba blanca (*Althernantera pubiflora*), frejolillo (*Erythrina* sp.), manito de ratón (*Coldenia dichotoma*), alfalfilla (*Trefosia sinerea*), jaboncillo (*Luffa operculata*), yuca de monte (*Apodanthera biflora*), yuca de caballo (*Proboscidea althaefolia*), pega pega (*Bohernavia erecta*),coquito (*Cyperus sculentum*), pajilla (*Aristida adscensionis*), calaverita (*Antephoia hermaphodita*), corrivuela (*Ipomea aegyptia*), miñate (*Desmodium s*p.) and verdolaga (*Portulaca olearacea*).

Figure 2. Vegetation of tropical dry forests

- **Wildlife**

The area of the project does not have a specific assessment detailing the rare or endangered species within this area. Then, can be only taken into account information collected for the ecosystem of the area.

According to a report by Angulo (2009)[40], there is a variety of wildlife in dry forests, especially bird species. The main mammals of tropical dry forest are the guayaquil squirrel (*Sciurus stramineus*), the sechuran mouse (*Phyllotis Gerbillus*), sechuran fox (*Lycalopex sechurae*) and the vampire bat (*Desmodus rotundus*). The reptile species include pacazo (*Callopistes flavipuntatus*), iguana (*Iguana iguana*), the barnett's pit viper (*Bothrops barnetti*) and boa (*Boa constrictor*). The most common birds are condor (*Vultur gryphus*), gallinazo rompehueso (*Polyborus plancus*) and caribbean hornero (*Furnarius leucopus*). Although these species are common in the tropical dry forest, are not necessarily living in forest communities, as they are casual, seasonally occupying the area.

[40] Angulo, M (2009), quoted by AIDER (2009)

E) Land Use

Land use in communal areas, both inside and outside the limits of the project, is based on livestock[41], farming during the rainy season and logging. Unmanaged livestock causes overgrazing in the area near houses and roads, and underutilization of pastures in other areas, leading to an accumulation of dry biomass that increase the risk of fires in the dry season.

1.2. . Economic characteristics

Families living in the peasant community José Ignacio Távara Pasapera have organized their economies based on activities related to the possibilities. However, these activities have a number of problems and shortcomings in their management so the generated income does not allow families to overcome poverty.

The main activities of the community are raising livestock, whose maintenance directly depends on the production of algarroba fruits and natural pastures for its maintenance. Also, temporary agriculture on small areas and only during the rainy season, intended for family consumption. Aslso, forestry activities are regulated by the forestry law which prohibits timber extraction without an approved management plan.

Farm families develop the following economic activities:

A) Livestock breeding

Considered as the main economic activity, it generates the household incomes, since their production is almost entirely to be traded in the nearest markets.

The main features of this activity are:

- Prevalence of raising goats and crossbreed sheep as Figure 3 shows, with an average of 45 heads per herd. Lesser extent, there are some cattle. Another relatively important activity is raising poultry (ducks, chickens and turkeys). Some families raise hogs, whose number varies from 2-7 animals per family.
- This activity is characterized by a production curve markedly dependent on rain season, due to the production of natural pastures which helps increasing the herd.
- The livestock requires daily attention, so its management requires the whole family to get involved, especially the wife and minor children. The wife notes if the number of heads is complete, as well as their diseases, children extract water from the wells and guide the livestock to selected pastures and the head of the

[41] AIDER (2009a)

family develops activities that require more work and physical effort and he is also who decides about trading.

- There is a lack of knowledge regarding to management, sanitation, nutrition and marketing.

Figure 3. Livestock of black belly goats

B) Agricultural activity

Agriculture, for its temporary characteristic, is complementary and mainly intended for the families' own consumption. The main features of this activity are:

- It is done only in the rainy season (the first 4 months of the year) in areas called "temporary plots"
- The average length of the temporary plots is 2 ha per family, depending on the amount of people that constitute the family unit, as the tasks are shared among all members.
- The sowed products are legumes, corn, watermelon and melon in some cases.
- The entirely production is for self-consumption, since families' nutrition comes from these.
- In case of having a surplus in the production of corn, Chilean beans or lentils, these are traded in nearby markets.
- There is lack of technical knowledge about the production process of these crops. Also, cropping is done without considering the quality of the seed, spacing per plant, number of seeds per hill, weeding, etc.
- There is confusion between pests and diseases, not knowing their treatment. Applications of some agrochemicals are done with no control and without really knowing the effects of these products.
- This activity is characterized by its low productivity, poor quality and high production costs, for which is not a competitive activity in a market economy.

C) Forestry Activity

This activity is restricted because the legislation establishes the need to have a forest management plan to take advantage of dry forests. However as the law allows, in times of drought, it is legally allowed trading algarrobo's branches for firewood, as well as zapote timber to crafts and overo rods for broomsticks and construction.

Generally these products are sold directly to traders who arrive to community with their trucks to load, either from each house or from highway sides. Others rather prefer to carry their products to the nearest markets in order to obtain a better price.

Being the uncontrolled extraction the main feature of forestry activity, it becomes the main cause of deforestation and consequent desertification of forest areas invaded by illegal loggers. There is a massive lack of knowledge about how to manage their forests to take what they need without destroying it.

D) Beekeeping

During the years (1995-2000), the national apiculture program of the Ministry of Agriculture donated 10 000 beehives and other beekeeping equipment to the peasant community. However, at present (2014), only a few families remain in the activity as they have dominated the art to keep the swarms during periods of drought. It is noteworthy that, because of its high dependence on climate, revenues from this activity are supplementary for peasant families.

E) Sale of the workforce

According to the agricultural calendar of the region, workforce of young people and adults are sold to develop them as laborers for farming, planting cotton, weeding, transplanting rice, planting and harvesting corn, in the areas of San Lorenzo, Catacaos and Chulucanas, or in the same area, for smallholders.

This population of eventual migrants returns to their area when rainy season arrives, to work on their temporary plots. Also, people with lands located along the banks of the river Piura, return to their areas when there is rain in the mountains and the resultant water comes down the river as it allows them to cultivate.

1.3. Social Characteristics

A) Type of dwelling

Dwelling of the families living in the tropical dry forest, are built with their own resources, so houses are recognized as private property of the family.

The predominant building material in the walls is the “tabique”, which is the traditional construction material. This is made by weaving overo rods, using pitchforks of algarrobo and algarrobo or cherry beams as support. The traditional roof is made of woven palm.

Families who achieve a better level of income, built their houses of brick and calamine roof. It is noteworthy that the poorest families use the “tabique” and ceiling made of corn panca, mats and woven palm.

In regards of sanitation, most dwellings have neither toilets or latrines, nor intended places for the disposal of garbage. Dwellings which have latrines are not the most appropriate for the area either by the material with which have been constructed or by their location.

B) Education

There is a 48% of illiteracy and a 41% of illiteracy by misuse, women being the group with the highest rate. In this context, people over 40 they have not assisted to school and younger ones because they barely achieved to be two or three years of elementary (illiteracy by misuse).

70% of the population has not completed elementary school. 30% of young people aged more than 15 years are not studying, also observing that they don’t have a job.

The 80% of the population that is literate, has only elementary education, on the other hand, 40% of young people aged more than 15 years can’t continue their studies for the lack of resources, noting that either have a permanent job.

Furthermore, in the vast majority of schools there are just centers for elementary education. It should be emphasized that exists a high rate of school dropout, which has to do with factors as rural poverty, too much distance between home and school and an educational model that is not consistent with the local reality.

C) Employment status

Most of the local men define themselves as farmers or ranchers; while women define as housekeepers, which make invisible the productive contribution of women to the household economy. However, they identified other occupations as: merchants, carpenters, masons and carriers (including truck drivers and his helpers as well as collectors on the buses in public transport). Besides helping with household chores and livestock, children, men and women also study in school.
It is observed that the prevailing unemployment in young people drives them to migrate to nearby cities, resulting in the depopulation of the countryside, although there are resources that, properly managed, could solve their subsistence needs.

Poverty levels: Given that families' income is about US. $ 909 per year and there are seven integrates per family, as much; then the per capita income is only US. $ 129.8. If we add to this the almost total lack of basic services, results that these families are classified in the ´very poor´ stratum.

II. Problematic

The current situation in dry forests of the north coast of Peru reflects the level of degradation caused by misdirected human activity, listing the indiscriminate logging and overgrazing, unsustainable exploitation of forest and the associated meadows that tiggers the desertification process in this part of the country, this way the forest is taken beyond its natural ability to be restored, which it is already limited by arid conditions.

If the current rate of deforestation keeps like this as well as the activities of logging for subsistence of the population (grazing, seasonal agriculture and firewood collection), community forests will have fewer tree densities, being replaced primarily by shrubs and if these shrubs are removed, given the scarcity of trees, then it will occur the total loss of vegetation cover remaining deserts, where dunes will take place. In addition to economic and social impacts associated to these losses, it will contribute to global warming because the significant loss of a carbon sinks which, once removed, will release CO_2 to the atmosphere.

The loss of forest biomass and subsequent desertification of the ecosystem also will meant the loss of habitat for wildlife, many of which are endemic and therefore inevitably be doomed to extinction. Desertification also result in a decrease in the production of fodder for livestock, by reducing the forest and meadows, there will be less availability of algarrobo, grasses and fodder shrubs.

Ignorance of the peasant population about technologies that enable reforestation; their lack of access to financial markets, despite being the titled and rightful owner of the land; and the historical absence of regulations to promote reforestation in tropical dry forest, have gave as a result that activities such as those posed by the project can't be implemented so far, remaining instead an environment that only contributes to further degradation of these soils through illegal logging.

It is for these reasons that the aforementioned project is focused on the recovery of forest cover in areas of degraded tropical dry forest of the northern coast of Peru, an activity which is of great ecological and economic importance because it involves the restoration of a great biological importance ecosystem, rich in endemic species and, on the other side, with a great economic and productive potential.

III. Project design

3.1. Conceptualization and pre-feasibility study of the project

Due to the existing problem in the area, it was decided to propose and develop the project “Reforestation, sustainable production and carbon sequestration in the Peasant Community of José Ignacio Távara Pasapera”, aiming to afforest 8,980.5 ha with native tree species from tropical dry forest, especially algarrobo (*Prosopis pallida*), zapote (*Capparis scabrida*) and overo (*Cordia lutea*), located on the degraded land belonging to the community.

According to the pre-feasibility study and evaluating the problems, impacts, activities and benefits, was checked the project viability so it could be continued with the proposal to restore degraded areas of tropical dry forest and develop sustainable economic activities, such as production of algarroba, timber harvesting and improving the quality of life of community.

The project was looking to reforest using direct seeding and replicating natural processes of plant succession and associations of species that occur in the dry tropical forest, thus reducing the risk of negative impacts on biodiversity and increasing the possibility of success of the activities proposed in the project.

3.2. . Design

The area of the project is located in the "Km 41" Annex, named Jose Ignacio Távara Pasapera community, covering an area of 8,980.5 ha to be reforested and managed, which would benefit over 2000 families in the 16 Annexes to the community and is designed using easy-to-replicate technology and promoting the local workforce, ensuring that most of the benefits will continue in the community.

The community saw the project as an opportunity to improve their quality of life for themselves and future generations. Reforestation will give them food for their livestock products to sell, work and an income that would help.

In order to reduce the impacts caused by the activities of the community, the project proposed to reforest and to do this it had to fulfill the conditions of applicability of the AR-AM0003 CDM PK methodology - AR3 methodology - which was developed following the CDM forestry projects, taking into account the following conditions:

- The activities of grazing and firewood collection will not be shifted from the project boundaries, but they will be regulated.
- The firewood collection will only be restricted to branches or bushes.
- Grazing activities will be redistributed in the area to prevent the livestock to approach planting in their first 3 years.
- Selected lands for the project must be degraded.

The map of tropical dry forest of Piura[42], which classifies as the area of the project as sparse forest plains, indicates that there are activities of illegal logging and overgrazing which is reducing natural regeneration and impoverishing the forest. It presents unfavorable environmental conditions (drought and wind erosion), anthropogenic caused degradation (through illegal logging) and insufficient availability of natural seed sources, which do not allow forest to regenerate. The definition of forest is according to the threshold values for the national definition of forest for CDM purposes. Adapting the project to the requirement of the AR3 methodology to the case of the project has the following characteristics:

A) The land will be reforested by direct planting with two native tree species, Algarrobo and Zapote in the activities of the project A/R CDM project activity.

B) Land preparation considered in the project neither cause significant decreases in the carbon stocks of soil at long-term, nor increases emissions of non-CO_2 from the soil because the movement of the earth is not mechanized and is focused only in the holes where the seeds will be planted. Activities based on intercrop have not been planned as a part of the A/R CDM project.

C) Carbon stocks in soil organic carbon, litter and dead wood can be expected to keep decreasing even more due to soil erosion and human intervention, due to the fact that the project will be implemented in soil under degradation process. According to Lal et al (2006)[43] the project area suffers from wind erosion and constant degradation due to overgrazing, agriculture and deforestation. These actions prevent soil organic carbon to increase; therefore without reforestation activities the carbon stocks in the soil cannot be replaced.

D) The irrigation by flood will not be used in the project. In its place it will be used a drip irrigation system locally developed.

[42] INRENA (2003)
[43] Lal et al. (2006)

E) Project activities will neither influence in soil drainage nor in soil disturbance, reason why the emissions of greenhouse gases, different from CO_2-e, can be considered as insignificant.

F) The activities of the A/R-CDM project use nitrogen-fixing species (NFS). According to the IPCC Guidelines for inventory of greenhouse gas (GNGGI[44]), there is a lack of evidence about significant emissions driven by the process of fixing nitrogen, so the biological nitrogen fixation it is not included in the sources of nitrogen (N) for direct estimation of nitrous oxide emissions (N_2O). Also, CDM-EB[45]-44 states that N_2O emissions from the decomposition of litter and fine roots from N-fixing trees are insignificant in the activities of the A/R CDM project, so it can be neglected in the A/R baseline and in the monitoring methodology.

Due to the nature of the degradation of the soils and their lack of economic attractiveness, without A/R CDM project, the lands in mention will keep suffering desertification as they have been doing for decades.

3.3. Participants

The project participants[46] are presemted in table 2.

[44] http://www.ipcc.ch/ipccreports/methodology-reports.htm, quoted by AIDER (2009)
[45] EB 44: means Agreement No 44 of Executive Board
[46] AIDER (2009a)

Table 2. Prticpants of the project

Participants	Location	Description and functions
Peasant Community "José Ignacio Távara Pasapera"	Chulucanas District, Morropón Province, Piura Region, Peru.	It covers an area of 53,309.1 ha and includes 16 annexes. Is a legal person with titled land where the project will be developed 95% of the area is forest land and scrub. The remaining 5% corresponds to areas occupied by different villages. The communal territory is attested with the titles Nº 30460 and 30621, registered as a property in the public records of Piura. The community committed to allocate for 40 renewable years the land area needed to perform the work for the reforestation project; also they gave the necessary municipal permits to obtain permissions from local, regional and national authorities to implement the project.
Association for Research and Integral Development (AIDER)	Lima, Peru.	Peruvian Non Governmental Organization working since 1992 in forest management activities, watershed management and urban forestry in life zones of tropical rain forest and tropical dry forest nationwide. It aims to implement projects in rural and marginal urban areas, contributing to research and development of human and organizational capabilities. It was the responsible institution for the technical leadership and had the commitment to make the necessary actions for the design, development and implementation of the project from a technical point of view.
National Fund for Environment (FONAM)	Lima, Peru.	It is a public organization governed by private law; aims to establish itself as an intangible trust fund, through financing plans, programs and projects focused on environmental protection activities, strengthening environmental management, sustainable use of natural resources and environmental assets by financial institutional mechanisms. Is the project Financial manager, being its role to obtain the financial resources to implement the project. Also advise the Peasant Community in the trade of emission reduction certificates issued by the project, which also will advise the community in monitoring the project.

3.4. Preparation of the Project Design Document

A) Time limits

The activities of the A/R CDM project and the date of the crediting period would start on November 2nd, 2009.

The operational period of the project is 44 years, with a period of accreditation of 20 years including forest management activities generated under the project and the stages to keep the area permanently under forest cover.

B) Spatial limits

After doing the analysis to determine the eligible areas of the project, according to the methodology AR3, were determined that 8,980.5 ha applied to the project, they were divided into 5 areas (See Figure 4). Table 3 shows the extensions of the reforested area.

Table 3. Distribution of the reforested area

Zone	Extension (ha)
1	1,665.2
2	2,003.1
3	2,366.7
4	1,693.8
5	1,251.8
Total	**8,980.6**

Figure 4: Map of the 5 reforested areas inside the community

C) Methodology

The projects based on CDM forestry projects[47], being either first time plantation or reforestation, refers to the conversion of naked lands to forest areas. Projects must demonstrate that lands, inside project limits, were not covered by forests, (that does not qualify as a forest according to the parameters adopted by Peru - see section E background) to the date when CDM was applied, and at the same time, were not covered by forest at the beginning of the project.

In this project it was applied the approved methodology for deforestation and reforestation AR-AM0003: "Deforestation and reforestation of degraded lands through planting, assisted natural regeneration and control of animal grazing" - Version 4.

[47] CATIE (2007)

IV. Wood production and carbon sequestration

4.1. Selection of species

The proposed area for the project had been reforested by direct planting with two native tree species, algarrobo (*Prosopis pallida*) and zapote (*Capparis scabrida*) and the native shrub species, overo (*Cordia lutea*).

4.2. Carbon quantification

To quantify the carbon in the eligible area as non-forest - baseline of preexistent carbon - previously two allometric equations were proposed, which are specific for each shrub species to evaluate.

To estimate the carbon were followed two stages: the first one was to build two allometric equations for two shrubs (present in 100% of the work area and there was no equations to quantify carbon for this vegetation type), the second one was to set field sample plots for measurements of vegetation and to estimate the carbon stock in the eligible area.

A) Phase 1: Determination of the allometric equation.

In the absence of an allometric equation for the evaluated shrub species: faique (*Acacia huarango*) and overo (*Cordia lutea*), these equations were determined applying a destructive methodology[48] to calculate the carbon in the aboveground biomass of shrub species, which developed as follows:

- Species were identified and variables were determined (DBH, DAC, crown diameter and total height); 12 strips were evaluated as part of the sampling design, where it was performed the destructive sampling of 5 individuals per strip, assessing 30 individuals of different sizes of Faique and Overo.

- The destructive samplings consist in cut and weigh all the aerial part of the plant, which was divided into branches and leaves, from which a sub-sample of approximately 1 to 2 Kg was extracted, recording their wet weight. These sub-samples were brought to the laboratory for respective dried in an oven at 80^{0}C until have a constant weight.

The carbon data were correlated with the parameters evaluated in the collection area and were determined the best correlation between the variables and the generated equation. Obtaining the following equation:

[48] Recavarren et al. (2009)

- <u>Faique (*Acacia huarango*)</u>

$$Y=0.126X^{2.679}$$

Where:

Y is the total carbon (Kg)
X is the average crown diameter (m)

In figure 5 is represented the cruve, with an R^2= 0.909, which indicates that the selected variables have a high correlation degree.

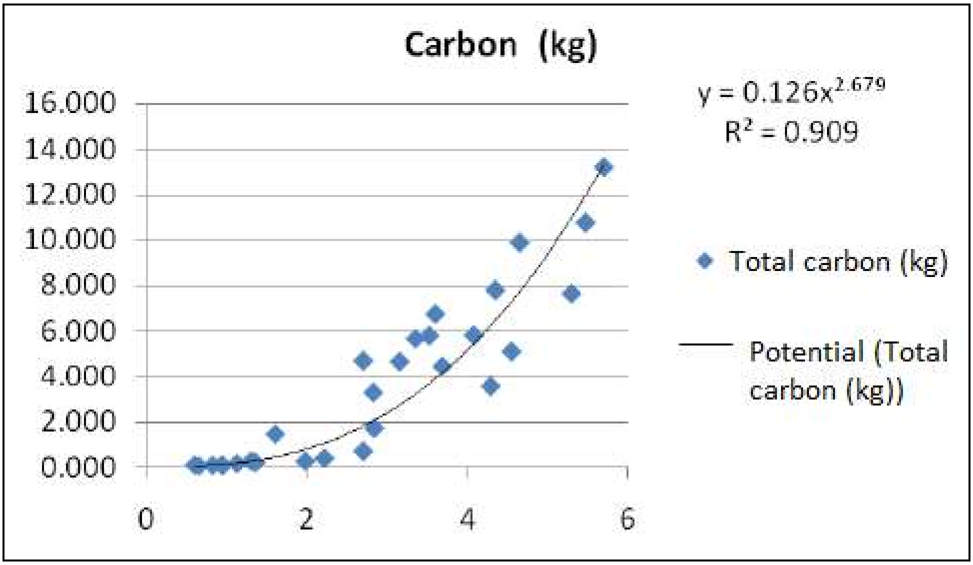

Figure 5. Allometric equation to estimate the carbon from faique

- <u>Overo (*Cordia lutea*)</u>

The allometric equation is:

$$Y = 0.092X^{2.912}$$

Where:

Y is the total carbon (Kg)
X is the average crown diameter (m)

This equation has a R^2 = 0.927

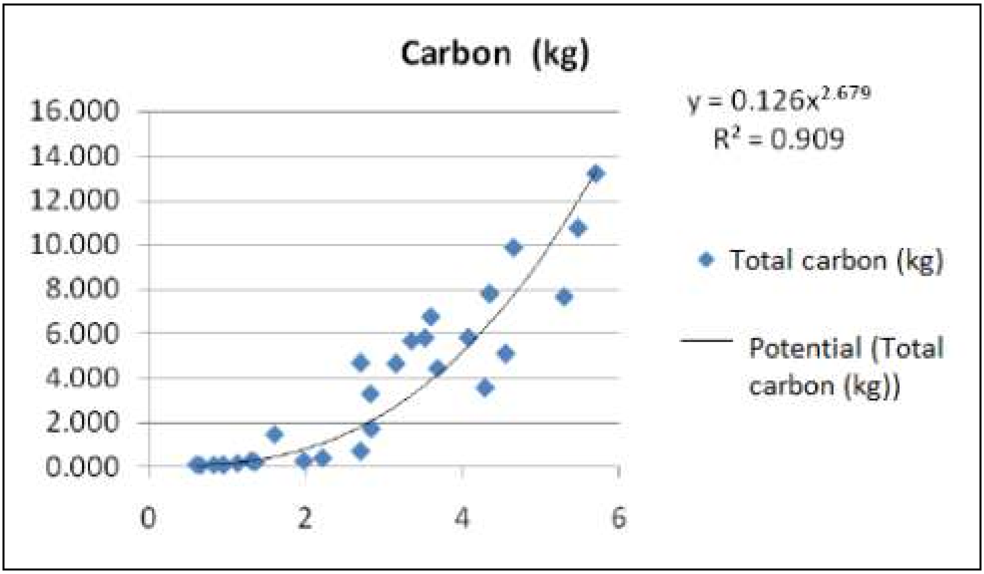

Figure 6. Allometric equation to estimate carbon from overo

B) Phase 2: Assessment of carbon plots

Having determined the allometric equation the next step is to set carbon plots (sampling unit) to estimate the existing carbon[49] through field sampling. This sampling was conducted as follows:

The evaluated variables were: living biomass of shrubs, from woody plants, faique and overo, without dominant trunk with an average crown diameter greater than 40 cm; also, the live biomass of trees from individuals of algarrobo and zapote and palo verde with a DBH up to 3 cm. There were also considered in this category plants that have several axes that together were equivalent to 3 cm or more. Then, these biomass results were carried to carbon.

In the sampling design was used a global sampling system for the entire eligible area as established by AR3 methodology. The sampling is randomly systematic, constituted by a network of points equidistantly distributed every 200 x 200 m throughout the eligible area. These points were chosen at random, which are respectively the sample plots.

For the size of the sample, the sampling unit is constituted by temporary circular plots of 30 m radius as shown in Figure 7.

[49] Recavarren et al. (2009)

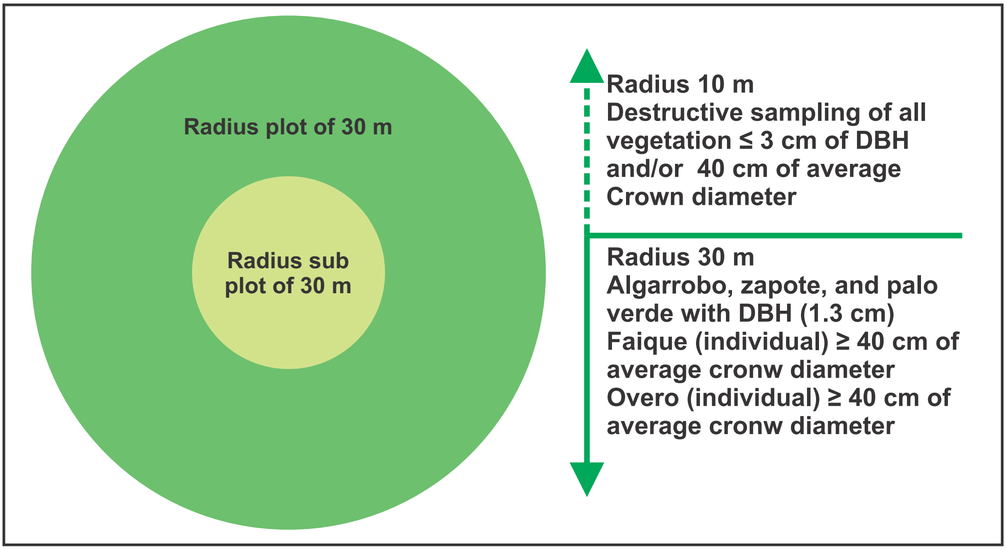

Figure 7. Shape of the plot

To collect the samples, the process was as follows:

- To quantify the living biomass in small plants, was performed a sampling in 4 places, using the following procedure:

  Small plants were located, identified and removed from the plot starting at the center of the plot and at an angle of 0 degrees clockwise within 10 m radius (destructive sampling), the collected samples were placed in a plastic sheeting, which subsequently were chopped and mixed, and also were taken a subsample of branches, stems and leaves of about 1 kg.

  This sub-sample was placed in a plastic bag with its own code and was sent to a lab for drying at 80^{o}C until get a constant weight.

  With the dry weights of the subsamples some relationships were established to estimate the dry weight of all biomass in the sub-plot.

- For biomass of shrubs and trees:

  Starting at the center of the plot, with an angle of 0 degrees and clockwise, shrubs and trees within the plot in a radius of 30 meters, every bush or tree was evaluated individually.

  For individuals located on the edge of the plot, they was considered inside only if more than 50% of its projected area were within the plot, as shown in Figure 8.

Once located each type of vegetation, if it was a shrub, then was measured its major and minor diameter of the crown, perpendicularly; and if it was a tree, DBH, stem height and total height.

In addition, with the purpose to have primary field data and determine eligibility, crown diameter (two measurements perpendicular to each other) and total tree height were measured. With these variables were calculated the area of the crown projection in order to estimate the tree cover and the average tree height.

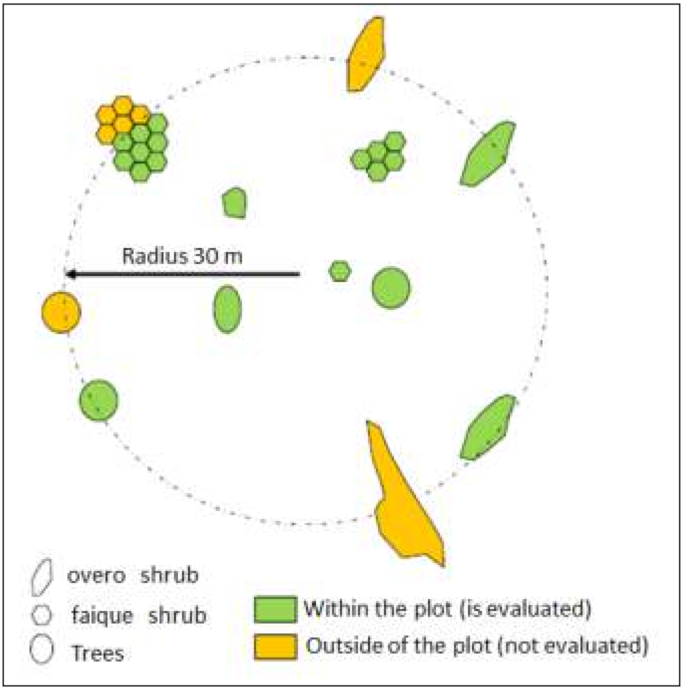

Figure 8. Shrubs and trees biomass assessment

4.3 Construction of growing curves for algarrobo and zapote

To determine these equations, was obtained information with the help of the local people who indicated and identified individuals of both species with known age. In the case of the algarrobo were registered 36 individuals; in the case of zapote, 30 individuals, considering that the data record proceeds from trees at different diameter, height and age class.
Such identification age was facilitated by the existence of natural regeneration caused by rainfall during the occurrence of El Niño events which have previously already occurred.

The evaluated variables were DBH, total height and age, then it was proceeded to process and analyze the data collected, and continued to generate allometric equations to determine the growth of DBH and height of the species which can be seen below:

A) **Algarrobo (*Prosopis pallida*)**

- The allometric equation for DBH growth of algarrobo is:

$$\mathbf{DBH = 4.056*T^{0.732}}$$

Where,

DBH : Diameter at breast height (cm)

T : age (years)

Having a R^2=0.97

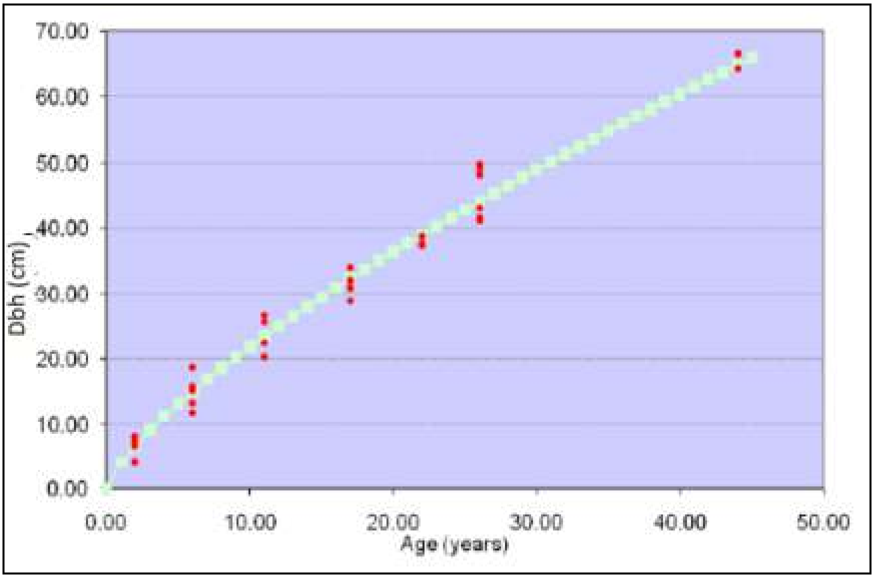

Figure 9. DBH growth model for algarrobo

- The allometric equation for height growth of algarrobo is:

$$\mathbf{H=21.08*(1-e^{(-0.0175*T)})^{0.493}}$$

Where,

H : Total height (m)

T : Age (years)

With a R^2=0.86

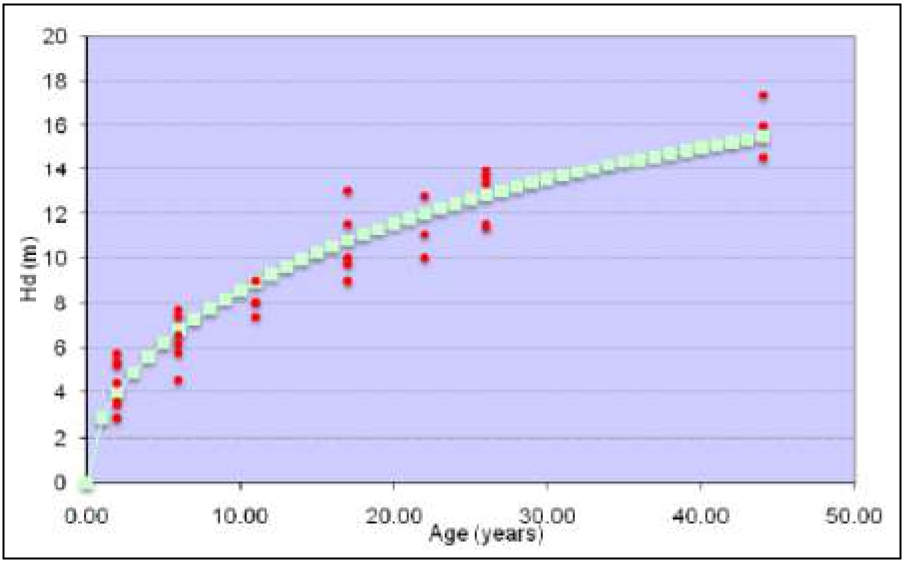

Figure 10. Height growth model for algarrobo

B) Zapote (*Capparis scabrida*)

- The allometric equation to estimate the growth is:

$$\mathbf{DBH = 1.146*T^{0.692}}$$

Where:

DBH : Diameter at breast height
T : Age (years)

With a R^2=0.95

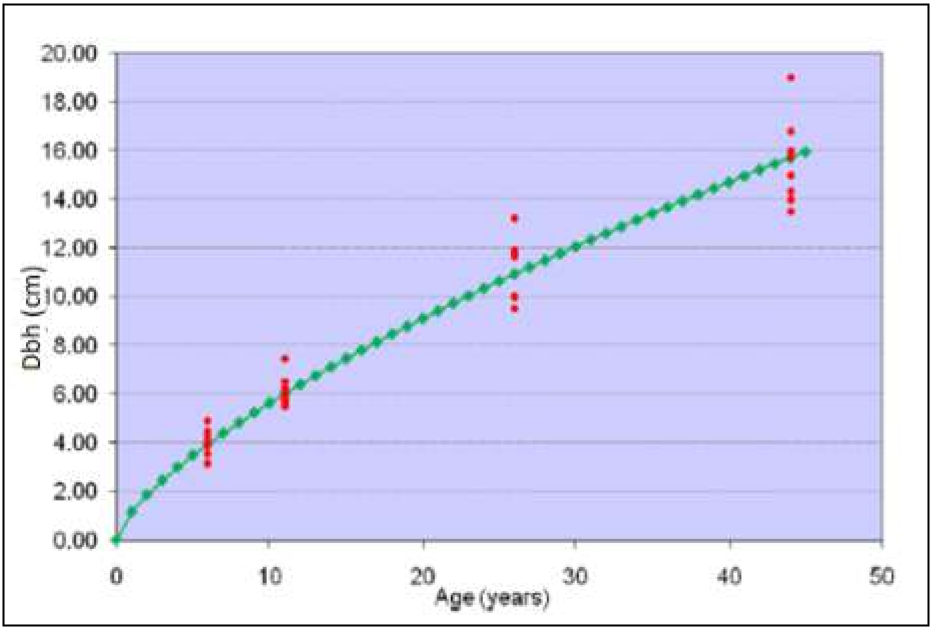

Figure 11. DBH growth model for zapote

- For the height growth, the allometric equation is the following:

$$H= 16.08*(1-e^{-0.0015*T})^{0.418}$$

Where:

H : Total height (m)

T : Age (years)

This equation has a R^2 = 0.88

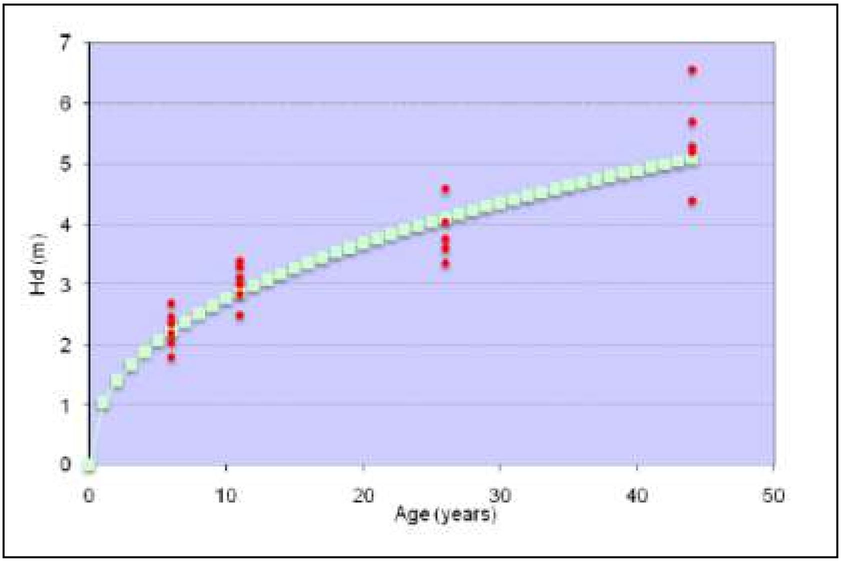

Figura 12. Height growth model for zapote

4.4 Estimation of carbon in the area of the project and CO_2 fixation

A) To estimate the carbon in the vegetation were used the following formulas[50]

- Algarrobo (*Prosopis pallida)*

$$\ln(AGB) = -0.961 + 1.821*\ln(D) + 0.198*(\ln(D))^2 - 0.0272*(\ln(D))^3 + 0.388*\ln(\rho)$$

Where,

AGB : Above ground biomass (Kg)
D : Diameter at breast height (cm)
ρ : specific gravity g/cm^3=0,7 for algarrobo

- Zapote (*Capparis scabrida*):

$$\mathbf{B_{AB,Capparis} = 10\text{^} (-0.535 + \log_{10} BA) \times 0.001}$$

Where,

$B_{AB,Capparis}$: Above ground biomass from zapote trees ton d.m. tree-1
BA : Basal area (cm^2)

[50] Recavarren *et al*. (2009)
[51] Recavarren *et al*. (2009)

B) The equation for the shrubs[51] is the following:

- - Faique (*Acacia huarango*)

$$Y=0.126*X^{2.679} * 0.001$$

Where:
Y is the total carbon (t)
X is the average crown diameter (m)

The following Table 4 and Figure 13 show the carbon stock in the area of the project for the baseline (removal by sinks in the baseline). Also it's shown the projection of CO_2 fixation during the crediting period (anthropogenic net removals).

Table 4. Quantity of carbon removed in the preoject area.

Year	Anthropogenic removal through the sinks ($t\ CO_2$)	Removal through the sinks in baseline ($t\ CO_2$)	Leaks (Ton CO_2)	Anthropogenic net removal ($t\ CO_2$)
2009	1,651	125,247	0	-12,396
2010	7,334	127,684	0	-120,349
2011	19,392	130,121	0	-110,729
2012	39,285	132,557	0	-93,272
2013	67,612	134,994	0	-67,382
2014	103,644	137,431	0	-33,787
2015	146,436	139,867	0	6,568
2016	195,393	142,304	0	5, 089
2017	250,054	144,741	0	105,314
2018	310,032	147,178	0	162,854
2019	374,994	149,614	0	225,380
2020	444,654	152,051	0	292,603
2021	518,757	154,488	0	364,270
2022	597,079	156,924	0	440,154
2023	679,414	159,361	0	520,053
2024	765,579	161,798	0	603,781
2025	855,402	164,235	0	691,168
2026	948,730	166,671	0	782,059
2027	1,045,418	169,108	0	876,310
2028	1,145,332	171,545	0	973,788

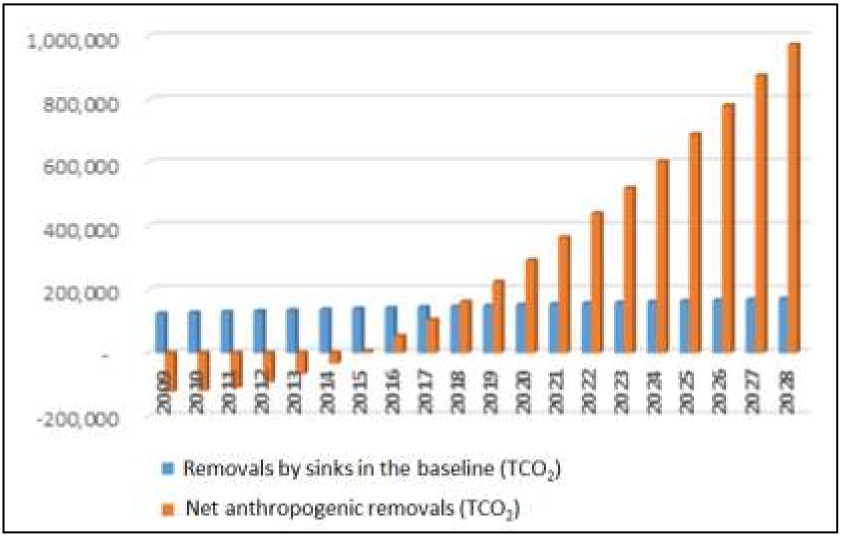

Figure 13. Quantity of carbon removed in the area of the project

The project shows a net positive effect on the cumulative estimation of greenhouse gases removed starting from year 4 onwards.

V. Project Management

The Forest Management General Plan prepared by AIDER together with José Ignacio Távara Pasapera community was made for 9,500 ha of tropical dry forest (which includes 8,980.52 ha of the proposed project), to be managed under a silvopastoral management after reforestation. This plan would cover the sustainable use of grasslands, the use of non-timber forest products and the establishment of a system of fire control.

VI. Project Monitoring of the project implementation

6.1. . Monitoring of the project implementation

A) The monitoring of the project boundary have been made as follows:

- The field study of the limits of the areas with current plantings, site by site.
- Measuring geographical positions (latitude and longitude at each corner of polygon sites) using GPS.
- Verification of the current limit so it can be consistent with the description.
- The geographical measurements are introduced to GIS, where areas of strata and groups will be calculated.
- The limits of the project and the integrity of the plantation area will be monitored regularly through periods of accreditation.

Table 5. Monitoring of the boundaries of the project

Data Number	Variable	Data collection frequency	Numbers of points of data/other measurements of number of collected data	Comment
1	Project boundaries	At the beginning of the project	100%	Measure all the coordinates of each corner of the polygon corresponding to the entire project.
2	Strata boundaries	At the beginning of the project and before each verification	100%	Measure all the coordinates of each corner of the polygon set.

B) Monitoring of forest establishment and management

The following monitoring activities will be conducted in order to ensure reforestation activities and practices described in the project design.

- Constitute the site and soil preparation based on practices documented in the PDD.
- Verification of survival
- Evaluation of weeding practices would be implemented as described in the PDD.
- The survey and monitoring of species and planting for each stratum are in line with the PDD.
- Document and justify the deviation of the planned establishment of the forest

Table 6 shows the parameters that will be considered:

Forest management practices are important drivers for the balance in the stock of greenhouse gases in the project, and these should be monitored:

- Measures for the preparation of the site and cleaning: date, location, area, and other measures.
- Planting: date, location, area, tree species (establishment of stand models).
- Forestry logging: date, location, area, tree species, volumes or biomass removed.
- Check and confirm that the harvested lands are re-planted or reforested as planned or as is required by law.
- Check and confirm that irrigation practices are performed according to the PDD.

- Check and ensure that there are good conditions for natural regeneration if harvested lands are left to regenerate naturally.
- Monitoring of disturbances: date, location, area (GPS coordinates), tree species, type of disturbance, biomass lost, implemented corrective measures.

The programming of material of propagation and fertilization will not be monitored as these occur once. These will only be verified at its respective time of implementation to ensure that it succeeds, as established by the PDD.

Table 6. Parameters considered for the establishment and monitoring of forest management

Data Number	Variable	Data collection frequency	Numbers of points of data/other measurements of number of collected data	Comment
1	Year of plantation of each stratum	At the establishment of each stand	100%	
2	Year of plantation of each sub-stratum	At the establishment of each stand	100%	
3	Number of trees/shrubs per specie per hectare per stratum	At the establishment of each stand	100%	As it is established en the field records during the plantation
4	Rate of trees/shrubs per specie per hectare per stratum surviving the first year	One year after the establishment of each stand	100%	Determined by the measurement of the sample plots established one year after each position

6.2. Monitoring of the actual net greenhouse gases removed by sinks

A field data collection is necessary in order to monitor the verifiable changes in the carbon content of the carbon reservoirs inside the boundaries of the project, as a result of the activities of the A/R CDM proposed project, more information of this activities are shown in the Annex 1.

6.3. Monitoring of leaks

The extent of the area used for grazing will be determined, in order it not to go neither beyond the limits of the project nor between the newly reforested areas as well as ensure that this does not affect reforestation, see Table 7.

In addition, the collected firewood will also be monitored as long as the leak is fixed to zero as a preventive measure. Firewood collection is set to zero because it is performed in areas considered forest that must be excluded from the project area (for being forest), so the reforestation area is not affected. As a preventive measure, gathering firewood will be monitored to ensure that the population remains outside the reforested area.

Table 7. Table of leak variables

Data Number	Variable	Data collection frequency	Numbers of points of data/other measurements of number of collected data
1	Grazing area	6 years	100% of the stratum
2	Firewood collection	Every year	100% of the stratum
3	Number of animals displaced outside the project	Every year	100% of the stratum
4	Number of present animals in the sampled areas	Every year	100% of the stratum
5	Fraction of the sampled areas to firewood collection	Every year	100% of the stratum
6	Fraction of the sampled areas to grazing	Every year	100% of the stratum
7	Firewood volume inside the area of the project	Every year	100% of the stratum

VII. Results

- Strengthen the capacity of the AIDER ecosystem services team.
- The forest management Plan prepared for the project was the first approved plan for the dry forest of Peru.
- The Project "Reforestation, sustainable production and carbon sequestration in the dry forests of José Ignacio Távara - Piura" is the first Forest CDM Project of Peru and the first CDM project for tropical dry forest in the world, making their validation and registration before World Convention on Climate Change[52].

[52] https:/cdm.unfccc.int/Projects/DB/TUEV-SUED1245856381.67/view

VIII. Challenges and lessons learned

- The main challenge was to develop a project under the CDM mechanism with AR3 methodologist, composed entirely by Peruvian professionals, who are the crew of ecosystem services team of AIDER.
- The project did not achieve its funding because the market for CDM forestry projects was very weak, relatively to those from the CDM energy; also because carbon credits for these markets did not take into account the co-benefits that could generate the project, like improving the life conditions of the local population and the fact that this proposal would contribute to the desertification and drought.
- The financial plan of the project was very weak given the commercial situation of the CDM forestry projects.

IX. Next steps

- Migrate from the MDL-AR3 methodology to the standard VCS for its insertion in the voluntary market.

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Project "Reforestation in degraded lands for the purposes of timber production and carbon sale – Ucayali"

Percy Recavarren Estares and Miriam Delgado Obando

ABSTRACT

The project "Reforestation of grassland with native species in Campoverde, Pucallpa - Peru", is located in the district of Campoverde, Coronel Portillo Province in Ucayali. This project began given an identified problem in the area of the project, which is the change of use of forest soils to establish unsustainable agricultural practices. In order to find an alternative solution to this problem, it was proposed the Project "Model of reforestation in degraded areas for certification and future sale of wood stands, in a sector of Campoverde, Ucayali", this project developed on a continuous area of 1,000 ha, starting with 100 ha. The mentioned project was funded by the Fund for the Americas (FONDAM), the regional government of Ucayali and Amazonian Forests (BAM), and implemented by AIDER.

The results of the project implemented by AIDER were favorable, as a result of this model reforestation was implemented the project "Reforestation of grassland with native species in Campoverde, Pucallpa - Peru" where was added the mechanism of payment for ecosystem services defined by the sequestrated carbon in the plantation. The project was designed and implemented following Standards and internationally recognized protocols like Verified Carbon Standard (VCS) and Climate, Community and Biodiversity (CCB), funded by the company SFMBAM (Sustainable Forest Management – Bosques Amazónicos S.A.C).

I. Problematic

The change in land use is caused by shifting cultivation, for which in Peru are annually converted huge extensions of forest ecosystems to cropland and pastures[53]. This problem has degrade soils in the Peruvian Amazon, some of them becoming to be considered as non-productive and therefore being abandoned and burned in summer seasons (July to September) under the mistaken belief that doing this will regenerate the vegetation. Burning lands degrade these areas even more, causing compaction by high temperatures of fire.

The project area was deforested in 1985 to install pastures for livestock and remained like this until 1998. Later, these lands were abandoned, their productivity was lost, without having generated any possibility of use, given the high degree of deterioration. The area was invaded by grass species, mainly *Brachiaria* sp., which prevented the regeneration of tree species.

Figure 1. Degraded land

[53] National Environmental Council (CONAM) (2011)

II. Background

In 2003 it was identified that the adjacent areas to Federico Basadre highway as well as to other roads (Campoverde-Tournavista, Campoverde Nueva Requena, etc.) in Campoverde District were heavily deforested. Soils before covered by forests, were cleared to be utilized for agricultural purposes, mainly for intensive cultivation and grazing, leading to abrupt changes in the floristic composition of vegetation and increasing the exposure of soil to weathering. As a result of deforestation the cycle of organic matter and available minerals in the soil is interrupted and, during the period of greatest rainfall, the erosion and water runoff increases, causing the loss of topsoil and its capacity to storage water, resulting in a poor vegetation, which mainly consists of grasses and shrubs without economic value.

In this context, a proposal was made, determining as the main problem that local people have limited knowledge about technologies to maintain productive lands in "high altitude" rainforest. In addition, it was found out the main causes for this issue: change of land use from forest to unsustainable agricultural practices; insufficient diffusion and transfer of sustainable technology, alternative to current land use; inadequate legislation which allows the practice of shifting cultivation, regardless of technical-ecological aspects.

After identifying the problem, the project "Model of reforestation in degraded areas for certification and future sale of wood stands, in a sector of Campoverde, Ucayali" was proposed; spreading over a continuous area of 1,000 ha , which the present project beginning over 100 ha.

This project was implemented by AIDER, for a period of two years (2004-2006) funded by the Fund for the Americas (FONDAM), the regional government of Ucayali and Amazonian Forests (BAM) - the property owner. In Figure 2 is shown the alliance formed to carry out the project.

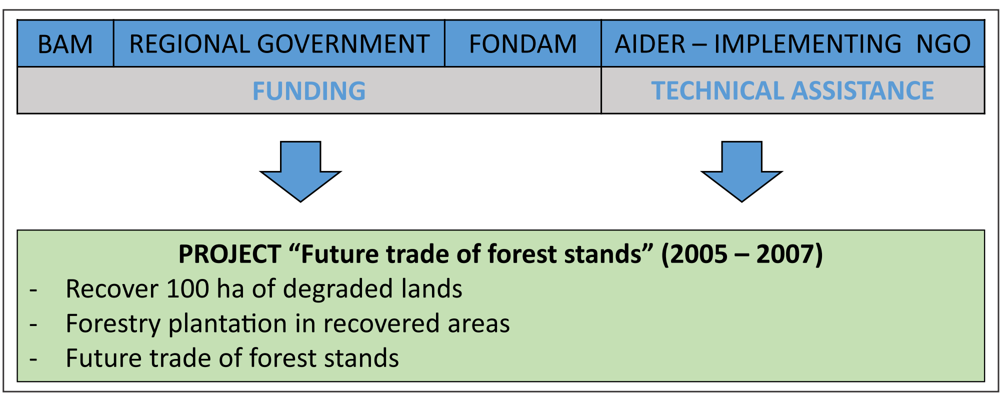


Figure 2. Institutional alliance to fund and implement the project.

The main objective of the project was to establish a productive and sustainable model of reforestation in degraded areas for certification and the future sale of the wood stands.

To achieve the productive and sustainable model, the first step was to recover the degraded areas, starting with the establishment of coverage by herbaceous and shrub species, legumes of rapid growth in open lighted areas and nitrogen-fixers species, which favor the development of other nearby plants. The planted species were mucuna (*Mucuna pruriens*) and kudzu (*Pueraria phaseoloides*), the most popular with those characteristics (See figure 3). Guaba (*Inga edulis*) was selected as a nitrogen-fixer specie and improver of the soil, having an increase of 2.5 m in the first year, 4.5 to 7 tons of increase biomass/ha/year, and fruits production in most of planted trees. In the second year, were planted timber species with spacing of 4 x 4 m, making a total of 625 plants/ha. The selected species have high commercial value and widespread use into the timber national and international market. As an example, there have been a frequent exportation of floors and billets from capirona (*Calycophyllum spruceanum*) and pre-parquet of tahuari (*Tabebuia serratifolia*), shihuahuaco (*Dipteryx odorata*) and pumaquiro (*Aspidosperma macrocarpon*). The 4 species are medium growth period, hard and semi hard woods with final harvest set after 15 to 25 years.

Figure 3. Establishment of mucuna (*Mucuna pruriens)*

Results of the project

- It was possible to develop a technology package for the recovery of degraded areas and the establishment of forest plantations for timber production and carbon sequestration.
- Implementation and improvement of the model developed in 100 ha of degraded soil.
- The indirect beneficiaries of the project (local people) were trained by professionals in the installation of forest plantations.
- Establish an organization formed to replicate the model developed for the initial installation of 100 ha, to replicate it in the remaining 900 ha owned by the company Amazonian Forests (BAM)
- BAM achieved an alliance with the English company Sustainable Forest Management (SFM), creating the company SFM BAM to replicate the project in the remaining 900 ha of its property with the project “Reforestation of degraded areas with timber production and carbon sale – Ucayali”.

III. Location and characteristics of Campoverde Estate

Campoverde Estate is located in Campoverde District, Coronel Portillo Province, Ucayali Region covering an area of 2,596 ha (see figure 4).

Figure 4. Location map of Campoverde fields

3.1. Biophysical characteristics

A) Climate, temperature and rainfall

The area of the project has a permanently humid tropical climate with annual rainfall of 1,700 mm, the annual mean temperature is 26ºC, with some monthly highs around 32ºC and monthly minimums of 20ºC; relative humidity has an annual mean of 84.3%, being the wettest season comprehended between the months of February to April[54].

B) Soil

The project area is characterized by gently undulating terraces with low gradients from 0 to 4%. The altitude ranges from 155 to 220 meters above sea level. The project area contains small hills, historic relic created by fluvial action, meaning that the topography is not affected by floods during the rainy season, drainage is good to moderate throughout the area of the project. The soils have a pH of about 3.5, which is considered strongly acidic, an average bulk density of 1.13 g/cm^3 and a low organic content which reaches an average of 0.86% of carbon in the top ten centimeters[55].

C) Hydrography

In the area of influence of the project, it can be found streams which refuge important species of aquatic invertebrates and fishes[56].

Table 1. Rivers and streams crossing the project area

Name of the lotic environments	Order according to its classification
Agua blanca Stream	Second Order
Garzal Stream	Second Order
Shiquihual Stream	Second Order
Oriol Stream	Second Order
Mojaral Stream	Second Order
Maputay Stream	Second Order

[54] SFM BAM (2008a)
[55] SFM BAM (2008b)
[56] SFM BAM (2008b)

D) Ecology

According to the Ecologic Map of Peru (INRENA, 1994), the scope of the project presents three life zones: Tropical Premontane moist forest (transition to Tropical moist forest), Tropical moist forest and Tropical moist forest (transition to Tropical Premontane moist forest)

E) Vegetation

In Campoverde Estate, the dominant vegetation is composed by the invasive herbaceous specie *Brachiaria decumbens*, with other few shrubs, trees or group of isolated trees. The surrounding area is a mixture of primary and secondary remnant forest. According to the ecological assessment, the project area has 18 species of flora. *Brachiaria decumbens* is the dominant specie, covering 62% of the grassland area, with an average height of 57 cm. These species are associated with hard stem weeds and grass chashaucsha (*Imperata brasiliensis*), invasive herbs with high fuel load, so causing periodic fires which prevent the natural regeneration to thrive in grasslands area (AIDER, 2006). Table 2 shows the predominant species Campoverde Estate[57].

Table 2. Predominant vegetation

Common name	Scientific name
Braquiaria decumbes	*Brachiaria decumbens Stapf. Stapf.*
Hard stem grass	*Alyra* sp.
Cashaucsha	*Imperata brasiliensis*
Cortadera	*Escleria* sp.
Yarahua	*Hyparrhenia rufa*
Yute	*Urena* sp.
Torourco	*Axonopus compressus, Paspalum conjugatum*
Paujil chaqui	*Tetraura* sp.
Shapumba	-
Sogal	-
Braquiaria	*Brachiaria* sp. *(humidicola,dictioneura)*
Pasto nudillo	-
Braquiaria	*Brachiaria brizantha*
Huaquilla	-
Piri piri	*Cyperus* sp.
Cola de zorro	*Andropogon bicronis*
Gramalote	*Alyra* sp.
Carrizo	*Chusquea* sp.

[57] SFM BAM (2008b)

F) Wildlife

Extraction of native forest species, overgrazing and the frequent wildfires have led to degrade the area, lose its biodiversity and soil quality. The removal of the forest and the consequent destruction of habitat have affected most of the wildlife species that usually live in low densities in the forest of the Region. Birds such as the macaw (*Ara* spp.), partridge (*Tinamus* spp.), the pihuicho (*Brotogeris* spp.), the toucan (*Rhamphastos* spp.) are not able to live in a grassland habitat.

Due to this degradation, the project area does not represent a permanent habitat for native species of wildlife, but the remaining primary forest and mature secondary forests bordering the project area continue to provide habitat for a variety of species.

According to a recent study of biodiversity in forest areas bordering the project area, there are 62 species of vertebrates; the most common species are carachupa (*Dasypus novemcinctus*), the majaz (*Agouti paca*) and sachacuy (*Proechimys* spp.). Table 3 shows some of the most representative species of wildlife found in the area of the project (AIDER, 2006).

Table 3. List of wildlife species found in the area of the project

Common name	Scientific names
Mammals	
Carachupa	*Dasypus novemcinctus*
Majaz	*Agouti paca*
Sachacuy	*Proechimys* spp.
Musmuqui	*Aotus* spp.
Zorro	*Didelphis marsupialis*
Añuje	*Dasyprocta fuliginosa*
Choshna	*Potos flavos*
Achuni	*Nasua nasua*
Huasa	*Saimiri sciureus*
Pichico	*Saguinus fuscicollis*
Sajino	*Tayassu tajacu*
Ardilla	*Sciurus* sp.
Ronsoco	*Hydrochoerus hydrochaeris*
Birds	
Perdiz	*Crypturellus cinereus*
Paucar	*Cacicus* sp.
Tucán	*Rhamphastos* spp
Pucacunga	*Penelope jacquacu*
Camungo	*Anhima cornuta*
Gavilán	*Leucopternis occidentalis*
Trompetero	*Psophia leucoptera*
Reptiles	
Jergón	*Bothrops* sp.

3.2. Socioeconomic characteristics

In the area of influence of the project there are 7 population centers, being these Native Communities and Associations located in Campoverde District.

To characterize these villages from a socioeconomic perspective, a socioeconomic diagnosis where performed, applying 147 surveys to the heads of family in the 7 villages, distributed proportionally according to their population.

The main features of the typical family of these communities are[58]:

- 4.6 members per family (partner, 1.5 children, 1 daughter)
- 33% are married couples, while 56% are living together and 6% are single.

[58] AIDER (2006)

- 51% of parents have only primary level education, while 33% have reached secondary level. Only 6% have some sort of advanced education. For mothers, 68% had primary education and 24% have secondary. For children, there are no significant changes, with 44% of boys and 41% of girls with high levels of education.
- A significant percentage of families are migrants from other parts of Ucayali Region and other regions of Peru: 26% come from the capital of Campoverde District; 21% come from Pucallpa city, and 44% are from other parts of Peru. The average age of migrants coming to the Region is approximately 24 years.
- 100% of families develop crops (with an average of 3 crops per family, mainly rice, corn, yucca), while one in three families raise livestock. Other activities are marginal.
- About half of the products are grown for own consumption; the other half is sold in markets.
- On average, each family has a monthly income of US$ 123, which is barely above the national poverty level.
- The average size of each plot per family is 28 ha, which is a normal size plot in the Peruvian Amazon. 43% of the land is dedicated to agriculture or livestock. Almost the same (46%) is covered by degraded or secondary forests, and the rest (11%) is degraded land, abandoned after few years of intensive agriculture or cattle breeding.
- Important to highlight, 72% of the parcels are still untitled.

Figure 5. Transplanting the seedlings to the bags

IV. Project Design

4.1. Design

With the problem identified, it can be indicated that reforestation is the main alternative to recover areas degraded by change in land use. With the model developed by AIDER as a result of the project " Model of reforestation in degraded areas for certification and future sale of wood stands, in a sector of Campoverde, Ucayali" it was decided to develop a project to reforest grasslands with native species, in Campoverde Estate owned by the company SFM BAM. The technical advice in the early years was provided by AIDER. The purpose of the project was to recover degraded areas, biodiversity, timber production and carbon sequestration mainly achieved by reforestation; as well as to generate co-benefits to people who are in the surrounding area through labor income. To achieve the mentioned purpose, it was developed the Project Description Document (PDD) following the requirements of two standards: Verified Carbon Standard (VCS) and Climate, Community and Biodiversity (CCB). For the VCS, the project name is "Reforestation of grassland with native species in Campoverde, Pucallpa - Peru"; and to CCB, "Reforestation in degraded lands for the purposes of timber production and carbon sale in Campoverde, Ucayali – Peru". Both documents are focused to achieve the following objectives:

- Develop a forest management system that promotes and accelerates the natural succession of regeneration stages from pioneer to secondary forest, finally reaching a climax composition of species.
- Generate a local development of the skills of neighboring families, not only as a way to generate more equitable economic development, but also as a strategy to change the unproductive current agricultural practices.

4.2. Participants

The main participants of the project are the company SFM BAM, AIDER and local villages located in the surroundings of the area of the project.

Figure 6. Participants and professionals of the project

Table 4. Participants of the project

Participants	Roles/commitment	Benefits
SFM BAM	As the owner, has responsibility to fund the installation, maintenance and management of the plantation.	Incomes for the wood and carbon credits trade.
Association for Research and Integrated Development. - AIDER (Techincal Consultant)	Responsible for the technical assistance in the installation and maintenance of early planting. Also responsible to collect and process the required information to formulate documents under the VCS and CCB standards.	Develop activities to achieve its institutional mission.
Winrock International (EE.UU.)	Provides technical support and assistance in the formulation of documents under the VCS and CCB standards.	Develop activities to achieve its institutional mission.
Population centers (villages, native communities and associations)	Human resources	Labor and technical knowledge

4.3. Preparation of the Project Design Document

The PDD prepared for VCS was developed according to the AR-AM003 methodology, Version 04 "Forestation and reforestation of degraded lands by tree planting, assisted regeneration and control of animal grazing," one of the approved methodologies under the UNFCCC Clean Development Mechanism forestry projects. An analysis of the applicability conditions was made to ensure that the project meets the criteria specified in the methodology. With this methodology was determined the baseline to quantify carbon stocks in the eligible area before start reforesting and so, estimate the projections of carbon with the implementation. The PDD under the CCB standard was conducted to assess the impacts of the activities in social and biodiversity terms.

Boundaries of the project

The estimation of the eligible area of the plantation was based on Landsat images supported with Ikonos and Quickbird images, processed with ERDAS and Arc View, worked mainly with a methodology for visual interpretation. Results show the area and perimeters of all vegetation types and, in the specific case of eligible areas, distinguish them of the ineligible ones.

The land cover (forest- non-forest) was classified with satellite imagery through two stages:

- Landsat images with a resolution of 30 x 30 m for 1996 and 2006: they were interpreted by the same criteria in order to be comparable with each other and make applicable the eligibility requirement of the standard. The result of this work was a map and a quantification of grazing areas for two years.

- Ikonos image with a resolution of 1 x 1 m from 2006: it was used as a support in order to get a more precise shot and distinguish the eligible area with a better accuracy, which included a total of 740 ha of grasslands. To this were added 180 ha of natural regeneration. Figure 7 shows the location of the eligible and ineligible areas for reforestation.

- Having decided the eligible areas for reforestation, it was made stratification according to the plantation models established for the purpose of the project. Two planting models were designed for each stratum, as it is shown in Table 5. These models were chosen to facilitate survivability capacity, growth and carbon sequestration of species, mainly from *Dipteryx odorata* and *Tabebuia serratifolia*. Also as a third stratum, there is the assisted natural regeneration. Table 6 and figure 9 show the stratification of the area of the project.

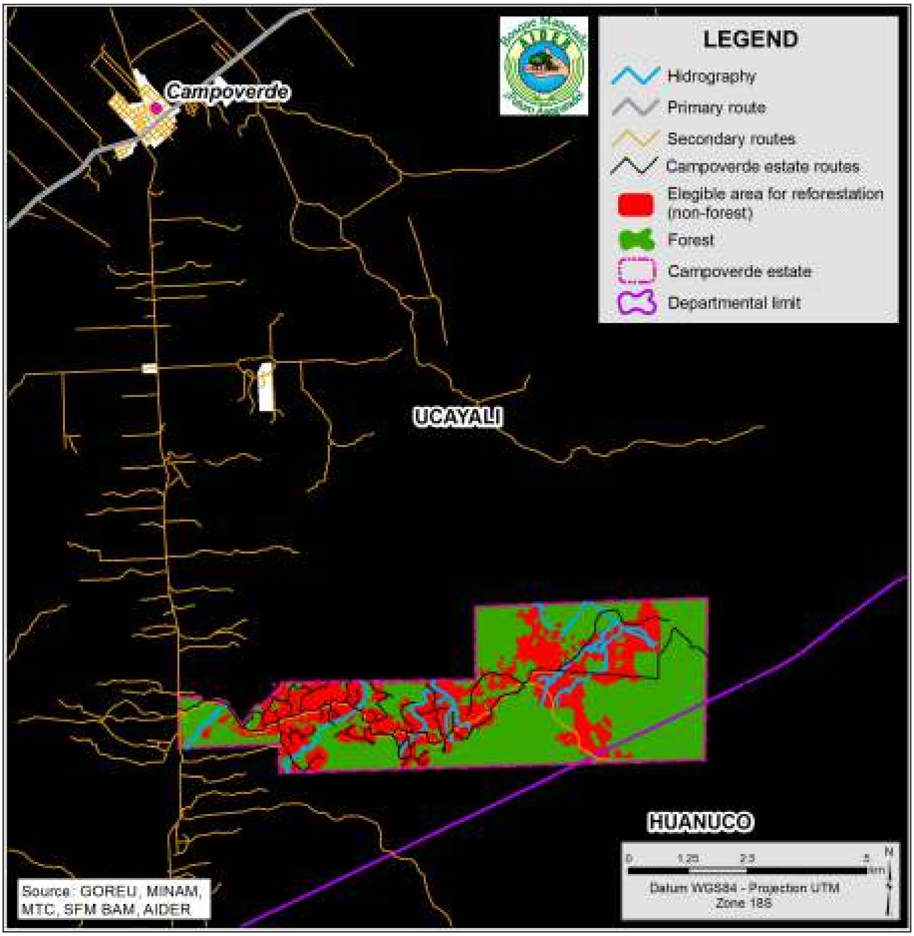
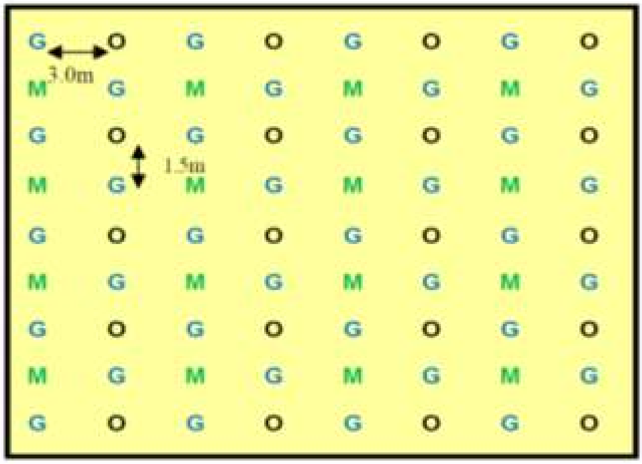


Figure 7. Location map of the eligible area for reforestation (non-forest) and the forest of Campoverde Estate

Table 5. Plantation models for grasslands

Specie	Stratum 1 (Model 1)	Stratum 2 (Model 2)	Comment
	Plants/ha	Plants/ha	
Guaba *(Inga edulis)*	1,111	1,111	*Inga edulis* was planted with spacing of 3 x 3 m. After 6 to 9 months were planted the commercial species next to *Inga edulis*.
Marupa *(Simarouba* amara)	555	555	
Shihuahuac***o*** *(Dipteryx odorata)*	539	0	
Tahuari *(Tabebuia serratifolia)*	0	539	
Caoba *(Swietenia macrophylla)*	17	17	



M: *Simarouba amara*, G: *Inga edulis*, O: *Dipteryx odorata / Tabebuia serratifolia*

Figure 8. Plantation design

Table 6. Stratification of the project area

Stratification	Description	Year of plantation	Hectare (ha)
Stratum 1	Model 1	2009	180
		2010	230
Stratum 2	Model 2	2009	80
		2010	250
Stratum 3	Assisted natural regeneration	No planted	180
Total area to be reforested			**740**

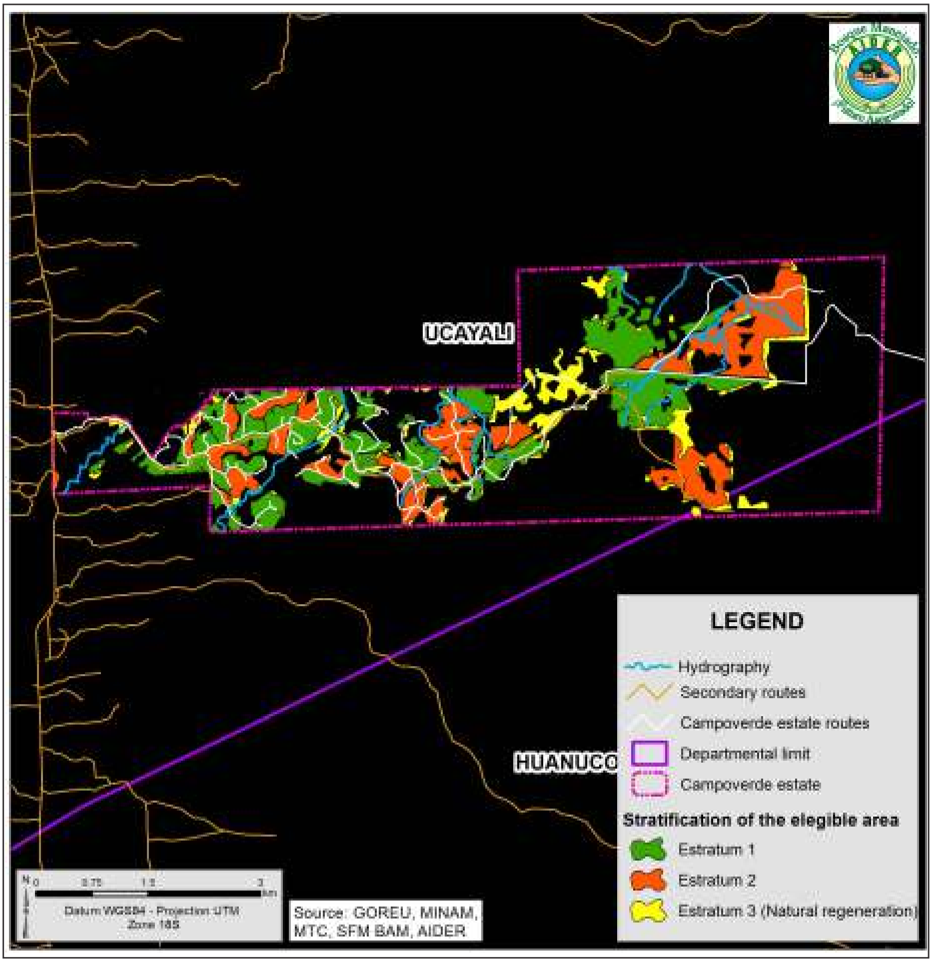


Figure 9. Stratification map of the area of the project

V. Carbon sequestration

5.1. Selection of species

Nitrogen-fixer and fast growing species were selected. Guaba (*Inga edulis*) was the initial seeding specie, being native to the area. Its seeds are easily available and trees are easily propagated. The guaba is known by its nitrogen-fixing capacity so will help to restore and enrich the soil; also will provide shade and protection for timber species. At 6 to 9 months after the establishment of *Inga edulis*, secondary and fast-growing species will be planted as marupa (*Simarouba amara*), simultaneously with climax species as shihuahuaco (*Dipteryx odorata*) or tahuari (*Tabebuia serratifolia*). A smaller percentage of mahogany (*Swietenia macrophylla*) will also be planted at this time.

All seeds proceeded from remnant native forests and forest reserves in Ucayali Region. The seeds of *Inga edulis* and *Tabebuia serratifolia* came from forests near to Campoverde Estate. Seeds of *D. odorata* derived from the native community Sinchiroca about 40 Km to the west of the area of the project. Marupa seeds were collected from Curimaná, located 50 km to the north-west. The seeds of Mahogany were collected from Purus Forest, located to the south-east of Ucayali Region, near the border with Madre de Dios Region. Each one of the parent trees were documented and georeferenced by GPS. In addition, arrangements were done with local communities living near these trees to ensure their protection for future seed collection.

Figure 10. Seedlings in the nursery

5.2. Quantification of the existent carbon in the area of the project

The quantification of carbon stocks was estimated to determine the project baseline. Therefore it was made a forest classification in Campoverde Estate. The types of forests presented in the area correspond to primary residual forests, secondary adult forest and grassland areas. The carbon inventory was conducted in both forest areas (primary residual and secondary adult) and grassland, the first covers an area of 2 376 ha; grassland, 915.6 ha. Having classified the latter areas, was conducted the exploratory carbon inventory by applying a randomly systematic sampling design, with samples distributed in proportion to the area of each stratum.

122 plots were set (110 plots of 20 m radius and 12 plots of 80 m radius), 30 for the comparative analysis of soil between residual primary forest and grasslands. The endpoints were: living biomass of small plants, shrubs, bushes and trees. In the case of the project have been included only reservoirs above and below ground biomass. Other

potential reservoirs, like the litter and dead wood are not significant. Applying a specific soil analysis was concluded that there are not significant differences between nearby forested areas and the area of the project; also observing that soil carbon probably remains constant during the project period[59]. Carbon contents were estimated in tons of CO_2e/ha, with allometric equations from secondary sources of areas with similar characteristics to the project area. Table 7 shows carbon stock in the established reservoirs.

The allometric equation[60] to quantify the biomass of existing trees is the following:

$$C_{AGexisting\ tree} = \rho * \exp(-1.499 + (2.148 * \mathrm{Ln}(DBH)) + (0.207(\ln(DBH))^2) - 0.0281 (\ln(DBH))^3) * CF * (44/12)$$

Where:

$C_{AGexisting\ tree}$	: Total of existing carbon in the biomass above ground (tCO_2e)
DBH	: Diameter at breast height (1,3m) expressed in (cm)
ρ	: Specific gravity of the species (g/cm^3)
CF	: Fraction of carbon in the biomass above the ground (tC)

Figure 11. Assessment of biomass above the ground

[59] SFM BAM (2008a)
[60] Chave *et al*. (2005)

Table 7. Carbon stock in the established reservoirs

Year	Shrubs (t CO_2e/ha)	Seedlings (tCO_2e/ha)	Existing trees (tCO_2e/ha)	Carbon stock (tCO_2e/ha)
2008	0.7	0	3.9	4.6

With the field results obtained was determined the carbon existence in the baseline during the project period, i.e. carbon stock without having implemented the activities of the project (reforestation). Table 8 shows the emissions of CO_2-e in the baseline scenario.

In Figure 12 it is observed the graphic showing the annual estimation of the net removal of anthropogenic GHG of the baseline. The growing trend without project is due to the existence of tree species in the project area.

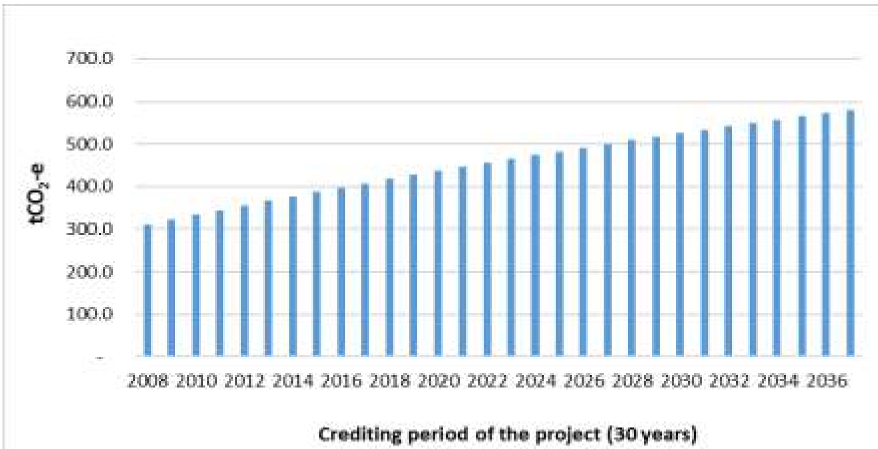


Figure 12. Graphic of the Annual estimation of net removal of anthropogenic GHG (tCO_2-e)

5.3. Projections of the carbon sequestrated by the plantation

Given that there is not experience in diameter and height growth of the species guaba (*Inga edulis*), mahogany (*Swietenia macrophyllya*), marupa (*Simarouba amara*), shihuahuaco (*Dipteryx odora*) and tahuari (*Tabebuia serratifolia*), it was made a literature review using the best information available from studies conducted in other places with species that have the same characteristics. To make the projection of the carbon sequestration it was used the plantation model designed and allometric equations for species with the same characteristics, thereby were estimated the projections of CO_2-e sequestrated by plantation. Table 9 and figure 13 show tons of CO_2-e to be captured with the project during the 30 years of accreditation.

Table 8. Carbon existence in the baseline

№	Years	Shrubs ($t\ CO_2e/ha$)	Seedlings (tCO_2e/ha)	Existing trees (tCO_2e/ha)	Carbon stock (tCO_2e/ha)	Annual estimation of the net removal of anthropogenic GHG (tCO_2-e)
1	2008	0.7	0	3.9	4.6	310.1
2	2009	0.7	0	4.2	5.0	321.8
3	2010	0.7	0	4.6	5.3	333.2
4	2011	0.7	0	5.0	5.7	344.4
5	2012	0.7	0	5.3	6.1	355.4
6	2013	0.7	0	5.7	6.5	366.2
7	2014	0.7	0	6.2	6.9	376.8
8	2015	0.7	0	6.6	7.3	387.3
9	2016	0.7	0	7.0	7.8	397.5
10	2017	0.7	0	7.5	8.2	407.6
11	2018	0.7	0	7.9	8.7	417.6
12	2019	0.7	0	8.4	9.1	427.3
13	2020	0.7	0	8.8	9.6	436.9
14	2021	0.7	0	9.3	10.1	446.4
15	2022	0.7	0	9.8	10.6	455.7
16	2023	0.7	0	10.3	11.1	464.9
17	2024	0.7	0	10.8	11.6	473.9
18	2025	0.7	0	11.4	12.1	482.8
19	2026	0.7	0	11.9	12.7	491.6
20	2027	0.7	0	12.5	13.2	500.3
21	2028	0.7	0	13.0	13.8	508.8
22	2029	0.7	0	13.6	14.3	517.2
23	2030	0.7	0	14.1	14.9	525.5
24	2031	0.7	0	14.7	15.5	533.7
25	2032	0.7	0	15.3	16.1	541.8
26	2033	0.7	0	15.9	16.7	549.7
27	2034	0.7	0	16.5	17.3	557.6
28	2035	0.7	0	17.1	17.9	565.4
29	2036	0.7	0	17.8	18.5	573.0
30	2037	0.7	0	18.4	19.1	580.6
Total estimation of net removal of anthropogenic GEI (tCO_2-e)						**13,651.0**

Table 9. Changes in the carbon existences from living biomass in the project scenario

Years of the project	Years	Stratum 1 Guaba, Caoba, Marupa, Shihuahuaco	Stratum 2 Guaba, Caoba, Marupa Shihuahuaco, Tahuarí	Stratum 3 Natural regeneration	Sum of the changes in the carbon existence in the biomass of living trees of the total project
		Total AG+BG[61] (tCO_2e)	Total AG+BG (tCO_2e)	Total AG+BG (tCO_2e)	tCO_2-e
1	2008	0	0	696	696
2	2009	1,139	505	759	2,403
3	2010	10,263	50,485	824	16,571
4	2011	35,090	22,785	891	58,766
5	2012	58,823	45,651	961	105,435
6	2013	61,698	50,674	1,032	113,404
7	2014	51,110	43,643	1,106	95,859
8	2015	39,116	32,771	1,181	73,068
9	2016	34,395	28,138	1,259	63,793
10	2017	35,009	28,051	1,339	64,399
11	2018	39,754	31,459	1,420	72,634
12	2019	47,899	37,718	1,504	87,121
13	2020	57,974	45,989	1,589	105,552
14	2021	70,808	55,697	1,677	128,182
15	2022	64,164	58,893	1,766	124,822
16	2023	48,221	39,342	1,857	89,419
17	2024	58,021	47,474	1,949	107,444
18	2025	68,923	56,534	2,044	127,501
19	2026	80,955	66,549	2,140	149,644
20	2027	94,143	77,541	2,237	173,921
21	2028	108,511	89,529	2,337	200,377
22	2029	124,078	102,532	2,438	229,048
23	2030	140,863	116,565	2,541	259,969
24	2031	158,881	131,642	2,645	293,169
25	2032	178,145	147,774	2,751	328,671
26	2033	198,667	164,971	2,858	366,496
27	2034	220,454	183,241	2,967	406,662
28	2035	243,514	202,589	3,078	449,181
29	2036	267,853	223,021	3,190	494,064
30	2037	293,473	244,541	3,303	541,317

Source: SFMBAM (2008)

[61] AG: Above ground biomass
BG: below ground biomass

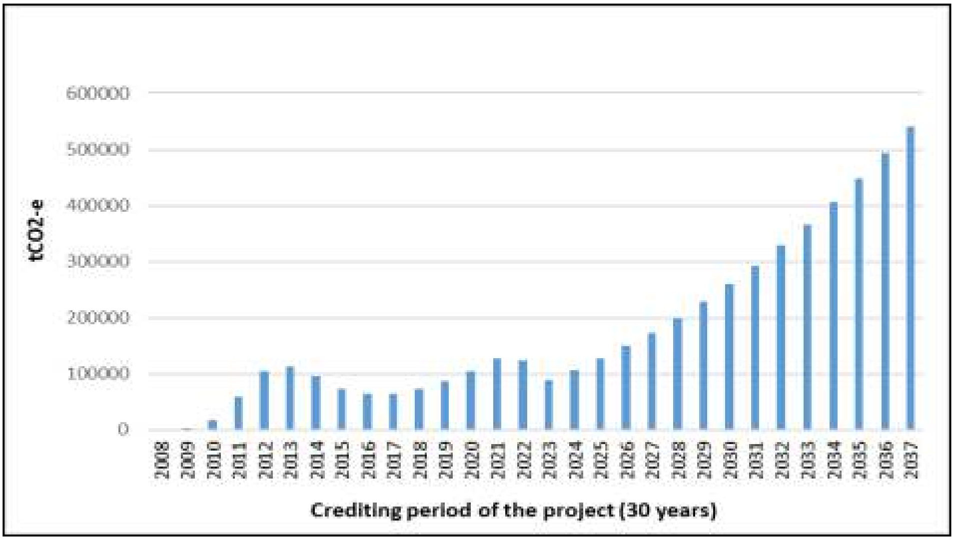


Figure 13. Graphic of the changes in the carbon existence in the living biomass in the project scenario

Figure 14. Plantation of 4 years

Figure 15. Plantations under management

VI. Project Management

For an adequate management of the project, several documents have been developed which have ensured and will ensure a good management in the future years. The main management documents that were developed are the following:

- Soil, vegetation and fauna biophysical Diagnosis.
- Socioeconomic assessment of the area of influence
- Environmental impact study of the project.
- Standard Operating Procedures (SOPs) for monitoring of permanent plots, baseline and project monitoring.
- Determination of the carbon baseline in Campoverde Estate.
- Forest Management General Plan

VII. Monitoring of the project

It has been developed a monitoring system according to the monitoring methodology AR-AM0003, which was approved by CDM, where are indicated the related issues to the monitoring such as: variables, indicators, frequency, sampling method and Standard Operating Procedures (SOPs).

Basically, the methodology describes how the information will be collected (frequency, tool, format, responsible) and how to process it. The results of the monitoring will be used to adjust the priorities and the actions related to investigation and development of the project. The proposal of monitoring also describes the flux of information between different areas of the involved institutions.

The monitoring will be focused on the following aspects:

- Carbon: sequestration, emissions, limits and leaks
- Forest management: nursery and plantation
- Costs, work and others
- Environmental and socioeconomic effects

Figure 16. Assessment of the plantations

VIII. Results of the project

8.1. Socioeconomic results

- Employment for 300 people who participated in the activities of the project and were also beneficiaries. This number decreased after the plantation establishment, given that the activities of maintenance demand less labor.

- Visits to the plantation and workshops for the local people located in the influence of the project.

8.2. Results in biodiversity

- Recovery of degraded land with 740 ha of forest plantation.

- Increase of wildlife populations, resulting in an improvement for the biological corridors in the area and the region.

8.3. Results in climate

The project will sequester, in a long-term, an average of 269,007 tons of CO2-e in the 30th year through the reforestation of 740 ha; in the case of assisted natural regeneration, the sequestration will sum a total of 3 303 tCO2-e by 180 ha. Table 9 describes the calculations.

Table 10. Carbon sequestrated by the plantation and natural regeneration to the 30th year

Stratification	Extension (ha)	Carbon captured in the 30th year (tCO_2-e/ha)	Captured CO_2-e until the 30th year (t)
Stratum 1	410	715.8	293,473
Stratum 2	330	741.0	244,541
Stratum 3 (natural regeneration)	180	18.4	3,303

Source: SFM BAM (2008)

IX. Challenges and lessons learned

- The interchange and facilitation of information of the pilot experiences at the investigation level, helped to design the developed model, which was elaborated with the support of INIA Pucallpa.
- Alliances between regional government, NGOs, private companies and research institutes make it possible to develop technically, economically and socially feasible projects.
- *Brachiaria,* dominant grass in the plantation area, demanded a lot of maintenance. The alternative selected was based on applying supplies to the guaba plantation. The alternative was aply poultry manure (1 – 2 kg) in guaba plantation in order to accelerate their height and crown growth and so, generate shade to stop *Brachiaria* spreading.
- The acquisition of seeds was hard work, consisting on identify the parent trees with features and optimal age, and then monitor them to collect seeds at the right time. In the case of shihuahuaco (*Dipteryx odorata*) given its seed size, the transport was difficult.
- Adapt the activities of soil removal, holes opening, weeding and phytosanitary control from pilot models to a large scale project improving it with mechanized process to reduce costs and time. This challenge was greater because there was no similar experience in Peru to take it as a reference.

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Recovery of degraded areas as a result of mining in Madre de Dios

Claudia Lebel Castillo and Aristóteles Vásquez Ascarsa

Summary

The pilot project "Recovery of degraded areas as a result of mining in Madre de Dios," was proposed in order to develop a methodology to mitigate the effects of gold mining, which has been transforming forest into areas without vegetation due to the washing of organic soil and its conversion to sand soils, 30 meters depth, where no seedling of natural regeneration thrive in the absence of the necessary conditions, also considering the high temperatures which impairs any genetic plant material.

As a result of this proyect nine hectares of guaba plantation were settled with spacings of 3x3, 4x4 and 5x5 meters, this experience provided a lot of information to develop a much larger scale projects in restoring degraded areas by mining. This pilot project was launched in 2010, the plantation was on March 2011, and the outcome was positive and negative experiences of each one of the tested spacing designs.

I. Location of the pilot area

The area where the experience took place is located in the Sub-basin of Inambari River, in Guacamayo and Quebrada Dos de Mayo Sectors, in Inambari District, Tambopata Province, Madre de Dios department.

In this area 6,616 hectares are assigned to mining; 41% are titled mining concessions and 46% corresponds to mining concessions with an approval process (Mosquera *et al*. 2009).

The specific area of the plantation is located in a rural area of difficult access, with inadequate communication or transportation infrastructure; the latter starts in the South Interoceanic Highway.

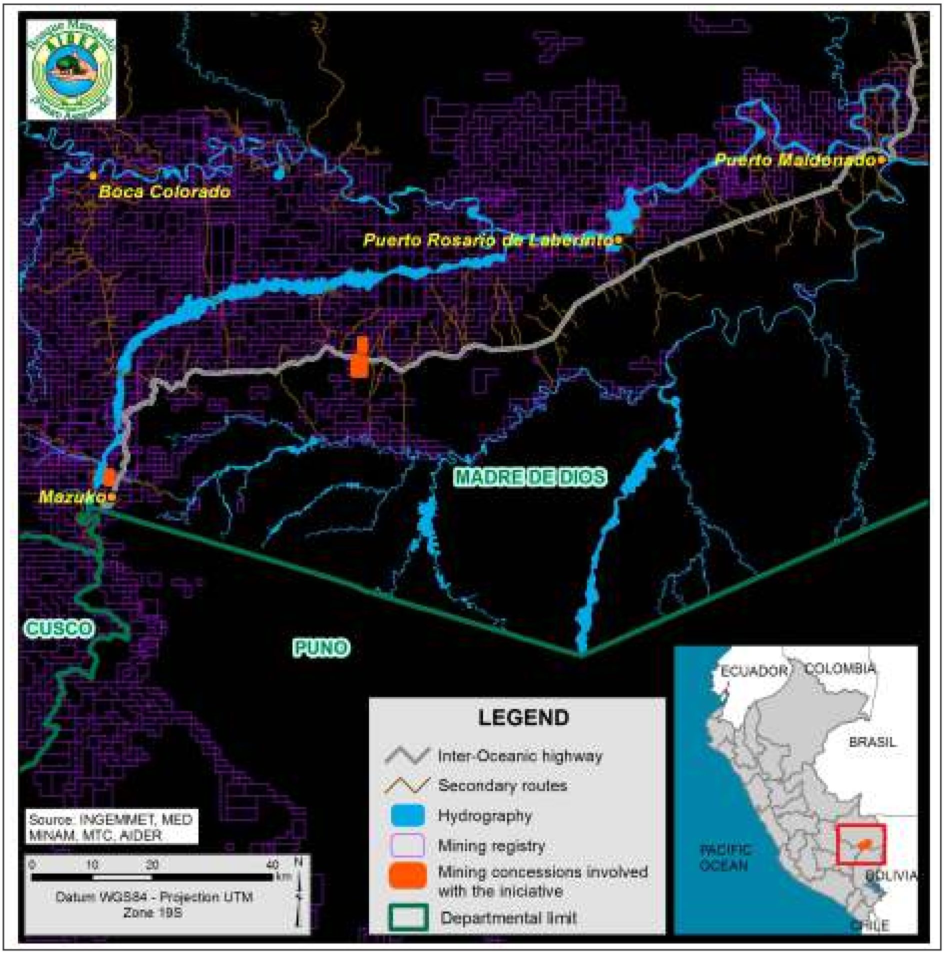

Figure 1. Location map of the mining concessions selected to be beneficiaries of the project "Recovery of degraded areas by mining in Madre de Dios "

II. Problematic

Gold mining is one of the most lucrative activities in the Department of Madre de Dios and the one which generates higher incomes. This activity represents 40% of the Region's GDP, and employs around 12,000 to 20,000 inhabitants. However, this activity is done mostly informally without considering the impacts generated in the environment, especially against water, soil, flora and wildlife resources.

The impacts of gold mining are leading to highly significant dramatic changes in the structure and fertility of soils. The operation consists, basically, in the extraction of alluvial material between 5 to 30 meters deep, washed with high pressure water in order to clean the fine soil particles. As a result of this intervention, the topsoil becomes sandy and sometimes in gravel mounds. Any trace of life in forests and soils is completely lost.

Figure 2. Extraction and washing of organic soil by alluvial gold mining

Alluvial mining activities in Madre de Dios department, have transformed forests into fields of mineral waste without any vegetation cover (Environmental Liabilities), and without a plan or effective methodology for the recovery of these areas after use (Vásquez, 2012).

Faced with this increasingly common problem in the Region, the pilot project was proposed: "Recovery of degraded areas as a result of mining in Madre de Dios". The initiative comes from the Ministry of Environment (MINAM) and is funded by the German Technical Cooperation (GIZ); being the responsible of the technical implementation, the Association for Research and Integrated Development (AIDER). The following objective was proposed: Implement a model to recover soils and forests by planting the forest specie guaba (*Inga edulis*) and as hedge specie, mucuna (*Mucuna pruriens*), in order to improve the physical and chemical characteristics, which will lead to restore the landscape and ecological characteristics. The positive results will be able to be replicated to achieve the ecologic restoration of other areas affected by mining in Madre de Dios.

III. Design

3.1 Selection of beneficiaries and the area of intervention

As a first step, visits and meetings were held with mining concessionaires to decide the areas which will be intervened. Four Sectors were visited: Guacamayo, Tres Islas, Quebrada Dos de Mayo and Alto Malinowski. According to the responsiveness and commitment of the miners to not carry out their activities over the degraded areas destined to be recovered, three beneficiaries located in Sectors of Guacamayo and Quebrada Dos de Mayo were selected. The following is the list of beneficiaries (Table 1), the Sector they are occupying and the area that they committed to recover.

Table 1. Benefited mining concessions and number of hectares to implement

Sector	Concession	Holder	Extension of the concession (ha)	Observations	Reforested area (ha)
Guacamayo	Pending	Leonardo Huamán Huanca	200	José Luis	3
	Pending	Cyntia Miranda Ramírez	600	Moran I	3
Quebrada Dos de Mayo	Certificated	Gladys Haydee Montesinos de Melinc	300	Santa Inés Dos mil Mercurio VIII	3

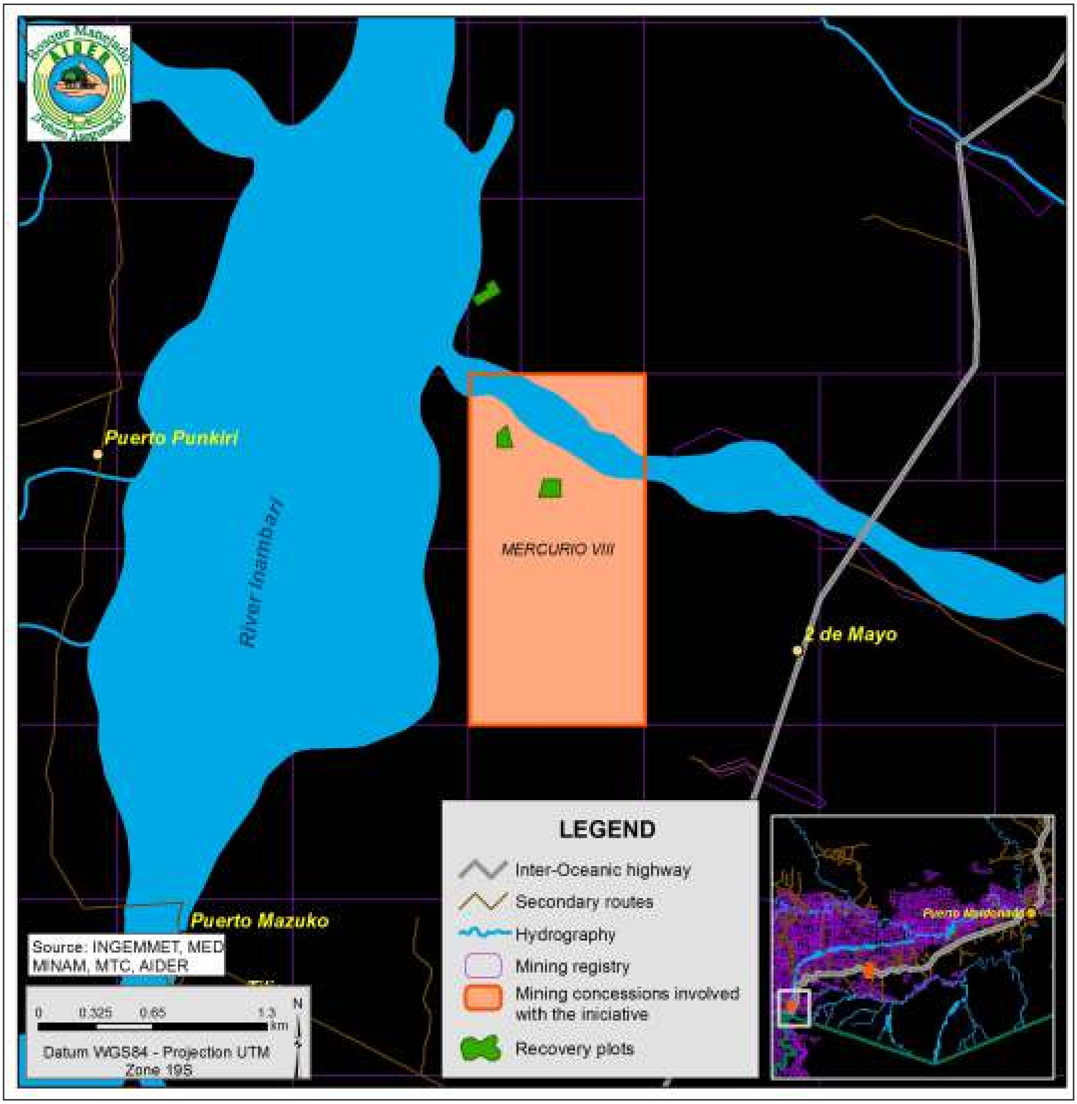

Figure 3. Location map of the Quebrada Dos de Mayo Sector

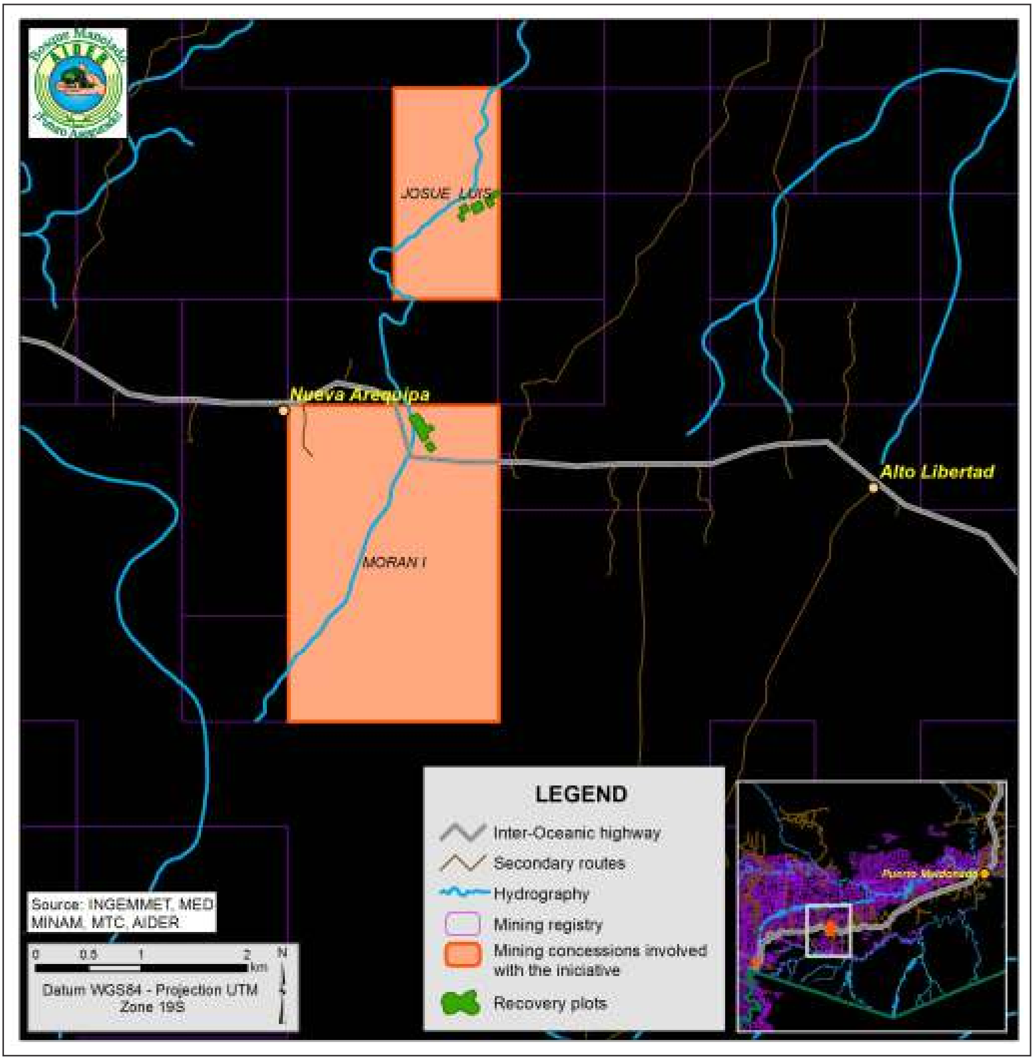

Figure 4. Location map of the Guacamayo Sector

Figure 5. Environmental Liabilities selected by the holder of the mining concession Moran I for the implementation of the recovery

Figure 6. Environmental Liabilities selected by the holder of the mining concession José Luis for the implementation of the recovery

Figure 7. Environmental Liabilities selected by the holder of the mining concession Santa Inés, Dos Mil and Mercurio VIII for the implementation of the recovery

3.2. Analysis of the initial conditions of the areas to be recovered

Once defined the area where the project will be developed, was proceeded to identify, define, georeference and stratify the pilot plots. In addition, a biophysical diagnosis of the plots using soil physicochemical analysis, diagnosis of flora and macro fauna from soil was conducted.

- For the soils physical-chemical analysis, the first step was to identify visually the soil types taking composite samplings[62]. In addition, were opened pits of 1.2 m high and 80 cm wide to collect information about soil profile. All soil samples were sent to the laboratory for their examination.
- Regarding the diagnosis of flora and macro fauna from soil, the implemented sampling strips are equivalent to 10% of the total area to be reforested per

[62] Each sample is composed of 10 to 20 subsamples taken randomly

beneficiary. Each strip has 10 meters wide and 100 meters long and is divided into 10 sub-plots of 10 x 10 meters as detailed in the following figure:

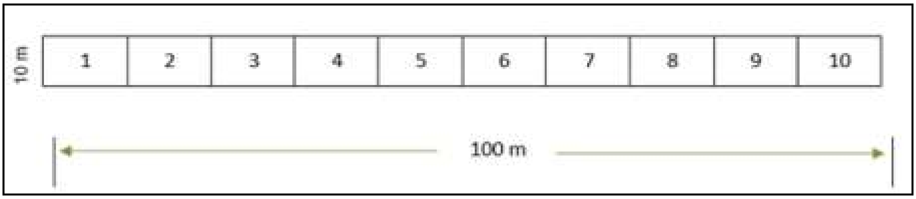

Figure 8. Distribution of sub-plots in the sampling strip

Herbaceous, shrub and tree vegetation were evaluated, as well as vegetation with diameters below 5 cm DBH, macro fauna from soil and wildlife.

IV. Development of the technical plan to recover the degraded plots

Once known the characteristics of the plots, was proceeded to identify the species to be used and was designed the plantation and maintenance system.

4.1. Selection of species

The chosen species for the revegetation of the plots were: guaba (*Inga edulis*) and mucuna (*Mucuna pruriens*), which belong to the family *Fabaceae*, both species have properties of nitrogen fixation in soil and litter production; also mucuna (creeping plant) provided cover to the ground, preventing the loss of organic matter as a result of runoff.

4.2. Implementation, management and production of nurseries

For the recovery of nine hectares, two nurseries located, one permanent and other temporary in the sector located in Km 103 Guacamayo, where the beneficiaries are Leonardo Huamán Huanca and Zea&Miranda.

Considerations taken on the nurseries construction were: proximity to relocate planting, windbreaks, access to sources of good quality water and a flat topography.

Each nursery included the following areas: beds for seedling bags, and housing.

A) Constituents of the nursery

A total of 10 beds 1.2 x 15 m permanent nursery and 5 beds 1.2 x 5 m were installed on the steering wheel nursery. The capacity of the beds was the first 1,800 seedlings and 600 for the steering wheel nursery.

The beds were separated by streets of 0.80 m wide to allow passage of a barrow and to conduct the activities corresponding to the nursery management.

To protect and provide enough light to plants was built a shed using a mesh of 50% shade. This shed covered both, beds and the streets in between. The mesh could be stretched or refolded, according to the needs of the seedlings in terms of light or shade.

Figue 9. Beds of installed plants in nusrseries in their respective sheds

In addition to the bed for seedlings, was built a shed of 16 m^2 with a single drop simple roof, to prepare the substrate for the bags.

Figure 10. Nursery's shed

B) Substrate

The substrate to be used for filling bags consisted of alluvial soil, sand and poultry manure, in a ratio of 2: 1: 0.5, respectively.

The volumes of material used for the production of substrate were as follows:

Table 2. Volume of substrate according to the extension to be reforested

Extension to be reforested	Alluvial soil (m_3)	Sand (m^3)	Poultry manure (m^3)	Total (m^3)
3 ha – 2,670 seedling	5.9	2.9	1.4	**10.2**
6 ha – 5,340 seedling	11.8	5.9	2.9	**10.6**

C) Propagation material and seed requirements

The number of seedlings produced was 25% more than is needed to install on final field. The amount of seed needed for reforestation of 9 hectares was as follows:

Table 3. Quantity of *Inga edulis* seeds used according to the total reforested area, by sector and total

Sector	Surface (ha)	Number of seeds/Kg	Number of seedlings required	Number of purchased seeds (Kg)
Total	9	200	8,010	40.1
Quebrada Dos de Mayo	3	200	2,670	13.4
Kilometro 103	6	200	5,340	26.7

D) Seedlings production

The seedlings produced in each nursery are detailed in table 4

Table 4. Guaba seedlings produced in the nursery

Sector	Reforested surface (ha)	Number of seedlings produced
Dos de Mayo	3	2,670
Km 103	6	5,340
Total	9	8,010

E) Bagging and seeding

In the nuersery, the seeding in the bags was directly, showing a high level of germination. The seeding depth was ¾ the size of the seed, which was planted with the radicle downwards. Due to the size of the seed, it was seeded only one per bag.

Figure 11. Direct seeding of guaba (*Inga edulis)*

F) Growth of seedlings

Once planted the seed, it was kept under shade for15 days, then hours of light were provided gradually, 5 days until 9am, 5 days until 11 am, 5 days to 1 pm and then all the shade was removed.

In regards to irrigation, after seeding, they were watered daily until the tenth day, the next 20 days were watered inter daily, every 2-3 days in the second month, every 3-4 days in the third, each 3-5 days in the fourth and every 5 days in the fifth and sixth months.

In order the seedlings keep healthy in the nursery, were conducted activities of weeding, pruning of roots and fungi and insects control.

Figure 12. Maintenance activities in the nursery

G) Final Transplantation

Guaba seedlings were transplanted to a final field starting their fifth month since were planted in the seedling bags.

V. Design of the plantation system

5.1. Density and number of seedlings per Sector

Were considered plantation with spacings of 3x3 m (1,111 plants/ha), 4x4 m (625 plants/ha) and 5x5 m (400 plants/ha) in order to determine the most appropriate distance to facilitate soil recovery. In each concession 3 plots of 1 ha each were installed, with 3 different spacings so that the number of plants installed in final stage for each mining concession was were 2,136.

5.2. Plantation design

For site preparation and installation of plants the following activities were conducted:

- Alignment
- Holes opening
- Fertilizing the bottom of the hole
- Selection and transportation of seedlings
- Installation of seedlings in final field.

A) Squared alignment

Given the flat to slightly undulating topography, was used square alignment to provide a space for each tree, avoiding competition for light, water and nutrients.

A line was traced, considering it as a baseline in the middle of each plot, the field was marked every ten meters, and then secondary lines were drawn perpendicular to the baseline. Subsequently, the secondary lines were marked every three meters to define the place to dig the hole.

Figure 13. Tracing of the baseline to define the place to dig the hole

B) Opening of holes

According to the marks made on the alignment, were opened the holes of 40 cm long x 40 cm wide x 40 cm deep. This task was performed manually using conventional tools (manual digger, shovel, pick, crowbar).

Figure 14. Plot with opened holes

C) Fertilization of the holes

In order to improve the texture, moisture retention and fertility of the soil, was added a rich in phosphorus compost mixed with organic matter.

The inputs used in the fertilization of the holes were:

- Phosphate rock from Bayobar at a dose of 50 to 200 grams per hole.
- Composted Poultry manure; 1/3 of the hole was filled with this.
- Substrate made of silt and sand in a ratio of 4: 1 respectively.

Figure 15. Worker composting the opened holes

The amount of material used for the installationof the seedlings in each concession was:

Phosphate rock	:	416.7 kg
Alluvial soil	:	107.6 m^3
Sand	:	26.9 m^3
Poultry manure	:	67.2 m^3

D) Selection and transportation of seedlings

– **Selection of seedlings.-** the following characteristics were taken into account in order to select the final seedlings:

- ✓ Stem with a good diameter.
- ✓ Free of diseases and nutritional deficiencies.
- ✓ With a single key guide.
- ✓ Straight, strong, woody stem.
- ✓ Provide a good mesh of roots.

Figure16. Seedlings ready for final field plantation

– **Transportation.-** The seedlings were transported from nurseries to definitive field by barrow, motorcycle or van, depending on the distance between nursery and definitive field, as well as on the accessibility.

Figure 17. Transportation of seedlings to final field

E) Planting

The seedlings of guaba were heavily watered one day before being planted on definitive field. Once in the field, every seedling was located next to its hole. Once located, proceeded to remove the bag and immediately placed into the hole above the compost and phosphate rock, then covered with a mixture of silt and sand. Finally it was given a slightly compaction in order to avoid the soil mix to be loose.

Figure 18. Planting of the seedlings of guaba (*Inga edulis)*

Figure 19. Photographs from the planting in final field

Between the planted Guaba seedlings was planted mucuna to provide more biomass covering the ground and input nutrients.

5.3. Maintenance

In order the plantation develops successfully, were considered maintenance activities such as irrigation, replanting and pest control.

A) **Irrigation**

It was used a manual type consisting of individual plant irrigation using sprinklers. In addition, was implemented a handmade irrigation by drip system.

B) Replanting

Replanting activities were conducted in case the seedlings not to survive reached, for any reasons.

C) Pest control

Pest control was performed in order to eliminate the presence of harmful fungi and insects, during the first year of planting.

Figure 20. Fumigation for pest control

VI. Project monitoring

The monitoring was conducted in the early stage in order to trace the physical progress for each of the activities performed; systematize the obtained information and propose activities that could have been skipped in the beginning.

Figure 21. Evaluation of seedling growth, plant health and presence of wildlife in the recovery plots

VII. Project results

The results presented below are based on data obtained in the assessments and monitoring conducted during 2011, after the planting (in March of that year).

According to assessments of establishment and development carried out at 50 days after planting in definitive field, the level of establishment of *Inga edulis* in all plots was higher than 95%.

Here are the results for the mining concession Moran I and for the mining concession José Luis during the three monitoring performed in 2011.

7.1 Mining concession Moran I

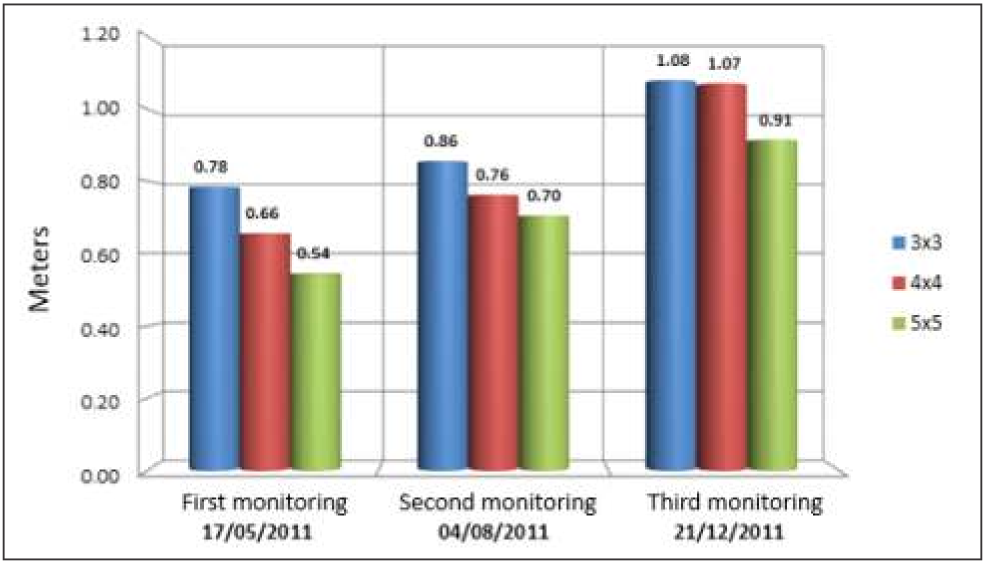

Figure 22. Graphic of the average plant height of guaba (*Inga edulis*) for each tested spacing in the mining concession Moran I

According to the figure 22, 3x3 spacing had better results in height of Guaba trees. However, 4x4 spacing shows a better height growth rate, reaching 0.41 m of increase since the first assessment, compared to 0.38 m of increase from spacing of 3x3. Furthermore, it can be seen that the spacing 5x5 m results in smaller heights.

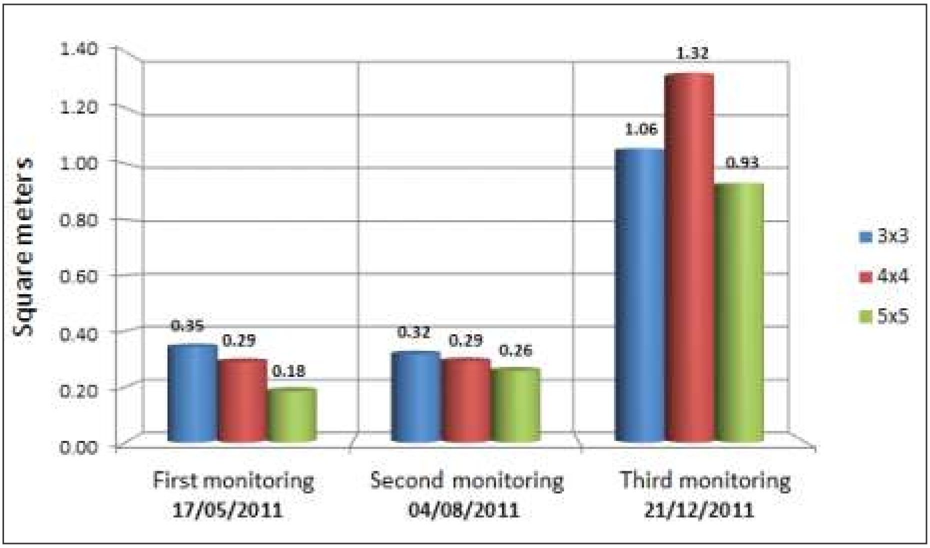

Figure 23. Graphic of average crown area of guaba plants (*Inga edulis*) for each tested spacing on the mining concession Moran I

As can be appreciate in figure 23, from the data shown in the graph, individuals at a distance of 4x4 m had greater crown area, which indicates that root level could also have a higher development compared to other tested spacings, and therefore a better adaptation to the environment in which they are found.

Figure 24. Mining concession Moran I: 1) before planting; 2) at the moment of planting and 3) with the plantation already established

7.2 Mining concession José Luis

In the graphs of Figures 25 and 26, can be clearly seen that individuals at a distance of 4x4 m are those with best results from the first monitoring, being substantially greater the cup area, which gives evidence that this distancing individuals respond better of the terrain.

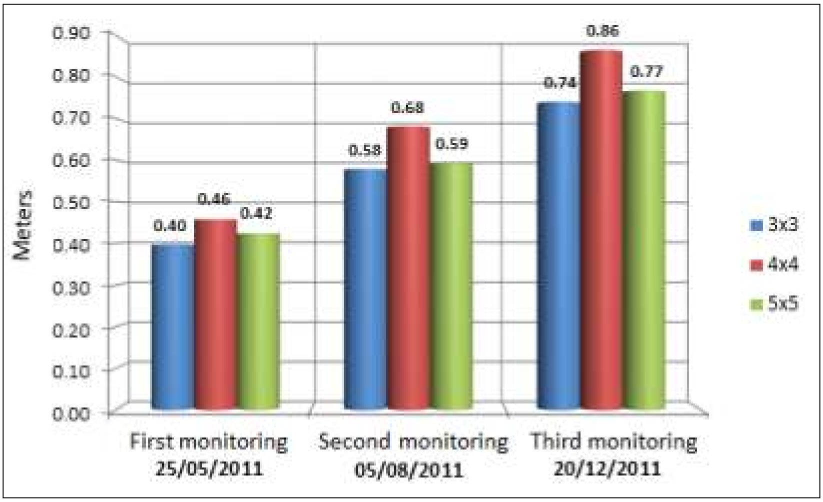

Figure 25. Graphic of the average plant height of guaba (*Inga edulis*) for each tested spacing in the mining concession José Luis

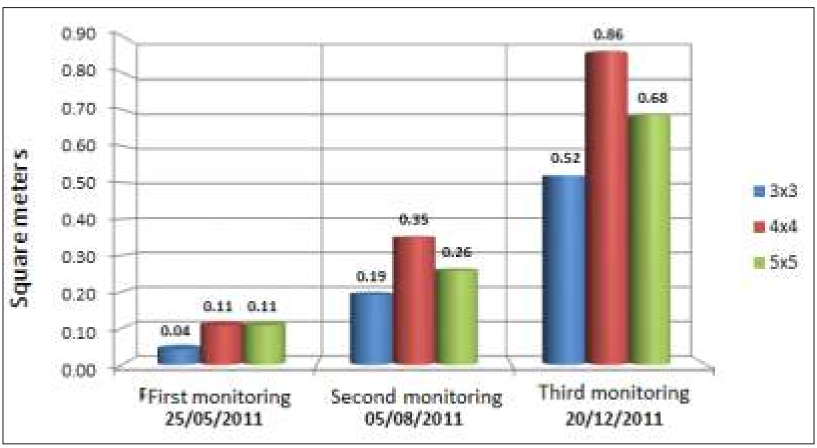

Figure 26. Graphic of average crown area of guaba plants (*Inga edulis*) for each tested spacing on the mining concession José Luis

Figure 27. Mining concession Jose Luis: 1) before planting; 2) at the moment of planting and 3) with the plantation already established.

VIII. Challenges and lessons learned

- It was possible to establish the specie Guaba (*Inga edulis*) in nine plots (one hectare each one) located in three mining concessions, with spacings of 3x3 m, 4x4 m and 5x5 m, achieving an establishment degree greater than 95%.
- Both, Guaba and Mucuna responded positively to the present conditions in degraded soils as a result of mining in Madre de Dios Region.
- Spacing of 4x4 m shows better results in terms of growth and crown area than spacings of 3x3 and 5x5 m.
- The use of hedge species as Mucuna accelerates the incorporation of organic matter to the soil and improves the growth of other species, so its use is recommended in similar practices.
- A larger spacing between trees makes more easily to lose litter and organic matter generated by Mucuna and Guaba, because there would be more empty spaces and larger areas exposed to rain and radiation. Therefore, it is recommendable to replicate this methodology to test smaller spacings.
- It is very important to conduct awareness reunions with local people, without their participation and commitment; it becomes very difficult to maintain the plantations.
- The maintenance of plantations should be applied at the right time and in consecutive stages (irrigation, fertilizers, management guide sticks and others).
- The species considered to recover soils and forests should be mainly native species for their easier adaptation.

IX. Next steps

It is recommendable to keep testing on spacings 1.5 x 1.5 m and 2 x 2 m, in order to avoid lose organic matter generated by the plantation, caused by the impact of the surface runoff and heavy rainfall.

X. Bibliography

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Experiences in forest management

REDD+ Project "Evio Kuiñaji Ese'Eja Cuana to mitigate climate change, Madre de Dios – Peru."

Percy Recavarren Estares and Carlos Sánchez Díaz

Summary

The REDD+ Project "Evio Kuiñaji Ese'Eja Cuana to mitigate climate change, Madre de Dios – Peru." starts from financially supported that AIDER receives from the thematic program to reduce deforestation and forest degradation and to improve the ecosystemic services of the forest (REDDES) powered by International Tropical Timber Organization (ITTO).

The project is developed in the entitled area in favor of the Ese'eja Native Community of Infierno and in the forest concession for ecotourism purposes administered by it. The project area is 7,750 ha, located in the province of Tambopata, Madre de Dios department.

The project is focused on strengthen the forest management area, where the community has acquired its use rights, in order to introduce them into the emergent markets of ecosystemic services and so, generate the additional incomes which will allow them to administrate adequately their communal territory and the ecotourism concession.

The project design was prepared following the technical requirements of the Verified Carbon Standard (VCS) and the Climate, Community and Biodiversity (CCB) Standard, the latter being used as a support of the REDD+ project.

The reference scenario projects a forest loss estimated in 2,897.6 ha in the area of the project for the next 10 years, emitting 261,301.38 t CO_2-e. To reduce this threat, a causal model for deforestation was made in the Community, designing the strategy to reduce emissions for deforestation and degradation. This includes the promotion of productive and sustainable activities, the strengthening of control and surveillance through the forest custodians and the forest governance.

I. Location and characteristics of the communities

Infierno Native Community is located in Tambopata District, Tambopata Province in Madre de Dios Region and is part of the buffer zone of Tambopata National Reserve, covering an extension is 9,701 ha.

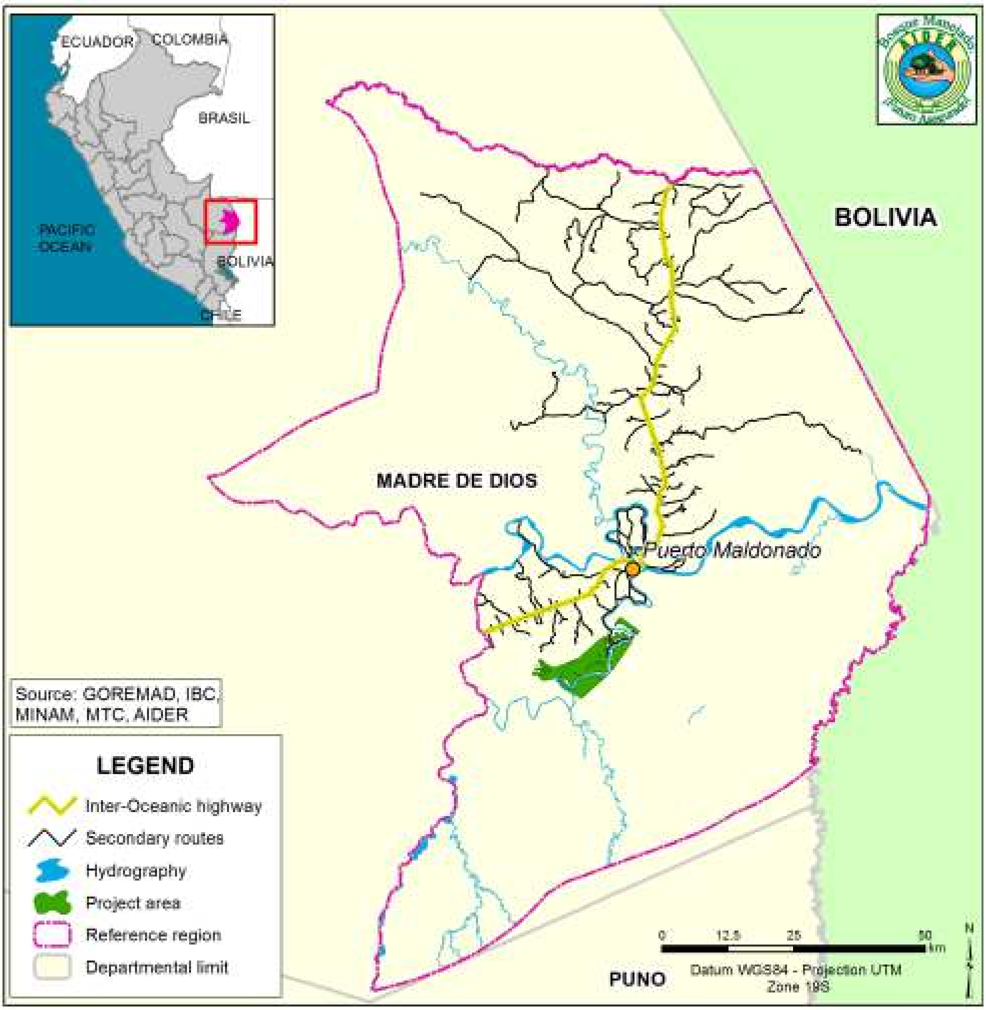

Figure 1. Location map of the community

1.1. Biophysical characteristics

A) Climate, temperature and rainfall

Climate corresponds to the Subtropical moist to wet forest, with an annual average temperature of 26ºC, fluctuating between 10 and 38ºC. The highest temperatures reach 38ºC frequently presented since September to October. The annual rainfall ranges from 1,600 to 2,400 mm, clearly marking two seasons based on the frequency and quantity of precipitation: a dry season between April and December, and a rainfall season from January to March. (INRENA, 2003)

B) Hydrography

The Tambopata River borders the community, being the main fluvial road for them and for the other communities and tourist companies along the river. This river leads in the Madre de Dios River, which is part of the large Amazon Basin.

The geographical borderlines of the community are Lakes Cocococha and Tres Chimbadas of 58 ha and 59 ha, respectively. (AIDER, 2013a)

Figure 2. Tres Chimbadas Lake

C) Soils

Soils in Madre de Dios Region are poor in nutrients, given the nature of lithology, the constant chemical weathering (caused by high temperatures and humidity) and the nutrients leaching caused by rainfall during all year long. Under these natural conditions, the fertility of soils is linked to the organic cycle. The abundant vegetation in tropical forests provide a constant supply of organic matter, mainly as litter, which is later transformed in humus.

These soils have poor agricultural aptitude, and those ones which do have this aptitude are qualified as middle to low fertility with drainage and flood problems. (INRENA, 2003)

D) Ecology

According to the Ecologic Map of Peru (INRENA, 1994), the region of reference present the following life zones:

- Subtropical moist forest bh-S
- Subtropical moist forest, transitional to bmh-S
- Subtropical wet forest bmh-S
- Subtropical rainforest bp-S

E) Biological diversity

Many investigations have been conducted in the Infierno Native Community by diverse institutions like International Conservation, Frankfurt Zoological Society, Rainforest expeditions, AIDER, among others. Through inventories of biodiversity and management documents have been registered 770 species of wildlife, being 21 amphibian, 678 birds, 52 mammals and 19 reptiles. Regard to flora, have been reported 213 species, mainly trees.

The area of the project encloses necessary habitats for the development of many species, which have been pressured by local hunting as an ancestral activity. The most hunted species are: deer (*Mazama americana*), sajino (*Tayassu tajacu*) and huangana (*Tayassu pecari*), being these for self-consumption.

In Tres Chimbadas Lake it can be found giant otters (*Pteronura brasiliensis*) which populations were threatened in the decade of 1950 for the value of their fur. Larger cats have been also registered like jaguar (*Panthera onca*), *Leopardus pardalis* and *Leopardus wiedii.*

Flora is also impacted as a result of non-sustainable use, among the main species under this influence are castaña (*Bertholetia excels*a), mahogany (*Swietenia macrophylla*), shiringa (*Hevea brasiliensis*) and aguaje (*Mauritia flexuosa*) (AIDER, 2013a)

1.2. Socioeconomic characteristics

The Infierno Native Community is constituted, at present, by population ethnically differenced: people from Ese’Eja ethnic group and Andean and riverbanks settlers. There have been patterns of occupation for each social group, reason why it is important to take into account their different process of settlement.

Regarding to modalities of natural resources use, there are two levels in land use rights, familiar and communal level.

The familiar level is constituted by individual plots given to the families by the community. Their average extension is about 30 ha. Until now ha has been delivered 3,360 ha to 115 families under this land use level.

Although there is no a defined and approved zonification of lands under communal level, AIDER (2011) has identified an implicit zonification made by the community which predetermines the way local people access to the natural resources. Table 1 shows the zone types and their characteristics.

Table 1. Implicit zoning in Infierno Native Community

Zone type	Characteristics and purpose
Urban growth and familiar plots	Plots of an average 30 ha. Human settlement and small-scale extractive activities. Owners' area and less exclusive use area. Adding approximately 3,359 ha.
Communal forest Reserve	Approximately 1,436 ha. In this area are located the Hostel Posada Amazonas and Ñape Center. For this area there is a ban on extraction of wildlife, wood, fruits, building materials, agricultural activities and housing.
Empty or free, communal use	Areas outside the family plots and communal reserve. Areas away from the riverbank.
Outside community	Lands of ancestral use by the Ese' Eja indigenuous population and continued to be used after the settlement of the community. Include Brazilian nut trees stand inside the TNTAMB that some families still use, under the figure of exploitation contracts.

Source: AIDER, 2011

The activities carried out by the community are agriculture, being the main crops bananas, rice, corn, yucca, papaya, fruit trees; wood extraction; collection of brazilian nut; collection of aguaje; minor animals breeding and crafting, employees at Posada Amazonas, and eventually offer their labour.is important to indicate that community families receive aprt of the profits of the ecotourisnm activity which is made in the association frame that they have with Rainforest Expeditions company.

According to an analysis made by Sabogal (2012) there are different levels of dependency toward the natural resources. These varies depending the domestic unit and ethnicity. As an example, the agricultural activities of Andean settlers are based on monoculture, although they have adapt to the amazon environment. While the native people, Ese' Eja and riverbanks settlers, cultivate a variety of products. Also, the Andean families invest more in fertilizers, seeds, pesticides and labor.

In contrast, Ese'Eja and riverbanks settlers are more familiarized with the use of forest resources. The vast majority of them have mixed plantation, hunt, fish and extract non-wood forest product for trading or domestic use. The diverse visions about the use of resources have different impacts on the latter and the forest cover. Figure 3.

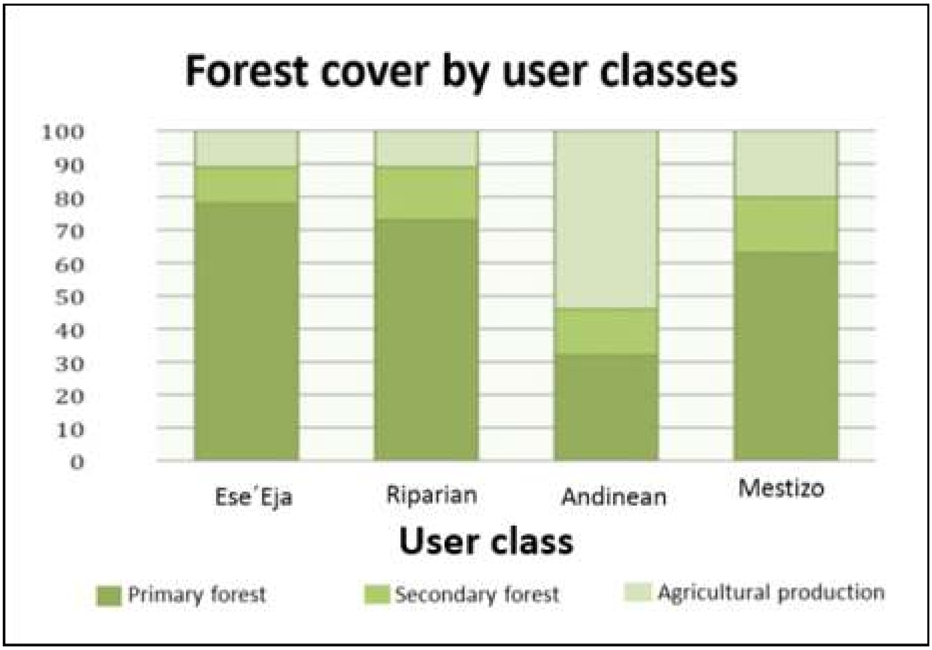

Figure 3. Forest composition per plot kind. (Source: Sabogal, 2012)

II. Problematic

In Madre de Dios Region, especially in Tambopata Province, has been developing socioeconomic processes which are affecting the way the forest are being occupied and used, very different from its traditiontal historical use made in the zone.

These processes are being powered by the pavin of the southern interoceanic highway (IIRSA); the increase of migration looking for better profits provided by gold mining and the lack of governance to order the latter mentioned activity; lands demand to agriculture and wood extraction. All these have an impact on deforestation and forest degradation.

The Infierno Native Community has an important area of primary tropical moist forests, which provide products and ecosystemic services, key to their way of life. However, given the above mentioned, these forest are threatened by deforestation[63] and degradation

[63] According to a SIG analysis, since 2000 to 2011, 650 ha have been deforested inside the community and the concession for ecotourism they manage.

caused by external and internal agents, bringing with them legal conflicts due to the overlap of use rights; expansion of the agricultural frontier and illegal wood extraction.

Figure 4. Illegal wood extraction

III. Project Design

3.1 Concept and assessment of pre-feasibility

According to the problematic, it was considered to develop a mechanism to help the forest conservation in the community. For this, were made the feasibility studies for the REDD+ project, taking information at a larger scale, its outcome determined the viability of this mechanism to generate profits for the carbon sale.

This way, it was possible to start the REDD+ project “Sustainable forest management and utilization of the ecosystem services in the forests managed by Ese eja native community in Infoerno”, implemented by AIDER with funding from International Tropical Timber Organization – ITTO.

The REDD+ Project “Evio Kuiñaji Ese’Eja Cuana to mitigate climate change, Madre de Dios – Peru” was made. As result of the project it is expected to avoid an annual average of net emissions estimated in 117,676 t CO_2-e.

3.2. **Design**

The first step to design the project was to identify the agents, drivers and causes of deforestation, degradation and biodiversity loss in the area of the project. This was made applying surveys, workshops and information collected from the socioeconomic diagnosis. With these, was prepared the causal model for deforestation and degradation of the Infierno forest and the ecotourism concession.

Figure 5. Workshop to prepare the causal model

Based on this model, a scenario without the project from the standpoint of the theory of change was built. On this basis, strategies, activities and goals to be reached by the REDD + project to prevent the scenario from happening projected defined.

3.3. Participants

The REDD+ project propose the participation on Infierno and AIDER. The roles and the obtained benefits for each participant are shown in table 2.

Table 2. Participants of the REDD+ project

Participants	Roles/commitments	Benefits
Native Community Infierno	It has rights over forest lands titled in their favor and ecotourism concession; therefore, it undertakes to manage these areas under the REDD + project and implement actions to prevent deforestation and forest degradation	Receive economic, social and environmental benefits for forest conservation and ecosystem services.
AIDER	Technical responsible for desingning the REDD+ project and the monitoring of reduced emissions. Technical assistance to Infierno to implement actions to avoid deforestation and forest degradation.	Comply with the strategic and institutional objectives.

Source: AIDER (2013a)

3.4. Preparation of the project design document

A) Time limits

- The historical period starts on 2000 and finish on 2011.
- The crediting period of the project; starts on July 1st, 2011 and ends on June 30th, 2031.
- The first period set on the reference scenario is 10 years, beginning on July 1st, 2011 until June 30th, 2021.
- The first monitoring has been accomplished 2011-2012

B) Spatial limits

- **Region of reference:** according to the methodology VCS 1.4 Modulo VMD0007, the region of reference is the xzen which represents the general patterns of unplanned deforestation that are influencing the area of the project and leakage belt. The reference region was defined using the following criteria: primary agents of deforestation, landscape factors, transportation networks and infrastructure, social factors, policy and regulation and exclusion of planned deforestation.

  Based on these criteria, the region of reference was delimited by tracing an area of influence of 50 Km around the Interoceanic Highway of Madre de Dios. This area of influence was defined taking into account the limits of the Districts of Las Piedras and Tambopata in Madre de Dios Region, and the road network[64]. The reference region covers an area of 1,184,167 hectares.

- **Area of the Project:** Is constituted of 7,750 ha of forest, 6,484 ha are within the communal area[65] of Infierno Native Community and 1,266 ha of forest are located within the concession of ecotourism[66].

- **Leakage belt:** It is a "buffer" of 6 kilometers from the boundaries of the project area and meets the following criteria:

  - Contain the closest forested area to the project area,
  - All its parts must, at least, be accessible and achievable by agents of deforestation,
  - It should not be spatially biased in terms of distance from the boundaries of the project area,
  - Include landscape factors, social factors, policies and regulations that have an impact on patterns of land use change.

[64] The road network has been edited by the Ministry of Transport and Communication in 2010.

All areas not classified as forest and agricultural land, according to information from the land registries of COFOPRI until 2011 (COFOPRI, 2010) were excluded. Also withdrew the leakage belt surfaces of the Tambopata National Reserve and the native community of Infierno.

- **Zone of the project.** It involves the producers' association Alto Loero, Loero, Chonta, Monte Sinai, Ulises López, Unión Chonta, La Torre, covering 31,581.6 hectares.

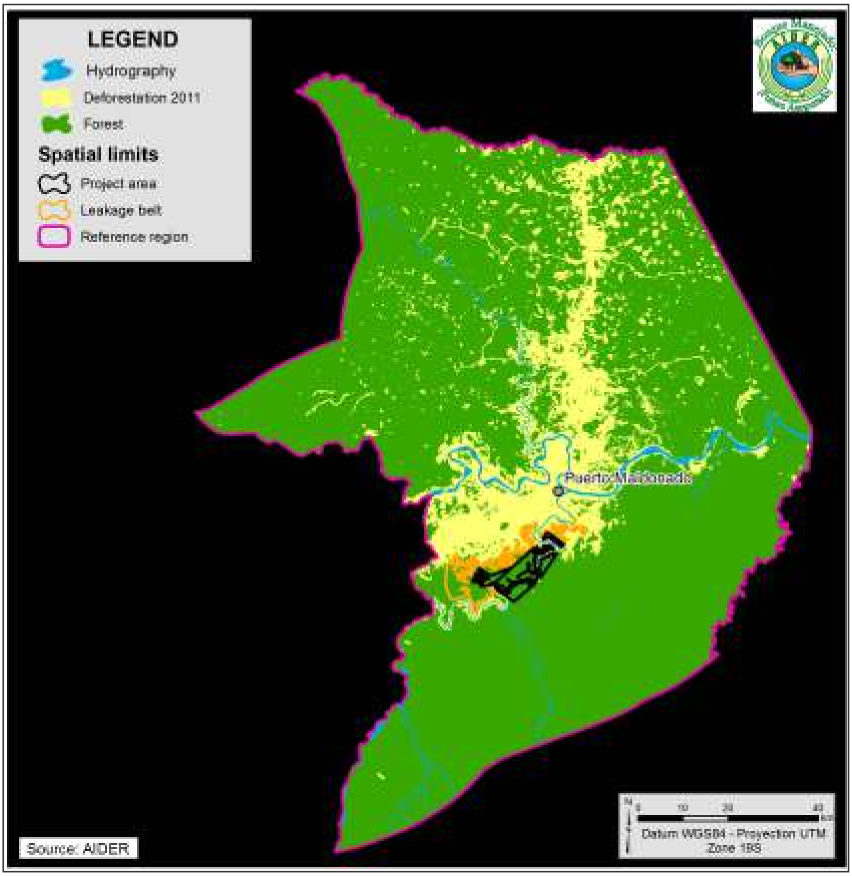

Figure 6. Spatial limits of the REDD+ project

[65] The communal area have a property deed given by the Ministry of Agriculture Nº 0059-762 supported in the Directorial Resolution Nº3909-76-DGRA/AR3

[66] The documents endorsing this category are the Executive Resolution N° 137-2006-INRENA 4 given by INRENA representing the Peruvian State, through which was conceded to the Community 1648.29 ha for 40 years. Also, directorial Resolution 067-2010-AG-DGFFS5 approved the Management Plan of the concession for ecoutourism.

C) Methodology

The project was designed following the methodology VM0007 version 1.4 from the VCS standard, the second version of the CCB standard and manual for social impact assessment and biodiversity (SBIA) of REDD + projects[67].

IV. Estimation of deforestation and avoided emissions.

4.1 Historical deforestation

Quantification and analysis of historical deforestation was conducted following the requirements established in the Module VCS VMD0007 “Estimation of changes in carbon stocks and GHG emissions by unplanned deforestation in the baseline scenario.” (BL-UP) Version 3.2.

The analysis consisted in a supervised classification using information from appropriated sources[68], as well as the acquisition of Landsat images 5TM and Software ENVI 4.7.1 and Arc Gis 9.3.1.

The analysis was made for all the region of reference obtaining maps with 95.32%, of accuracy, being the assessed years 2000, 2005 and 2011. In table 3 and figure 7, it is shown the result of the historical analysis.

Table 3. Analysis of the historical accumulated deforestation in the region of reference in the years 2000, 2005 and 2011

Years	historical accumulated deforestation (ha)
2000	95,900.1
2005	105,254.1
2011	131,238.9

[67] Part 1. Basic guide for the proponents and part 2: toolbox for social impact evaluation

[68] Sources: National Institute of Space Research – INPE (Brasil), University of Maryaland (USA) and USGS Glovis: The Global Visualization Viewer.

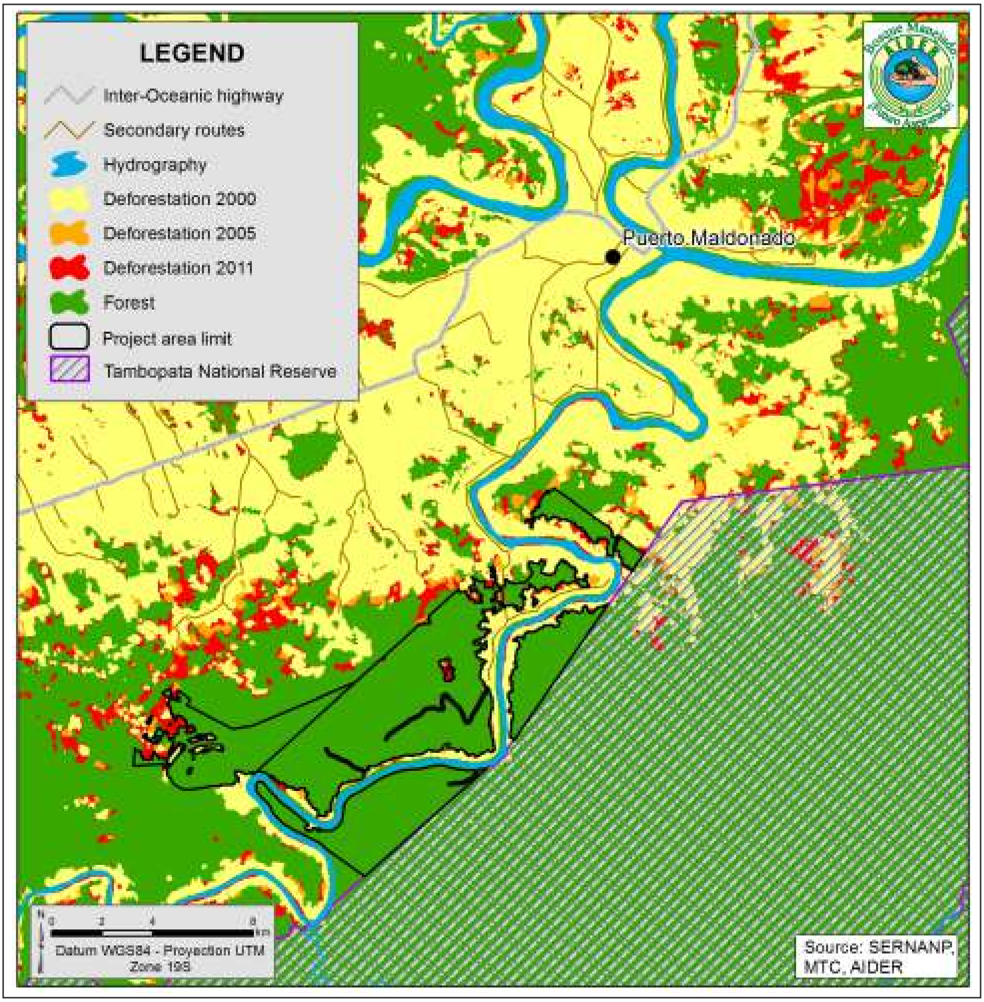

Figure 7. Map of historical deforestation in the years 2000, 2005 and 2011

4.2 Estimation of carbon stock

The estimation of carbon stock was performed through a biomass exploratory inventory, with optimum allocation stratified sampling design; the samples were randomly distributed in the identified strata types.
The sampling unit was constituted by temporary circular net plots of 1, 5, 16 and 30 m of radius. In each plot were considered trees with diameters over 5 cm.

For the nest plot of 1m of radius woody species with DBH below 5 cm were considered, also were considered plants with several axes, with a grater DBH average or equal to 5 cm. a total of 49 plots were evaluated.

The next step was to apply a statistic analysis of the inventory results. The statistic parameters are shown in table 4, the sampling error is 13.3%.

Table 4. Statistic parameters of carbon sampling plots

Parameter	Value
Number of plots	49.0
Min (t/ha)	25.5
Max (t/ha)	319.9
Average (t/ha)	144.7
Standard deviation	65.5
CV %	45.2
Sampling error (%)	13.1

Source: AIDER (2013c)

Figure 8. Biomass inventory in Infierno Native Community

The estimation of carbon content was conducted following the requirements of VCS VMD0001. "Estimation of carbon stored in above and below ground biomass of trees reservoirs and non- trees (CP-AB)." The measured reservoirs were aboveground and belowground biomass. The allometric equations used to quantify biomass are shown in table 5.

Table 5. Technical parameters to estimate carbon stocks

Forest type / species group	Allometric equations	Source
Aerial biomass (tropical rainforest)	$AGB = \rho x \exp(-1{,}499 + 2{,}148(\ln(D)) + 0{,}207(\ln(D))^2 - 0{,}0281(\ln(D))^3$	Chave *et al.* (2005), mencionado por AIDER (2014a)
Cecropia species	$\text{Biomass} = 12{,}764 + 0{,}2568 * (\text{dbh})^{2{,}0616}$	Pearson *et al.* (2005), mencionado por AIDER (2014a)
Palms (ungurahui)	$Y = 23{,}487 + 41{,}851 * (LN)Ht))^2$	Pearson *et al.* (2005)
Palms (huasai)	$\text{Biomass} = 6{,}666 + 12{,}826 * \text{Ht}^{0{,}5} * \text{Ln}(\text{Ht})$	Pearson *et al.* (2005), mencionado por AIDER (2014a)
Palms (aguaje)	$Y = 0{,}00006 * (Ht)^3 + 0{,}0046 * (Ht)^2 - 0{,}043 * (Ht) + 0{,}1259$	Freitas *et al.* (2006), mencionado por AIDER (2014a)
Palms	$Y = 10{,}0 + 6{,}4 * \text{TH}$	Pasa (2008)
Lianas	$Biomass = \exp(0{,}12 + 0{,}91 * Log(BA\ at\ dhb))$	Putz, F. (1983), mencionado por AIDER (2014a)
Destructive sample	$Biomasa = PHM *$ (1-(%CH/100))	
Underground biomass	$\text{Biomass} = \exp(-1{,}0587 + 0{,}8836 * \text{Ln}\ (\text{BSS}))$	Cairns *et al.* (1997), mencionado por AIDER (2014a)

Once the inventory results were processed, the estimated carbon content per hectare for each one of the strata was obtained, as shown in table 6 and figure 9.

Table 6. Estimation of carbon stocks

Strata	Carbon stock (t CO_2 – e /ha)
Mixed aguajal	552.2
Slightly dissected high terraces	454.1
Good to moderate drainage low terraces	500.5
Poor drainage low terraces	596.7
Very poor drainage low terraces	577.6

Source: prepared based on AIDER, 2013c

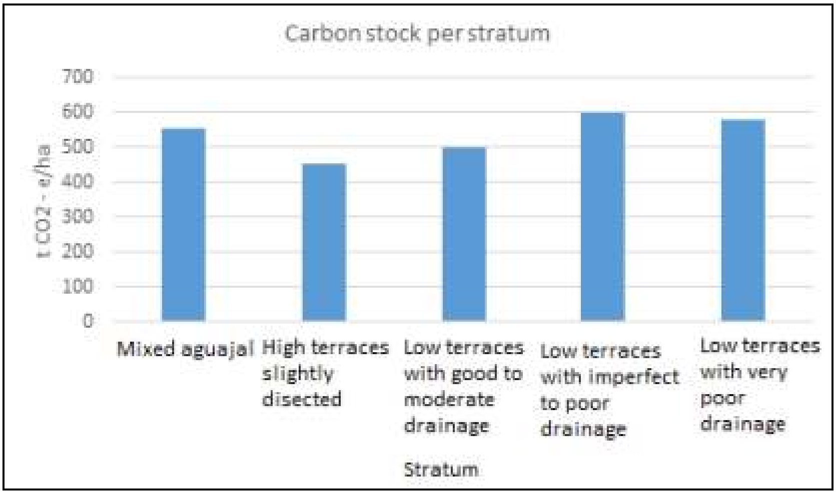

Figure 9. Carbon stock per stratum (Source: prepared based on AIDER, 2013c)

To determine the carbon stored in the area of the project and leakage belt were used data of carbon per ha per each stratum and the ir respectives areas.

Then, it was estimated that the area of the project stores 4, 274,803.6 tCO_2-e, as shown in table 7 and figure 10. In the case of the leakage belt a stock of 4,375,950.8 tCO_2-e was estimated, the results are shown in table 8.

Table 7. Estimated carbon stocks in the area of the REDD+ project

Strata	Extension (ha)	Carbon stock (t)	tCO_2-e
Mixed aguajal	97.4	14,672.1	53,797.4
Slightly dissected high terraces	1,904.2	235,846.5	864,770.3
Good to moderate drainage low terraces	641.0	87,490.7	320,799.2
Poor drainage low terraces	4,463.4	726,417.0	2,663,529.0
Very poor drainage low terraces	640.0	101,429.3	371,907.6
Total	**7,750.0**	**1,16, 855.5**	**4,274,803.6**

Source: AIDER, 2013c

Table 8. Estimated carbon stocks in the leakage belt

Strata	Extension (ha)	Carbon stock (tn)	tCO2-e
Slightly dissected high terraces	8,168.3	1,011,685.4	3,709,513.1
Good to moderate drainage low terraces	375.4	51,248.1	187,909.7
Poor drainage low terraces	441.6	71,873.8	263,537.1
Very poor drainage low terraces	372.3	58,633.9	214,990.9
Total	**9,357.6**	**1,193,441.1**	**4,375,950.7**

Source: AIDER, 2013c

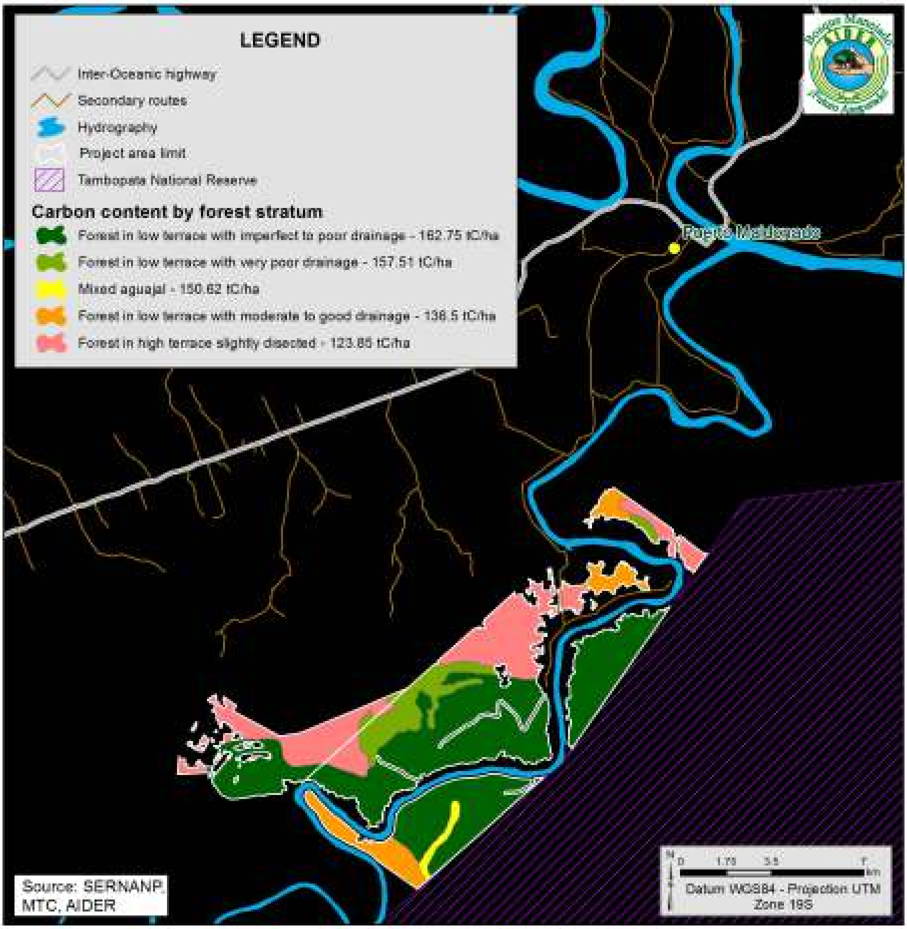

Figure 10. Map of carbon stored in the area of the project

4.3 Deforestation rate

A) Scenario selection

Applying the tool VCS VT0001 - Tool for the demonstration and assessment of aditionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities, were identified, evaluated and determined the scenarios of land use for the project.

From this analysis, were selected the most plausible land use is the continue loss and degradation of the forest managed by Infierno, caused by conflicts for overlays legal conflicts of land tenure rigths , extensive grazing and the illegal timber extraction with high impact. These activities have been registered before in the area of the project.

B) Estimation of deforestation rates

The estimation of the future deforestation rate was based on an econometric model, which relates the forest cover and the population density as dependent and independent variables, respectively.

Collected data about forest cover and population in Districts of Tambopata and Laberinto were registered; both districts are within the region of reference.

The model is explained by the following equation:

Forest cover = $1{,}000{,}000 * 2.718281828459^{(-1.358*\text{population density})}$

The Coefficient of determination (R^2) of this equation was 93%, which indicates that the independent variable (population density) explains the dependent variable (forest cover) with 93% of accuracy. Figure 11 shows the graphic of the equation.

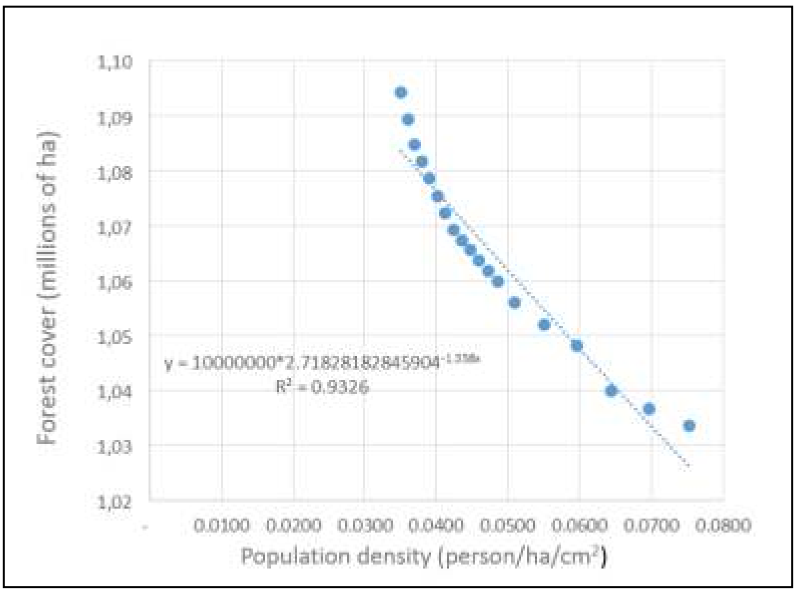

Figure 11. Graphic of the equation (AIDER, 2013c)

Finally, considering the resultant regression, it can be obtained the forest cover, forest area, annual deforestation, accumulated deforestation and the deforestation rate, projected from 2012 to 2021, as it's shown in table 9.

Table 9. Deforestation rate projected to 2021

Year	Accumulated deforestation (ha)	Annual deforestation rate	Accumulated deforestation rate
2012	14,391.2	0.0089	0.0248
2013	22,372.8	0.0096	0.0344
2014	30,921.1	0.0104	0.0448
2015	40,069.5	0.0112	0.0561
2016	49,852.2	0.0122	0.0682
2017	60,303.9	0.0131	0.0814
2018	71,459.6	0.0142	0.0956
2019	83,354.6	0.0153	0.1109
2020	96,023.7	0.0166	0.1275
2021	109,501.1	0.0179	0.1453

Source: AIDER (2013c)

4.4 Projected deforestation

The modeling of the unplanned deforestation was applied to the whole region of reference and the tools used were the following:

- Maps of forest and non-forest of historical period (2000, 2005, 2010, 2011)
- Cartographic nformation of the Variables with influence on deforestation processes: natural protected areas, roads, hydrography, population centers, mining concessions, mining requests, brazilian nut stands concessions, among others.)
- Future deforestation rate (estimated in section 4.3)
- Software of modeling (Dinámica EGO)

The preparation of the model followed three steps: calibration, simulation and validation Regarding to spatial variables considered as an influence in the deforestation processes, were collected all those referred to the region of reference. In that context, the sources of information were: regional government, Ministry of Education, Ministry of Transport, Ministry of Environment, Geological mining and metallurgical Institute, among others, as can be seen in figure 12.

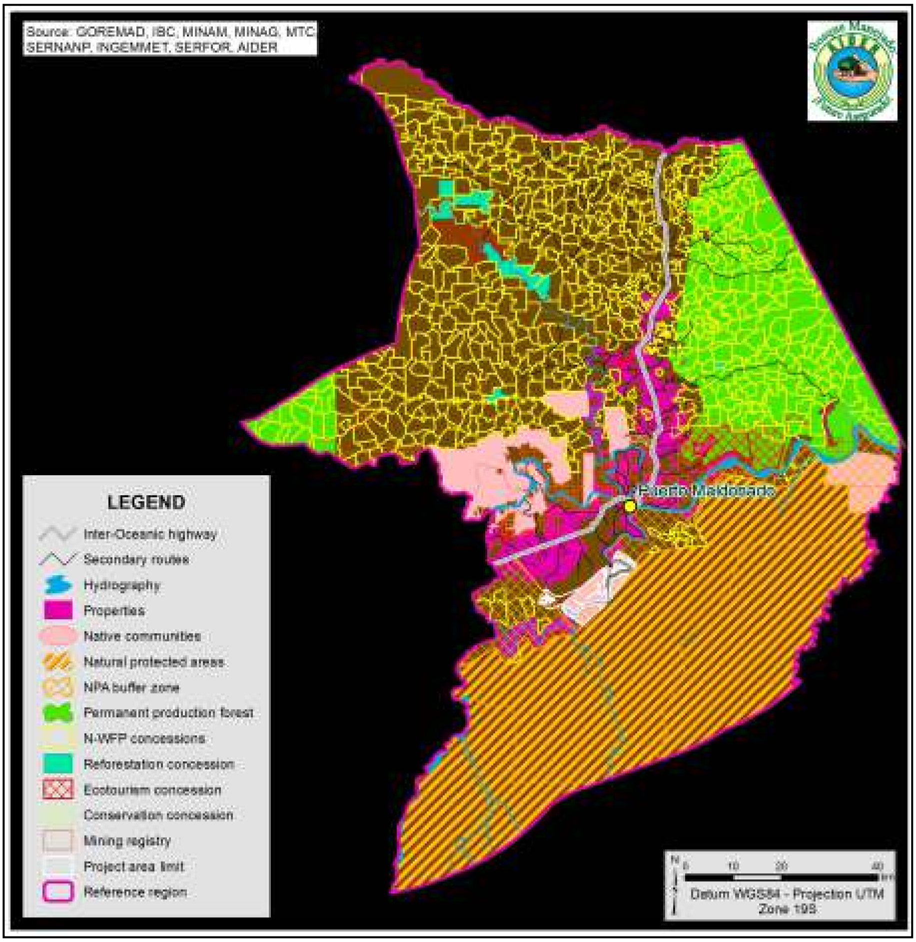

Figure 12. Map of occupancy of the territory of the reference region

Having defined the variables and the maps of forest non-forest from historical period (2000, 2005 and 2011); and also having prepared the matrix of change from forest to non-forest, were prepared the risk maps applying the Dinámica EGO Software. These risk maps indicate the probability of deforestation occurrence in a certain area.

This process allowed to calibrate the model, the same that was used to project the location of future deforestation as can be seen in figure 13.

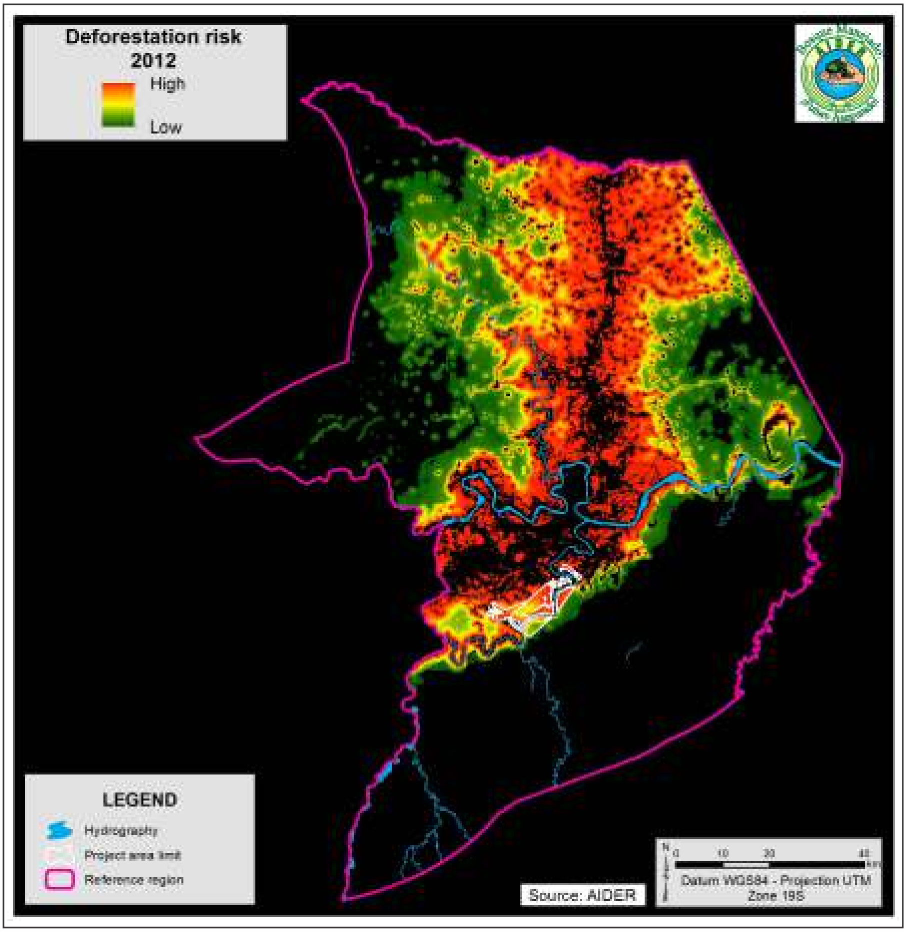

Figure 13. Deforestation risk map projected to 2011

Having calibrated and validated the model and deforestation rate, were prepared the maps representing the areas with more probabilities to be deforested in the period of referenced scenario. (Figures 14 and 15)

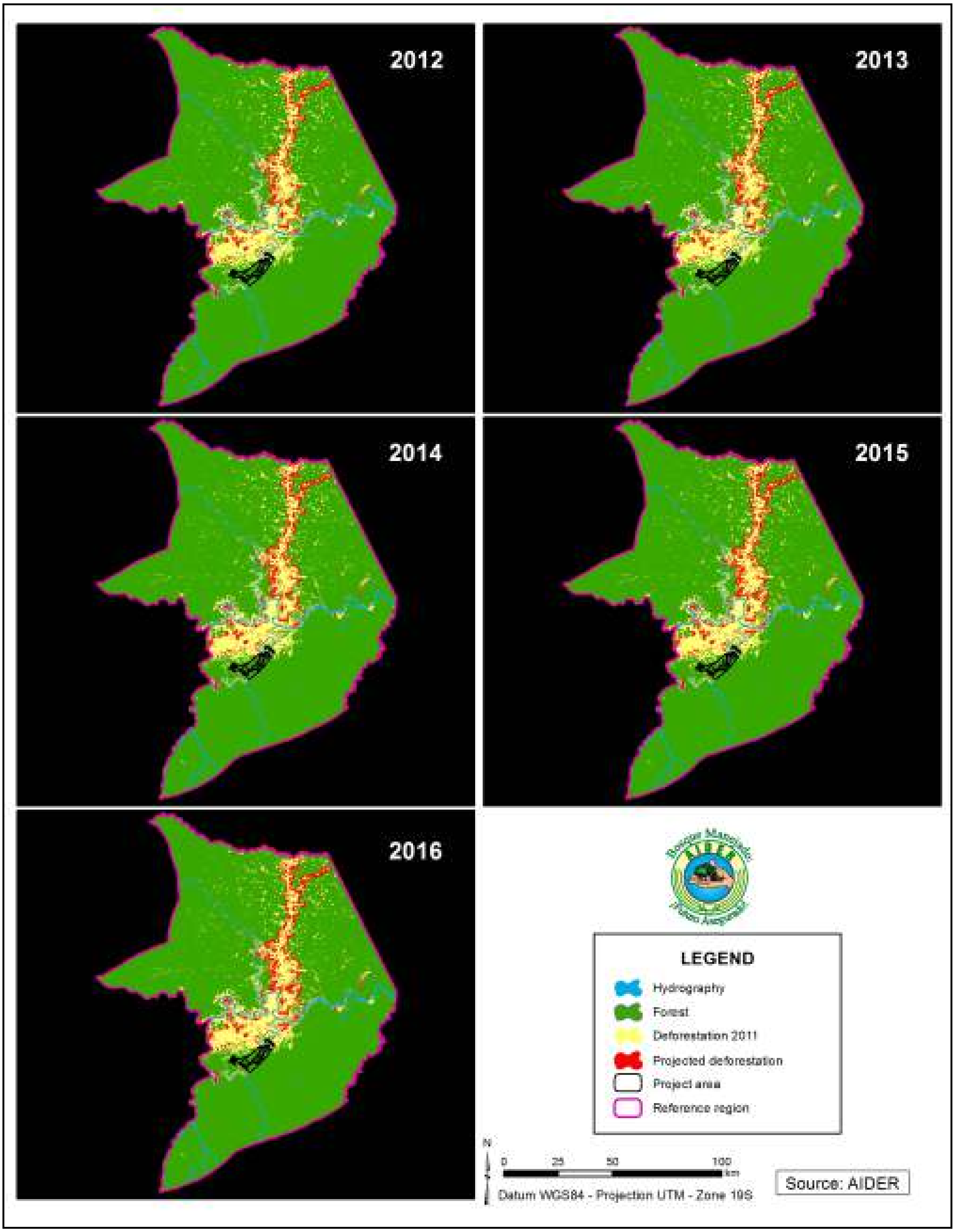

Figure 14. Projected deforestation for the region of reference, since 2012 to 2016

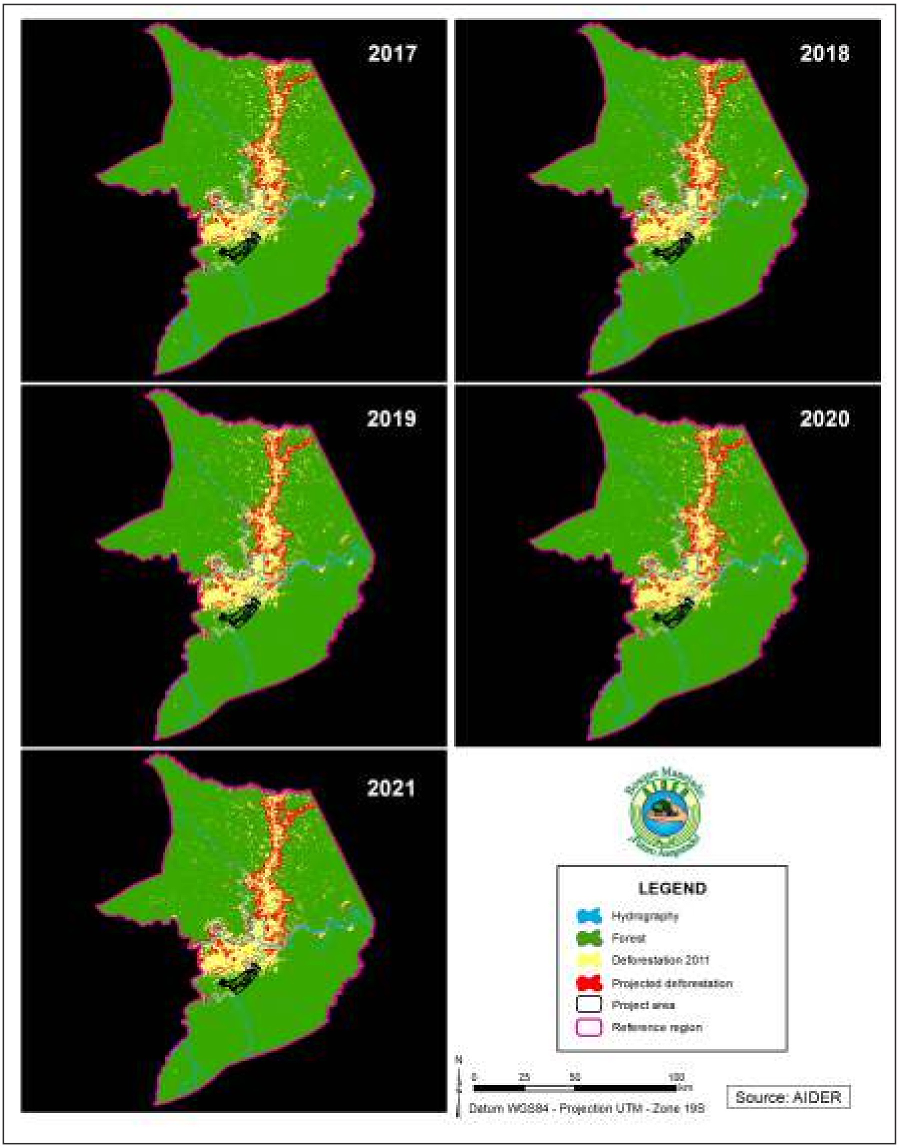

Figure 15. Projected deforestation for the reference region, since 2017 to 2021

Also, it is shown in figure 16 the map comparing accumulated deforestation at the beginning of the REDD+project (2011) with the same proposed to the reference scenario (2021). Comparing, it is estimated that, without the project implementation, 2,897.6 ha of forest would be lost in the comprehended area and 3,733.2 ha in the leakage belt. It can be observed in table 10.

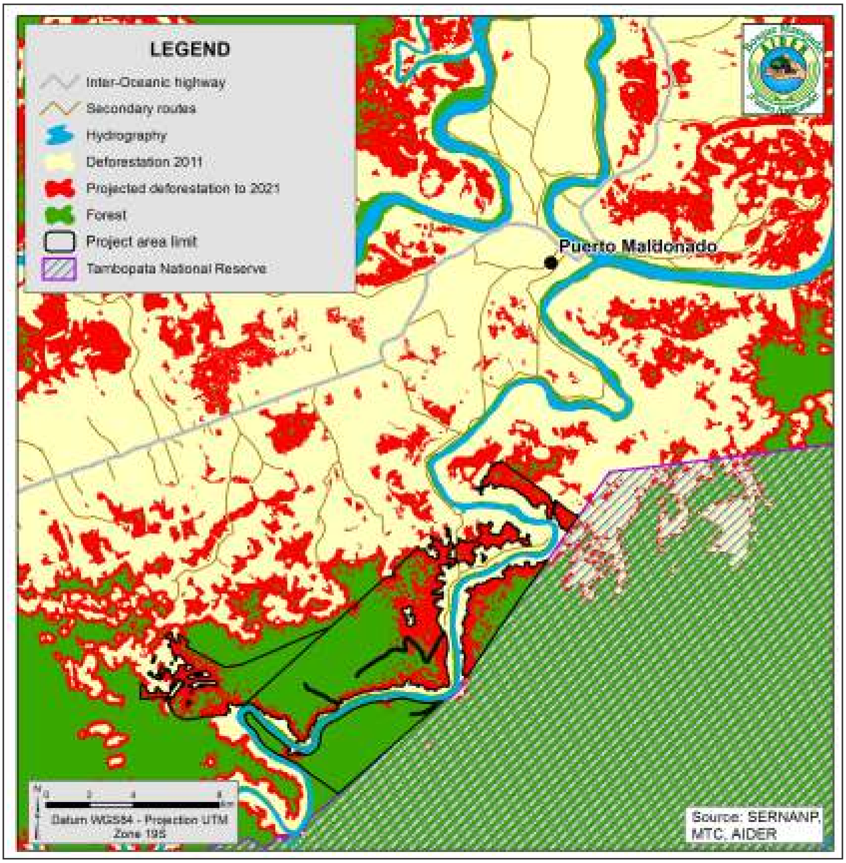

Figure 16. Map of accumulated deforestation to 2010 and projected to 2021 within the region of reference

Table 10. Deforested areas within the area of the project and leakage belt for the first period of the reference scenario

Period	Area of the project		Leakage belt	
	Annual (ha)	Accumulated (ha)	Annual (ha)	Accumulated (ha)
2011-2012	184.3	184.3	404.0	404.0
2012-2013	172.8	357.1	317.7	721.6
2013-2014	200.3	557.4	336.5	1,058.1
2014-2015	222.0	779.3	351.2	1,409.4
2015-2016	251.9	1,031.2	367.2	1,776.6
2016-2017	264.3	1,295.6	375.7	2,152.3
2017-2018	320.5	1,616.1	357.2	2,509.6
2018-2019	371.6	1,987.7	370.7	2,880.3
2019-2020	432.0	2,419.7	398.2	3,278.6
2020-2021	477.8	2,897.5	454.5	3,733.1

Source: AIDER (2013c)

4.5 Estimation of emissions to be avoided

To the ex ante estimation of the net reduction of GHG emissions and carbon credits (VCU) to be generated with the REDD+ project was followed a methodological process which required information about: emissions in the reference scenario; land use after deforestation; emissions provided from the project implementation; leaks from the project; and the project risk analysis.

The following are the detailed steps to estimate ex-ante the carbon credits for the reduced emissions, whose results can be observed in table 11.

A) Baseline emissions

These emissions were calculated according to the Module "Estimation of changes in carbon stocks and GHG emissions by unplanned deforestation in the baseline scenario." (BL-UP Version 3.2.)
To quantify the emissions in the area of the project have been only considered those ones caused by the aboveground and belowground biomass loss for elimination of forest cover.
To estimate the net emissions, the carbon stock in the strata after deforestation, was discounted.

B) Emissions from the project

The emissions caused by the activities of the project were considered insignificant after their analysis.

C) Leaks for activity shifting

Quantification of leaks from the REDD+ project was conducted applying the VCS Module VMD0010 "Estimation of emissions from activity shifting for avoided unplanned deforestation" (LK-ASU).

D) Reduction of emissions

This estimation was carried out subtracting the net emissions and leak from the totan net reductions in the project reference scenario.

$$\mathbf{CREDD,\ t = C_{BSL} - C_P - C_{LK}}$$

Where:

CREDD,t	: Total net reduction of GHG emissions in time t, tCO_2 –e
C_{BSL}	: GHG emissions in the reference scenario; tCO_2 –e
C_P	: GHG net emissions in the reference scenario; tCO_2 –e
C_{Lk}	: GHG net emissions due to leaks; tCO_2 –e

E) Voluntary Carbon Units (VCU)

The approach of VCS Standard regard to the non-permanence of the carbon credits is to reserve a percentage of these (buffer) which is managed by VCS. This percentage is related to the risk level of the project, estimated in 13% applying the "AFOLU Non Permanence Risk Tool: VCS Version 3.1"

The estimation of the Voluntary Carbon Units was made subtracting the reserve of risk of non-permanence credits (13%) from the net GHG emission reductions.

Table 11. Reductions and VCU Estimation

Year	GHG emissions in the baseline scenario ($tCO_2 - e$)	Carbon stock after deforestation ($tCO_2 - e$)	GHG emissions in the baseline scenario ($tCO_2 - e$)	Leakage emissions ($tCO_2 - e$)	Estimation of project emissions ($tCO_2 - e$)	Reduction of net emissions ($tCO_2 - e$)	Buffer (depending on the risk) 13% ($tCO_2 - e$)	VCU ($tCO_2 - e$)
2011-2012	97,235.3	13,421.2	83,814.3	10,445.2	0	73,369.1	8,804.3	64,564.8
2012-2013	91,713.6	12,584.7	79,128.9	9,852.1	0	69,276.7	8,313.2	60,963.6
2013-2014	105,943.2	14,585.8	91,357.4	11,380.6	0	79,976.8	9,597.2	70,379.6
2014-2015	117,456.4	16,164.7	101,291.7	12,617.4	0	88,674.3	10,640.9	78,033.4
2015-2016	134,055.7	18,350.7	115,705.0	14,400.5	0	101,304.5	12,156.5	89,147.9
2016-2017	140,376.4	19,251.4	121,125.0	15,079.5	0	106,045.5	12,725.5	93,320.0
2017-2018	171,725.7	23,342.0	148,383.7	18,447.1	0	129,936.6	15,592.4	114,344.2
2018-2019	199,768.3	27,066.0	172,702.4	21,459.5	0	151,242.8	18,149.1	133,093.7
2019-2020	235,225.3	31,463.6	203,761.7	25,268.4	0	178,493.3	21,419.2	157,074.1
2020-2021	261,309.4	34,798.7	226,510.7	28,070.4	0	198,440.3	23,812.8	174,627.5

Source: prepared based on AIDER 2013c

V. Project Management

5.1 Organization

The organization for the REDD+ project management is enclosed in a specific agreement of institutional coordination between the Infierno Native Community and AIDER, conforming a REDD+ Management Committee. Functions of Management Committee:

- Prepare the reglamentations for its operations as well as its presentation to the communal assembly.
- Approve the project annual operative plan (AOP)
- Supervise the implementation of the activities proposed in the AOP
- Approve the reports of physical and financial progress.

In the framework of this agreement, Inferno is responsible for the managing the REDD + project, implementing the REDD strategy based on the POA developed and approved by the Management Committee and validated Community Assembly.

AIDER is responsible for advising the verification of emission reduction, process carbon monitoring reports and provide technical assistance for the implementation of REDD strategy.

5.2 REDD strategy

To the project planning was applied the methodology from the manual for the assessment of impacts on society and biodiversity (EISB) by REDD+ project[69]. The undertaken steps are the following:

- ✓ Study of original conditions: this was conducted through a socioeconomic diagnosis of the Infierno Native Community and their closest neighbors, in which the population was described based on their main economic activities, access to natural resources, average income per family, access to services, conflict with neighbors, among others.

- ✓ Designing the non-project scenario: it was made utilizing the causal model for the hot spots of agriculture, wood extraction, use rights overlap conflicts, hunting, among others.

- ✓ Designing of the project scenario: The construction of the project scenario resulted from the actions applied to deal with the main problems and causes of deforestation identified in the scenario without the project. This was documented in the REDD strategies for the project, which is the management

[69] Richards, M and Panfil, S. (2011)

document to reduce deforestation and degradation. It was used the methodology of tree of problems and solutions, as well as the construction of the project logical framework.

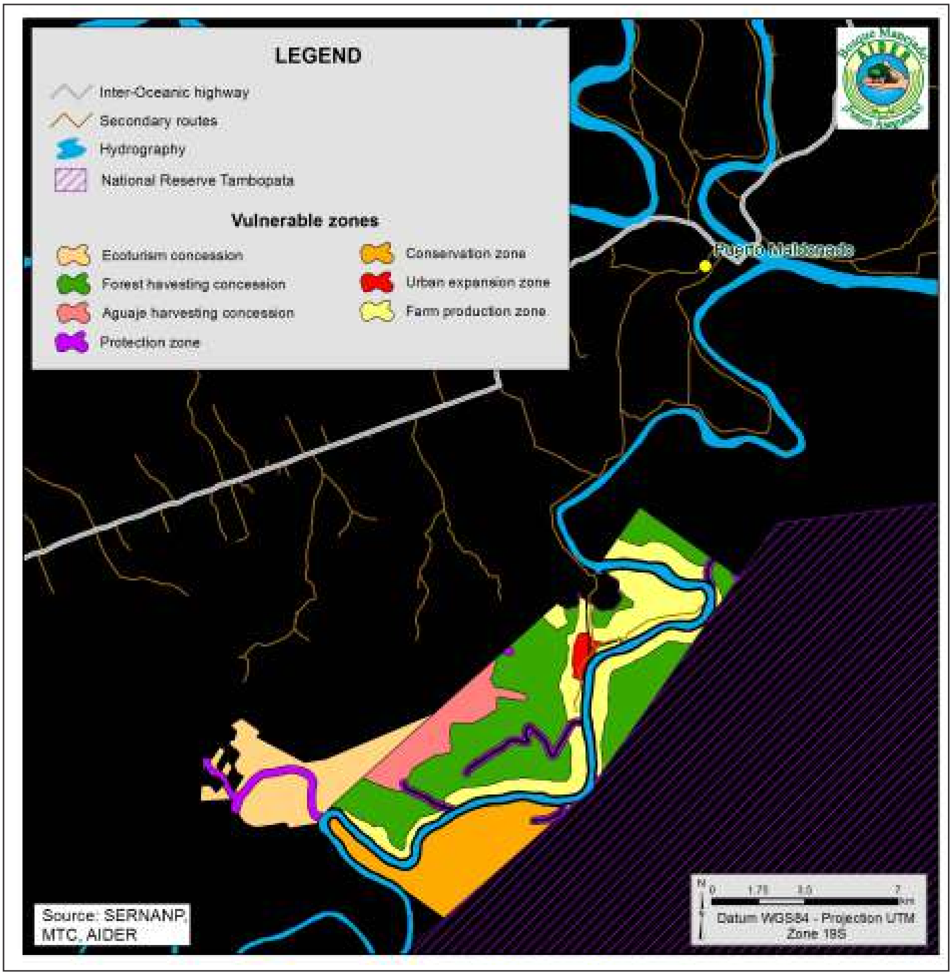

Figure 17. Map of areas identified as vulnerable

The budget of the REDD+ project is US$ 562 593 for the first five years. Table 12 shows a resume per strategic result.

Table 12. Budget to implement the REDD strategy

Code	Strategic result	Amount (US$)	Percentage (%)
R1.	Productive activities in the Infierno Native Community are carried out by local people under sustainability criteria (economic, environmental and social) and minimizing the leaks.	496,271	60.9
R2.	Improve the operative capacity of the Infierno NC for control and surveillance.	108,200	13.3
R3.	Improve the capacity of the Infierno NC to govern and conserve biodiversity	123,700	15.2
R4.	Implement a collectively prepared communication strategy about ecosystemic services, conservation and forest management in the Infierno NC	28,300	3.5
R5.	Conservation agreements have been signed with population established in leakage belt.	59,000	7.2
Total		**815, 471**	**100.0**

Source: AIDER (2013d)

Table 13 shows other management documents, generated in the framework of the REDD+ Project, which is achieve a higher level of compliance of the CCB standard.

Table 13. Complementary documents to design REDD+ project

Management documents	Finality	Achieved criteria of CCB Standard
Socioeconomic diagnosis	Diagnosis allowed identifying the original conditions in the scope of the project. It was determined population, ethnic composition, organization, main economic activities, incomes, accessible services, internal and external conflicts, among others	G1, G2
Social baseline	Project impacts: are needed indicators to describe how the socioeconomic conditions could change in the future with the project implementation. Monitoring of the impacts on community	G3, CM1, CM3
Communication Plan	Communication Plan allowed identifying the canals, messages and strategies of communication, in order to ensure the REDD project information to circulate at all social levels through their representative organizations.	G3.8
Mechanisms and procedures for conflicts resolution	This guide has allowed including into the project design a process to listen, answer and resolve the complaints of the community and other actors related to REDD+ project	G3. 10

VI. Project monitoring

6.1 Socioeconomic monitoring

This monitoring is conducted to determine the impacts of REDD+ project related to original socioeconomic conditions, for which have been defined variables, indicators and measurement frequency.

6.2 Biodiversity monitoring

The monitoring of the impacts on biodiversity will be determined through the assessment of the status of the conservation issues: jaguar (*Panthera onca*), maquisapa (*Ateles chamek*), tapir (*Tapirus terrestres*), huangana (*Tayassu pecari*), harpy eagle (*Harpia harpyja*), scarlet macaw (*Ara macao*), river wolf (*Pteronura brasiliensis*) and licks. Will be also periodically assessed the status of the identified High Conservation Value Forest (HCFV).

6.3 Carbon monitoring

Have already carried out the first monitoring of emissions reduction to period 2011-2012 according to the established on “VCS Methodology VM0007, REDD Methodology Modules (REDD-MF) version 1.4, developed by Avoided Deforestation Partners”.

The monitoring of the changes in carbon stock and GHG emissions are being performed under the approach of participative monitoring, in which the technical team from AIDER and the forest custodian of Native Community Infierno are participants.

The monitoring included the utilization of images from Landsat 8 satellite for both years, as well as the field validation with the participation of the forest custodian.

Figure 18. Forest custodians carrying out the land use change monitoring

With this information, were identified the changes in land use in 2012 compared to 2011, as can be observed in figure 19.

Figure 19. Image of forest of the Community to 2012

To evaluate the effectiveness of the project to reduce deforestation, it was compared the projection of deforestation for the period 2011-2012 with the deforestation occurred according to monitored data (real occurrence) for the same period.

According to the reference scenario, the deforestation to be avoided within the area of the project for the period 2011-2012 was 184.3 ha. With an effectiveness of 100%, the latter would create 73,369.08 Verified Emission Reduction (VER) credits, valuing these credits in US$3.00 (moderate price) they would generate incomes equivalent to US$ 220,117.

However, based on the monitoring, was determined that the project avoided deforesting of 138.3 hectares (having been deforested 51 ha), which represents an efficiency of 75% in reduction of deforestation.

The conservancy of 138 ha of threatened forest has generated 53 064 carbon credits, each one valued on US$3.00 per tCO_2-e once traded. Therefore, the incomes for the community sum US$159,192.

The deforestation of 51 ha is equivalent to US$ 60,915, which the community will not perceive. Table 14 shows the comparison between the projected and the real occurrence for period 2011 – 2012.

Table 14. Monitoring the avoided deforestation in the project area 2011 – 2012

PROJECTED IN PD-VCS	
Deforestation to be avoided	184.3 ha
Carbon credits to be generated	73,369.1 VER
Projected incomes	USD 220,107 – at a price of USD 3
MONITORING REPORT – REAL OCCURENCE 2011-2012	
Effective avoided deforestation	133.3 ha
Deforested area	51 ha
Generated credits	53,064 VER (valued on US $159 192)
NON-generated credits	20,305 VER (valued on US $ 60 915)

Source: AIDER, 2014

The land rental to third persons to cultivate papaya (*Carica papaya*) has been the driver of deforestation in the area of the project (Figure 20). Community people rented these areas for US$535/ha per cultivation period (3 years), which multiplied by 51 deforested ha for this activity results US$ 27,321.

Making a comparison between the income from the rental of land for agriculture, compared to revenues of avoiding this deforestation and generate carbon credits, it appears that the option of renting land produces a loss of US $ 33,594 for carbon credits not generated, US $ 30,600 for timber resources untapped, besides the loss of biodiversity and other forest products such as medicinal plants (Figure 21).

Figure 20. Papaya cultivation in Community area

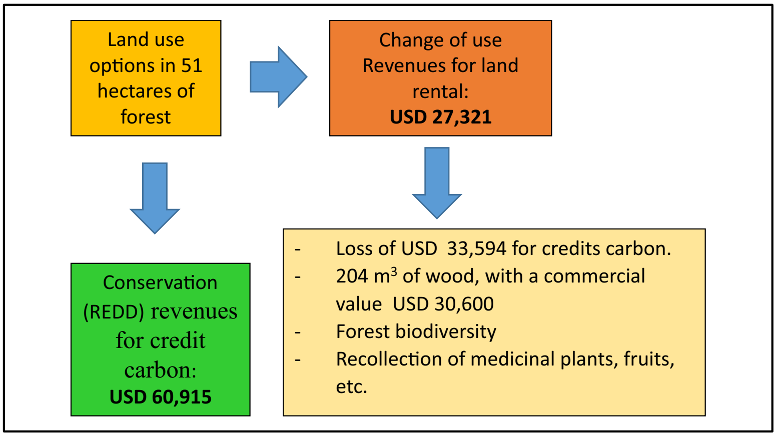

Figure 21. Option of land use in the area of the project

As a consequence of this valorization, the community decided not to log more primary forest, avoid the papaya cultivation by third persons and perform agricultural activities only in current deforested lands.

6.4 Monitoring of the project's implementation

The Monitoring Plan to be applied consist the following:

- Indicators
- Method to collect data
- Tools to collect data
- Frequency of data collection
- Information sources

Results of monitoring are communicated to communal assembly and to Management Committee of the REDD+ project. The project monitoring will also assess the transversal lines of the implementation: participation, transparency, interculturality and gender equality. The information flux scheme of the monitoring is graphed in figure 22.

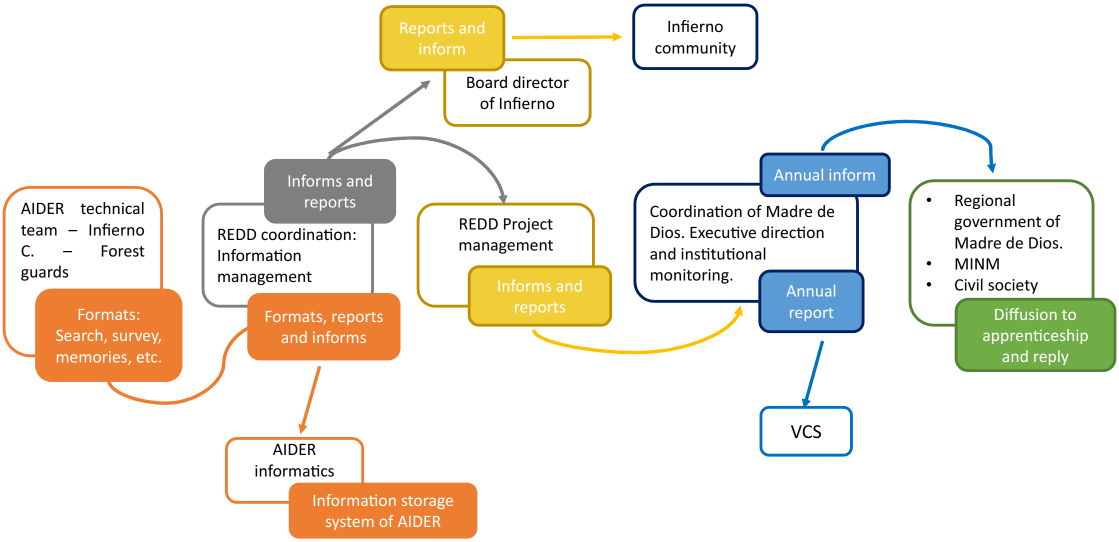

Figure 22. Information flux scheme of monitoring

VII. Results of the project

From a participatory process, this experience has achieved the following results:

- Project Desin Documents (PDD) one under the VCS Standard; the other under CCB Standard.
- Instruments to the forest management as the REDD strategy Guide to conflicts resolution, Training Plan and Communication Plan.
- Diagnosis of the productive potential of community forests and silvicultural treatment required to ensure their conservation, with which it was designed and developed a multi-purpose forest management plan for timber and non-timber forestry (Mauritia flexuosa). Added to this, the ecosystem service of carbon storage was valued by the REDD + mechanism, thereby increasing the opportunity cost of forest stands in relation to the practices of traditional unsustainable management in the community.
- For the period from 2011 – 2012 the avoided deforestation is about 133.3 hectares, which is the equivalent to 42,631.65 carbon credits for net GHG emission reduction.
- According to the REDD strategy, Infierno has decided to invest income from the sale of carbon into sustainable economic activities such as agroforestry, ecotourism, among others.

VIII. Challenges and lessons learned

- Along the process of the project design, one of the challenges was to effectively communicate the mechanism of a REDD* project to the different actors involved. Comprehensively, they expressed fear and distrust to the possibility that this kind of project excludes their economic activities (agriculture or wood extraction).

- Valuing the losses and benefits of forest management, as well as of the REDD+ mechanism, with real occurrence, strengthen the decision to conserve forests.

IX. Next steps

- The verification of GHG emission reduction for the period 2012 – 2013.
- Establish agreements with buyers to sell the carbon credits generated from the project.
- Continue strengthen the work of forest custodian and the Management Committee of the REDD+ project.
- Keep the link between community forest management and the activities of the REDD+ project in order to generate larger co-benefits.

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REDD+ Project "Forest management to reduce deforestation and forest degradation in Shipibo Conibo and Cacataibo indigenous communities in the Ucayali region."

Luz Nadir Valdivia Marquez

SUMMARY

This experience describes the REDD+ project "Forest management to reduce deforestation and forest degradation in Shipibo Conibo and Cacataibo indigenous communities in the Ucayali region." It involved the participation of the beneficiary communities of: Callería, Flor de Ucayali, Roya, Curiaca, Pueblo Nuevo, Sinchi Roca and Puerto Nuevo, in Ucayali department. The development of this project was funded by the International Tropical Timber Organization (ITTO). AIDER developed and implemented the project design document REDD + project (PDD) under the VCS (*Verified Carbon Standard*) and CCB Standards (*The Climate, Community and Biodiversity Standards*) standards.

This REDD + initiative has born for the vulnerability of the permanence of forest resources in the territory of these communities. The main agents of deforestation and degradation of forests are communal agricultural activities and unplanned logging.

In this section is presented the experience of the carbon reference scenario of this project, prepared under the VCS standard, with which it was determined that the REDD+ project is expected to avoid an annual average of 569,938.6 tCO2-e net emissions for the first 10 year period; considering that with the first control, a total 410,335 VCUs[70] have been verified (period 2011-2013). In addition, with the application of the CCB standard, it is expected that REDD+ generates social skills for the managing of the natural resources by both, authorities and villagers.

The development of this publication is based on the systematization (2010 - 2013) of the design, implementation and monitoring of the project, which is an explanatory summary of the project design documents under the VCS[71] and CCB[72] standards; as well as their management documents "Strategy for the reduction of deforestation and forest degradation", their main management instrument.

[70] Verified Carbon Units
[71] AIDER (2014b)
[72] AIDER (2014b)

PROJECT BACKGROUND

This experience has its foundation in 1999, under a strategic partnership between the Association for Research and Integrated Development (AIDER), the Regional Organization AIDESEP Ucayali (ORAU) and the Netherlands Development Organization (SNV). With funding from the Royal Embassy of the Netherlands, the "Community forest conservation in the Peruvian Amazon" project was implemented with the purpose of "contributing to the conservation of tropical rainforests belonging to 22 indigenous communities in Ucayali region" (1999-2003), as well as the "*Jemabaon nii*, community forest management" project, implemented with the purpose of "contributing to the conservation of the Amazon forests and the development of indigenous communities" (2004-2005). These projects laid the technical and social foundations, establishing the guidelines for forest management with the native Amazon communities through forest utilization (timber and non-timber), agroforestry, crafts and management of the fish resource.

From 2000 to 2003 these projects achieved strengthening the indigenous organization within communities, federations and regional organizations, the development of the socio-economic diagnosis, communal life plans, forest assessments, forest management plans and the knowledge of forest harvesting for self-consumption.

Figure 1. Forest resources diagnosis

From 2004 to 2005 five communities achieved the approval of their general forest management plans and their respective operational annual plans, they also performed forest harvesting. In 2005, they gain access to the voluntary forest certification (VFC) under the principles and criteria of the Forest Stewardship Council (FSC) and the forest stewardship of AIDER. This was the first voluntary forest certification for timber in Peru. From 2006 to 2010 the communities continued the implementation of the forest management plans under the technical assistance of the forest stewardship of AIDER. Is on 2010, that the communities begun activities oriented adecuate the the sustainable forest management of forest as a strategy for implementing the REDD + mechanism.

I. Location and characterization of the communities

The REDD+ project is being implemented in seven communities: Callería, Flor de Ucayali, Curiaca, Pueblo Nuevo, Roya, Puerto Nuevo and Sinchiroca, that belong to the districts of Irazola, Masisea, Callería and Iparia, found in the provinces of Padre Abad and Coronel Portillo, in the Ucayali region; and to the districts of Codo de Pozuzo, Puerto Inca and Tournavista, in Puerto Inca province, in the Huánuco region.

The land rights of the Native Communities comprise a total of 142,247.5 hectares.

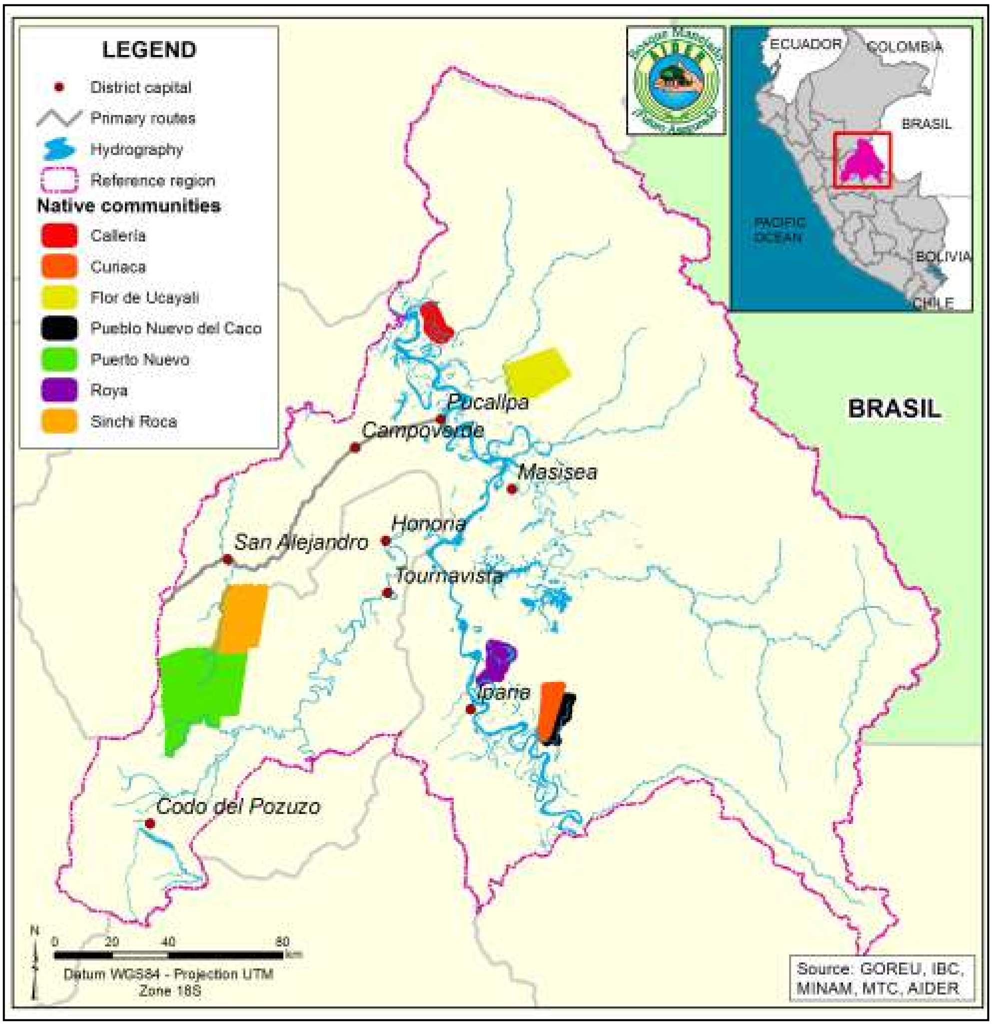

Figure 2. Location map of the 7 native communities that participate in the REDD+ project

1.1. Biophysical characteristics

A) Climate, temperature and precipitation

The climate is warm, humid and rainy for most of the year. The abundant rainfall reaches an annual average of 2,000 mm and it varies throughout the year, with relatively dry periods between July and August and heavy rainfall between November and March. The average temperature varies between 19.7 °C and 30.6 °C; the maximum is registered between May and August and the minimum between December and March.

B) Hydrography

Numerous rivers cross the area forming several watersheds with different volumes of water. The main river is the Ucayali River, which has a winding course that runs from south to north, turbid waters due to the presence of sediment, abundant and powerful water flow, an average speed of three knots, 1771 km of length and a variable width, and numerous islands and islets present throughout its length.

C) Ecology

According to the Ecological Map of Peru[73], the following life zones are present in the area covered by the project, INRENA (1994), (cited by AIDER (2014b):

- Tropical Premontane rain forest (transition to Tropical wet forest)
- Tropical Premontane moist forest (transition to Tropical moist forest)
- Tropical moist forest
- Tropical moist forest (transition to Tropical Premontane wet forest)
- Tropical moist forest (transition to Tropical Premontane moist forest)
- Tropical Montane wet forest
- Tropical Premontane wet forest
- Tropical Premontane wet forest (transition to Tropical moist forest)
- Tropical Premontane wet forest (transition to Tropical Premontane rain forest)
- Tropical wet forest
- Tropical wet forest (transition to Tropical Premontane rain forest)
- Tropical Lower Montane rain forest
- Tropical Montane rain forest
- Tropical Premontane rain forest

[73] INRENA (1994); as quoted by AIDER (2014b)

D) Biological Diversity

Different studies were compiled for the biodiversity analysis, such as: biodiversity registers available for the area, native communities management plans, monitoring programs, environmental impact studies and documents generated by baseline studies for the ecological and economic zoning of Ucayali region. Fieldwork also took place for the collection of information, as well as some interviews and the latter analysis of all the information obtained. This resulted in the registry of the flora and fauna species found in the project area, making a total of 166 species of flora, mainly arboreal; and 257 species of wildlife, between amphibians (55), reptiles (44), mammals (57) and birds (101).

Tables 1 and 2 list the main flora and fauna species that are considered threatened in the project area.

Table 1. Threatened flora species present in the project area

Specie	Family	D.S 043-2006-AG
Fabaceae	*Amburana cearensis*	Vulnerable
Arecaceae	*Astrocaryum huicungo*	Almost threatened
Meliaceae	Cedrela odorata	Vulnerable
Bombacaceae	*Ceiba samauma*	Almost threatened
Cannabaceae	*Celtis iguanae*	Critical danger
Moraceae	*Clarisia biflora*	Almost threatened
Moraceae	*Clarisia racemosa*	Almost threatened
Fabaceae	*Copaifera paupera*	Vulnerable
Euphorbiaceae	*Croton draconoides*	Almost threatened
Sapotaceae	*Manilkara bidentata*	Vulnerable
Celastraceae	*Maytenus macrocarpa*	Almost threatened
Bignoniaceae	*Tabebuia incana*	Vulnerable
Bignoniaceae	*Tabebuia serratifolia*	Vulnerable

Source: AIDER (2014b), DS 043-2006-AG

Table 2. Main fauna species in the project area, according to their conservation status (IUCN International Classification of national classification of MINAGRI)

Order	Family	Specie	IUCN Conservation status	DS. 004 -2014-MINAGRI
Artiodactyla	Cervidae	*Mazama americana*	DD	*DD*
Artiodactyla	Tayassuidae	*Tayassu pecari*	VU	*NT*
Carnivora	Felidae	*Panthera onca*	NT	*NT*
Carnivora	Felidae	*Puma concolor*	LC	*NT*
Cingulata	Dasypodidae	*Priodontes maximus*	VU	*VU*
Perissodactyla	Tapiridae	*Tapirus terrestres*	VU	*NT*
Pilosa	Myrmecophagidae	*Myrmecophaga tridactyla*	VU	*VU*
Primates	Atelidae	*Ateles chamek*	EN	*EN*
Primates	Atelidae	*Lagothrix lagotricha*	VU	*EN*
Rodentia	Dinomyidae	*Dinomys branickii*	VU	*VU*
Galliformes	Cracidae	*Mitu tuberosum*	LC	*NT*
Galliformes	Cracidae	*Pipile cumanensis*	VU	*NT*
Psittaciformes	Psittacida	*Ara chloroptera*	LC	*VU*

Source: AIDER (2014b)

Where:
VU=Vulnerable, LC=Least concern, NT=Near threatened, DD=Insufficient data, CR=Critically endangered, EN=Endangered, LR/cd = Lower risk, conservation dependent.

1.2. Socio-economic characteristics

The seven native communities that make up the project belong to two ethnic groups in the Peruvian Amazon. The communities located near the Ucayali river belong to the Shipibo Conibo ethnic group, while the communities located riverside of the San Alejandro river belong to the Cacataibo ethnic group.

From the rapid participatory assessments – RPA, developed by the implementation team of the project[74], relevant information was obtained concerning the socioeconomic situation of each native community.

A) **Callería Native Community.** Shipibo Conibo ethnic group, has a population of 307 inhabitants (51% are male and 49% female). It consists of 66 families, with an

[74] AIDER (2014b)

average number of 4 children each. The population density is of 0.076 inhabitants/km^2 of their total territory. The main economic activities are fishing, agriculture and logging.

B) **Flor de Ucayali Native Community**. Shipibo Conibo ethnic group, has a population of 92 inhabitants (52% are male and 48% female). It consists of 22 families, with an average number of 3 children each. The population density is of 0.084/km^2 of their total territory. The main economic activities are fishing, agriculture and logging.

C) **Puerto Nuevo Native Community.** Populated by the descendants of the Cacataibos ethnic group, has a population of 476 inhabitants (57% are male and 43% female). It consists of 93 families. The main economic activities are fishing, agriculture, crafts and forest use (timber and non-timber).

D) **Sinchi Roca Native Community.** Populated by the descendants of the Cacataibos ethnic group, has a population of 443 inhabitants (51.8% are male and 48.2% female). It consists of 106 families. The main economic activities are fishing, agriculture, crafts and forest use (timber and non-timber).

E) **Curiaca Native Community.** Populated by the descendants of the Shipibo Conibo ethnic group, has a population of 483 inhabitants (49% are male and 51% female). It consists of 66 families. The main economic activities are fishing, agriculture, logging and crafts.

F) **Pueblo Nuevo Native Community.** Populated by the descendants of the Shipibo Conibo ethnic group, has a population of 476 inhabitants (57% are male and 43% female). It consists of 93 families (2013 census, in AIDER 2014). The main economic activities are fishing, agriculture, logging and crafts.

G) **Roya Native Community.** Populated by the descendants of the Shipibo Conibo ethnic group, has a population of 440 inhabitants (49% are male and 51% female). It consists of 95 families. The main economic activities are fishing, agriculture, logging and crafts.

Figure 3. Shipibo woman kneating as a part of her economic activity

II. Problematic

For Latin America, a net loss of 88 million hectares of forest (9% of the total forest area) was registered between 1990 and 2010; the main cause of deforestation was agricultural expansion and conversion of forests to pastureland. If this rate of forest degradation continues, Latin America will run out of forest area in about 220 years (FAO, 2012).

In Peru, deforestation is due to illegal logging, agriculture and mining, activities that account for 150,000 hectares of forest loss per year. Deforestation processes are driven by different variables, including the insufficient control over the use of the forest resource, the lack of monitoring, and the agents and drivers of deforestation. Besides considering that opportunity cost promotes land-use change from forest to agriculture due to higher incomes, it is also a threat to forest conservation. This way, forest management must be complemented by activities that add to the forest management cycle, thus providing a greater economic value to the forest.

The main agents of deforestation that were identified are: farmers (67%); loggers (60%); and livestock (13%). Also, the variables that drive deforestation and that explain its reasons and its extent, are: rural wages, prices of agricultural products, timber prices, access to credit and subsidies; and the variables that explain the location where deforestation takes place are: proximity to roads and navigable rivers, fertility/physiography of the area, proximity to existing populated areas, ownership of the land and security in the possession of the land.

Deforestation generates environmental and social impacts especially, and more directly through when are the people who depend on the resources that are lost as a result of deforestation. In the case of indigenous communities, the impact is enormous, since they base their activities in the use of resources from the forest (wildlife, fruits, medicinal plants, rural construction elements, etc.).

Figure 4. Shipibo mother

III. Project design

3.1. Conceptualization and pre-feasibility evaluation of the project

Considering the problems identified in the area of the project, especially the pressure over the forests by the various ways of land use change, the need to develop a project that would help in the conservation of the forest resources and at the same time provide benefits for the communities involved, was identified.

Consequently, AIDER developed the project idea note (PIN), and through secondary information, determined that in the absence of a project like the one proposed to preserve the forest resources, pressure over them would increase and thus displace them for other land uses (agriculture, livestock, illicit crops), which would affect the communities living in the surrounding areas on a short period of time. On the other hand, if there was a project for the conservation of the forest resources that used mechanisms designed for this purpose as well as the active participation of the benefited communities (native communities in this case), the results obtained would be the following: populations trained in conservation and monitoring of resources, conservation of the resource of interest and payment for ecosystem services; having community forest management as a main activity, in which some of these communities have a voluntary certification under the FSC principles and criteria. So it was considered that the REDD + project turns out to be social, climatic and economically viable in the scope of the study.

Figure 5. Presenting the project to the communities

Finally, the idea of the project was concretized with the development of the REDD+ project "Forest management to reduce deforestation and forest degradation in Shipibo Conibo and Cacataibo indigenous communities in the Ucayali region" executed by AIDER, with funding from the International Timber Tropical Organization - ITTO. The communities were selected to form a part of the REDD+ project for having forest areas to preserve, for posing a threat to the conservation of the forest resources and for taking initiative in forest management.

The purpose of this project is to contribute with climate change mitigation while generating social benefits, and with these actions the project is expected to avoid an average net emission of 564,818.6 tCO2-e per year during the first period of 10 years.

Figure 6. Community forests with initiatives in forest management

3.2. Design

The project area is located in the regions of Ucayali and Huánuco, covering a total of 127,004 hectares of forest for 2010 (year in which the REDD+ project started) of seven native communities.

According to item 3.1, it was determined that a REDD+ mechanism type of project was to be implemented in the area of the native communities. Such projects, through the use of policies and incentives, aim to reduce the emissions caused by deforestation and forest degradation and support the conservation of the existing forest carbon stocks, as well as encourage a sustainable forest management and the increase of forest carbon stocks in developing countries.

The objective of the REDD+ project is to avoid CO2-e emissions due to unplanned deforestation, allowing the conservation of biodiversity and improving the quality of life of the communities participating in the project.

3.3. Participants

The REDD+ project was developed under the project RED-PD 033/11 Rev.3 (F) “Revaluation of environmental services in managed forests of 7 native communities in the Ucayali region”, which was funded by the International Tropical Timber Organization (ITTO).

The main participants of the REDD+ Project are described in table 3.

Table 3. REDD+ project participants

Participants	Roles/Commitments	Benefits
Native Communities in the regions of Ucayali and Huánuco.	In charge of the implementation of the project according to what is stated in the REDD+ strategy. This strategy is implemented through an annual work plan for each community. As the owners of the VCU generated by the project, they will be the ones making the commercialization decisions.	Compensation for ecosystem services.
Association for Reasearch and Integrated Development (AIDER) – Technical advisor	Implementation of the project and development of the Project Design Document (PDD) of the REDD+ project, under the VCS y CCB standards. They are responsible for the Monitoring, Reporting and Verification (MRV) for the whole project and for each community, as well as the technical advisors on the implementation of the REDD strategy.	Achievement of their strategic objectives.
International Tropical Timber Organization (ITTO)	In charge of the funding of the project.	Achievement of their strategic objectives.
Supervising committee conformed by: Gerencia de Recursos Naturales del Gobierno Regional de Ucayali (GOREU), Organización Regional AIDESEP Ucayali (ORAU), and Instituto Regional de Comunidades Nativas (IRDECON).	Supervise the work performed by the executive committee and the technical advisor.	Fulfillment of the functions of the supervising committee.

Figure 7. Permanent information about the REDD + project among stakeholders

Figure 8. Acknowledgement of the forest management activities that are part of REDD+ projects

3.4. Project Design Document (PDD) elaboration

Given the characteristics of the project, the projected scale for the carbon benefits, location and applicability, with the available methodologies for REDD+ projects, the use of the Verified Carbon Standard (VCS) and the Climate, Community and Biodiversity (CCB) standard was considered.

A) Temporal limits

- ***Start and end dates of the historical reference period;*** in the case of this REDD+ project, have the years 2000 and 2010 marked as the beginning and end of the historical reference period (10 years) of the project, respectively.

- ***Start and end dates of the credit period;*** the beginning and end of the credit period of the project will range from the 1st of July of 2010 up to the 30th of June of 2030, making a total of 20 years.

- ***First established period for the reference scenario;*** the period established for the reference scenario is 10 years, beginning on the 1st of July of 2010 until the 30th of June of 2020.

- ***Monitoring period;*** for this project, the first monitoring period took place between 2010 – 2013.

B) Spatial limits

- ***Reference region***; is the defined area considering its biophysical and socioeconomic characteristics, which must be similar to the ones of the project area. In addition, it should be considered that the reference region will be the area according to which the historical deforestation and projections will be determined. It is advisable to use the political boundaries as criteria to determine the reference region, as demographic information (input to calculate the rate of future deforestation) is given according to political boundaries. The reference region for the REDD+ Project is 4,735,649.4 hectares.

- ***The project area;*** for this REDD+ Project, the total area covered by the project is of 127,004 hectares. Table 4 shows the forest area in each native community involved in the REDD+ project.

Table 4. Project area within every native community involved in the project

Native community	Forest area (ha)	With VFC under the P&C of the FSC
Callería	3,718.8	Yes
Curiaca	5,901.9	Yes
Flor de Ucayali	19,650.2	No
Pueblo Nuevo del Caco	4,422.4	Yes
Roya	4,165.8	Yes
Puerto Nuevo	61,517.5	No
Sinchi Roca	27,627.4	No
Total (ha)	**127,004.0**	-

Source: AIDER (2014a)

- ***Leakage belt area***, is of 54,837.9 hectares.

- ***Leakage management area***, is of 1,209.2 hectares.

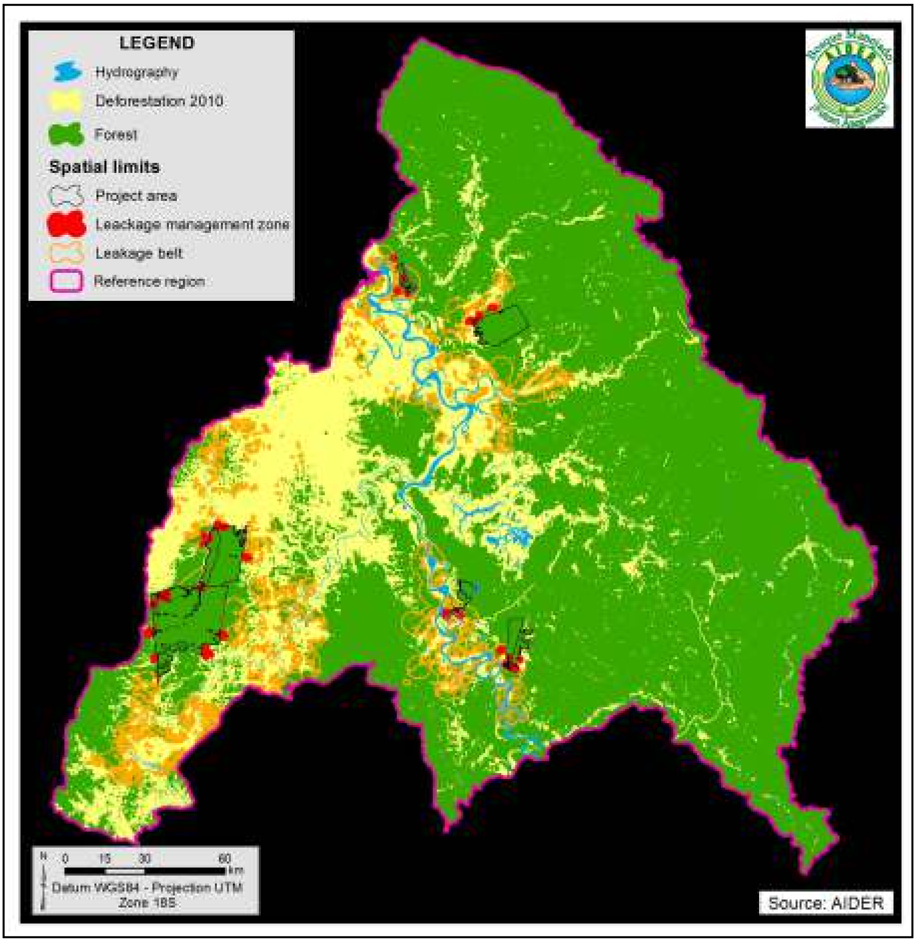

Figure 9. Map showing the spatial limits of the REDD+ project

C) Methodology

Once the pre-feasibility study of the project was concluded, and the activities to be implemented and the participants to be involved in the project have been defined, the standard and methodology for the development of REDD+ project were subsequently defined. For the development of the project design document (PDD), the VCS standard was used and the parameters of the VM0015 methodology version 1.1 were followed; in these, the production of the forest carbon baseline stands out, which allows estimating the amount of emissions that could be avoided and the amount of VCUs to be generated during the reference scenario.

Regarding the CCB Standard, the social and biodiversity impact assessment (SBIA) manual for REDD+ projects was used (Part 1: Core guidance for project proponents and Part 2: Social impact assessment toolbox). As a result, a document focused on the benefits for communities, climate and biodiversity was obtained.

Figure 10. Workshops with the key stakeholders

IV. Deforestation and avoided emissions estimate

4.1. Historic deforestation

The historical deforestation analysis was performed with the use and interpretation of Landsat 5TM satellite images, this analysis was performed for the entire reference region for the years 2000, 2005 and 2010. See table 5 and figure 11.

Table 5. Forest and non-forest cover for the reference region

Year	Type of cover Surface area (ha)			Reference region total (ha)
	Forest	Non forest	Water	
2000	3,985,811.4	653,016.1	96,821.9	4,735,649.4
2005	3,880,638.7	758,188.8	96,821.9	4,735,649.4
2010	3,716,712.9	922,114.6	96,821.9	4,735,649,4

Source: AIDER (2014a)

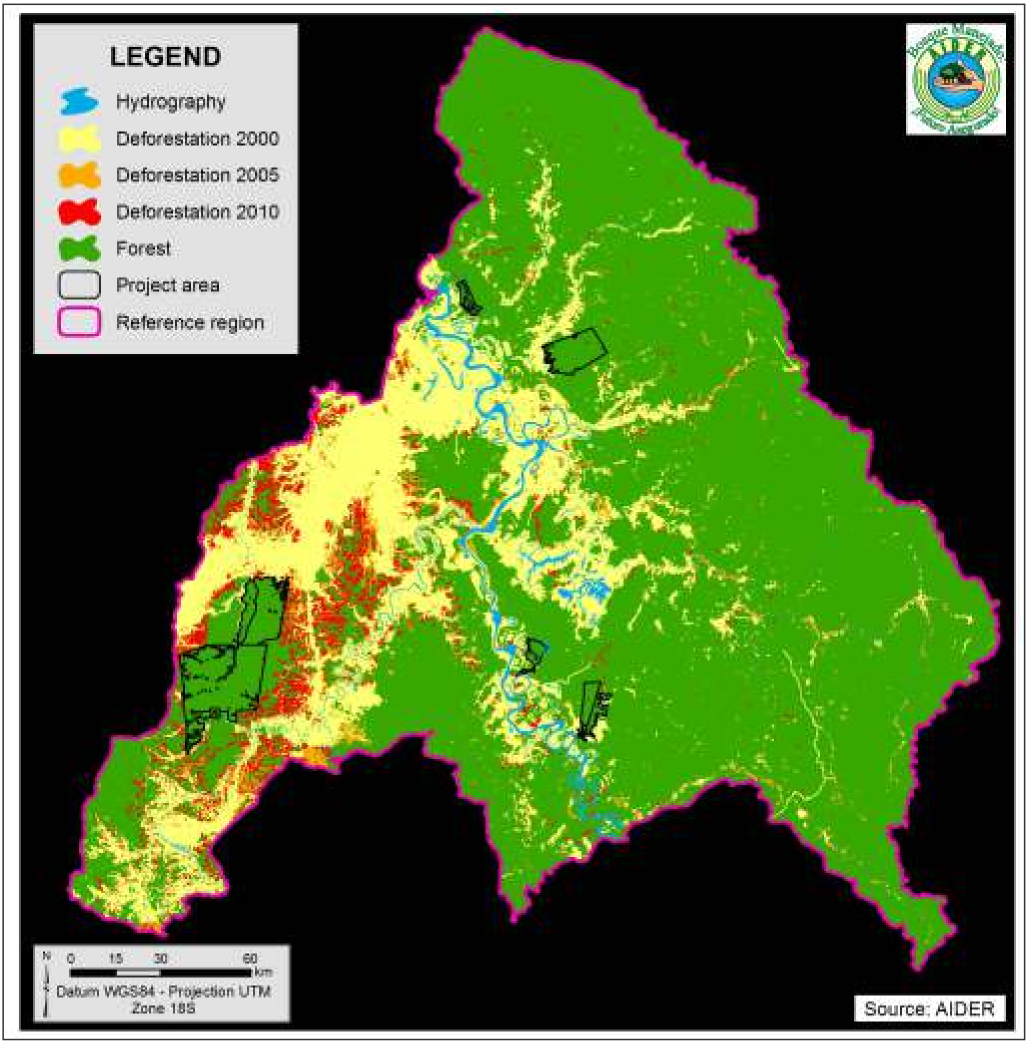

Figure 11. Historical deforestation map (2000, 2005 and 2010)

4.2. Carbon content estimate

The carbon content estimation was performed through a carbon inventory, which was exploratory with an optimum stratified sampling design and a random systematic distribution of plots, the ones that were located in the vegetation types identified in the project area. The inventory was conducted in the years 2011, 2012 and 2013, evaluating a total of 104 plots in forested areas.

Field measurements focused only on aerial biomass, while the underground biomass was estimated using the "aerial biomass/underground biomass" ratio. This ratio was used only for huasaí, ungurahui, aguaje and all palm trees in general; as for woody species, allometric equations were used according to each type of forest.

Figure 12. Forest carbon inventory activities

Figure 13. Participation of community members in the forest carbon inventory

The allometric equations used to quantify carbon content were obtained from different literature sources. The equations used to calculate biomass above and below ground are the same as presented in Table 5 of the REDD+ Project "Evio Kuiñaji Ese'Eja Cuana to mitigate climate change, Madre de Dios – Peru." (p. 193), are unprecedented for use carbon projects, as validated by standards like the VCS.

The detailed carbon content found for each layer in the project area and leakage belt area can be seen in table 6 and figure 14.

Table 6. Existing carbon content per hectare for every type of forest found in the project area and in the leakage belt area

Types of forest	Aerial storage (tC/ha)	Aerial storage (tCO_2-e)	Underground storage (tC/ha)	Underground storage (tCO_2-e)	Total (tC/ha)	Total tCO_2-e
Complex riverbank forests	134,34	492,57	35,35	129,60	169,68	622,18
Low terrace forest	81,20	297,74	20,53	75,29	101,73	373,02
Medium terrace forest	117,62	431,26	29,76	109,11	147,37	540,37
High terrace forest	104,24	382,21	33,50	122,82	137,73	505,02
Hillock forest	110,22	404,14	31,25	114,57	141,47	518,71
Low hill forest	136,75	501,41	34,31	125,79	171,05	627,20
Medium hill forest	96,90	355,28	25,36	93,00	122,26	448,28

Source: AIDER (2014a)

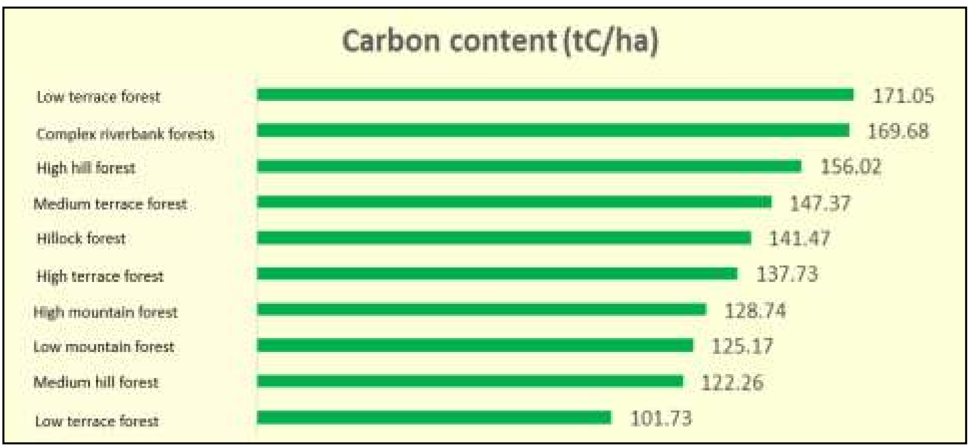

Figure 14. Carbon content per forest type and stratum type

4.3. Deforestation rate

To determine the deforestation rate, it was decided to use the modeled approach, which states that, in order to calculate the deforestation rate of the reference scenario, one-variable models are to be used. For this project, population was chosen as the variable driving deforestation. In that sense, population density and forest area for the historical reference period were used in three types of models, choosing the model that presented the best fit results, which for this case was the exponential model.

Exponential equation: $\mathbf{Y = 5(10)^6 e^{-3,453X}}$

Where:

Y : Forest cover

X : Population density

With R^2 = 99.53%

When the selected equation was applied, the results shown on table 7 were obtained, in which the increase in the annual future deforestation rate can be noted.

Table 7. Projected deforestation rate

Year	Rate (Exponential equation)
2011	1.14%
2012	1.19%
2013	1.23%
2014	1.28%
2015	1.33%
2016	1.38%
2017	1.43%
2018	1.48%
2019	1.54%
2020	1.60%

Source AIDER (2014a)

4.4. Projected deforestation

In order to obtain the future deforestation geospatial projection, it was necessary to have the following inputs and tools:

- Maps of forest and non-forest cover for the historical period (2000, 2005 and 2010).
- Variables that are considered to influence the process of deforestation (cartographic information to generate the factor maps, for example: protected areas, roads, hydrography, and populated areas, among others).
- Future deforestation rate (calculated using the selected approach).
- Modeling Software (EGO Dinámica).

Forest and non-forest cover maps for the historical period are important inputs as they allow determining a pattern in cover change

As for the variables considered to influence the deforestation process, all of those that could have an influence on deforestation for being present in the reference region, whether increasing it or preventing the change from happening, were collected. In this search, official sources such as Regional Governments, the Ministry of Education, the Ministry of Transport, the Ministry of the Environment and Geological Mining and Metallurgical Institute, among others, were consulted. See figure 15.

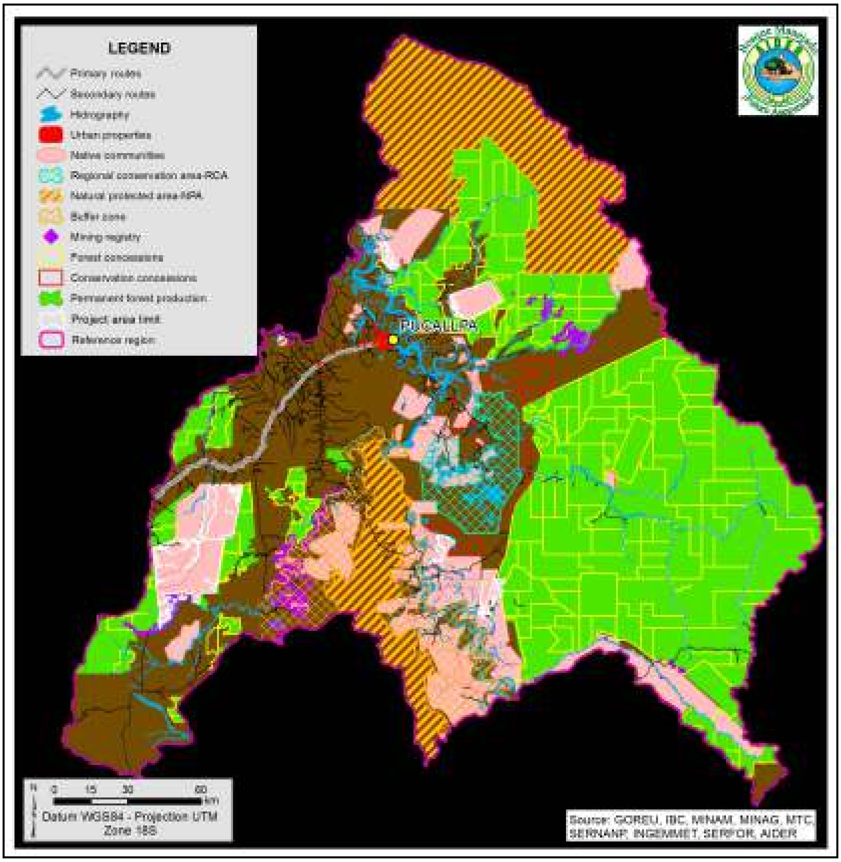

Figure 15. Map showing the land occupancy of the reference region

Having defined the variables, as well as the type of cover (forest and non-forest areas) maps for the historical period (2000, 2005 and 2010), and with the development of the change from forest to non-forest cover matrix using the "EGO Dinámica" software, the development of risk maps, indicating the probability of deforestation happening in a particular place, were generated. This process allows the calibration of the model, which will be used to project the location of future deforestation (See figure 16).

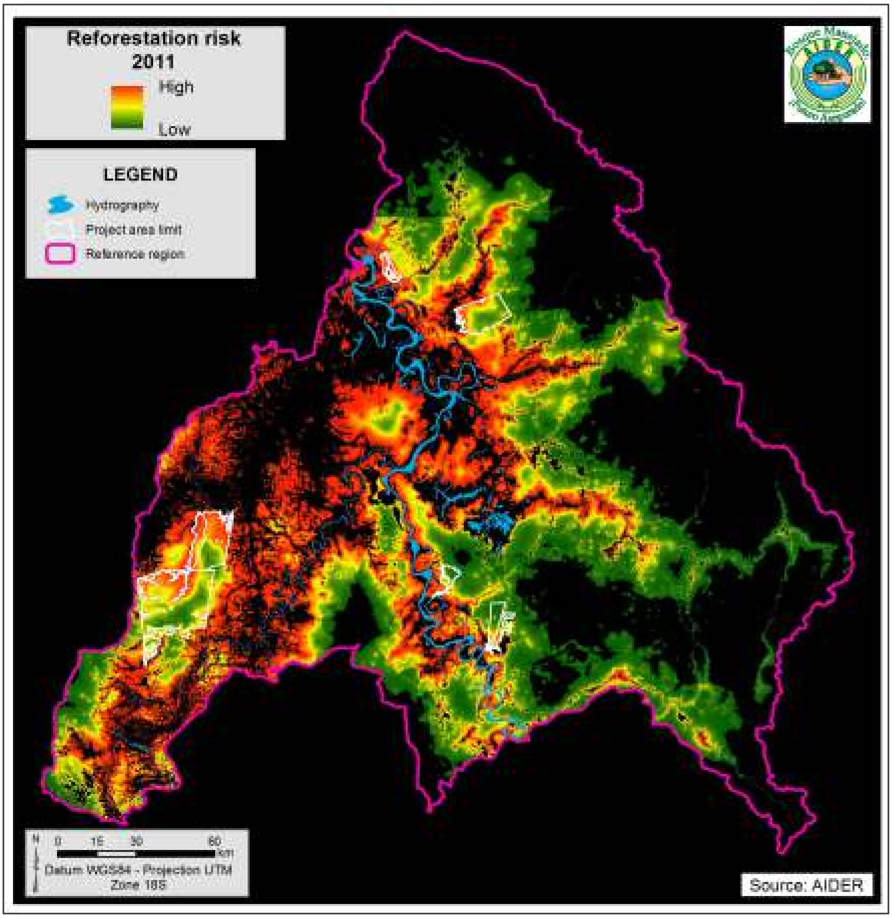

Figure 16. Map showing the deforestation risk for the year 2011

Having calibrated and validated the model, in addition to the projected deforestation rate, other maps representing the areas most likely to be deforested on the reference scenario period for the project were subsequently generated. (See figures 17 and 18)

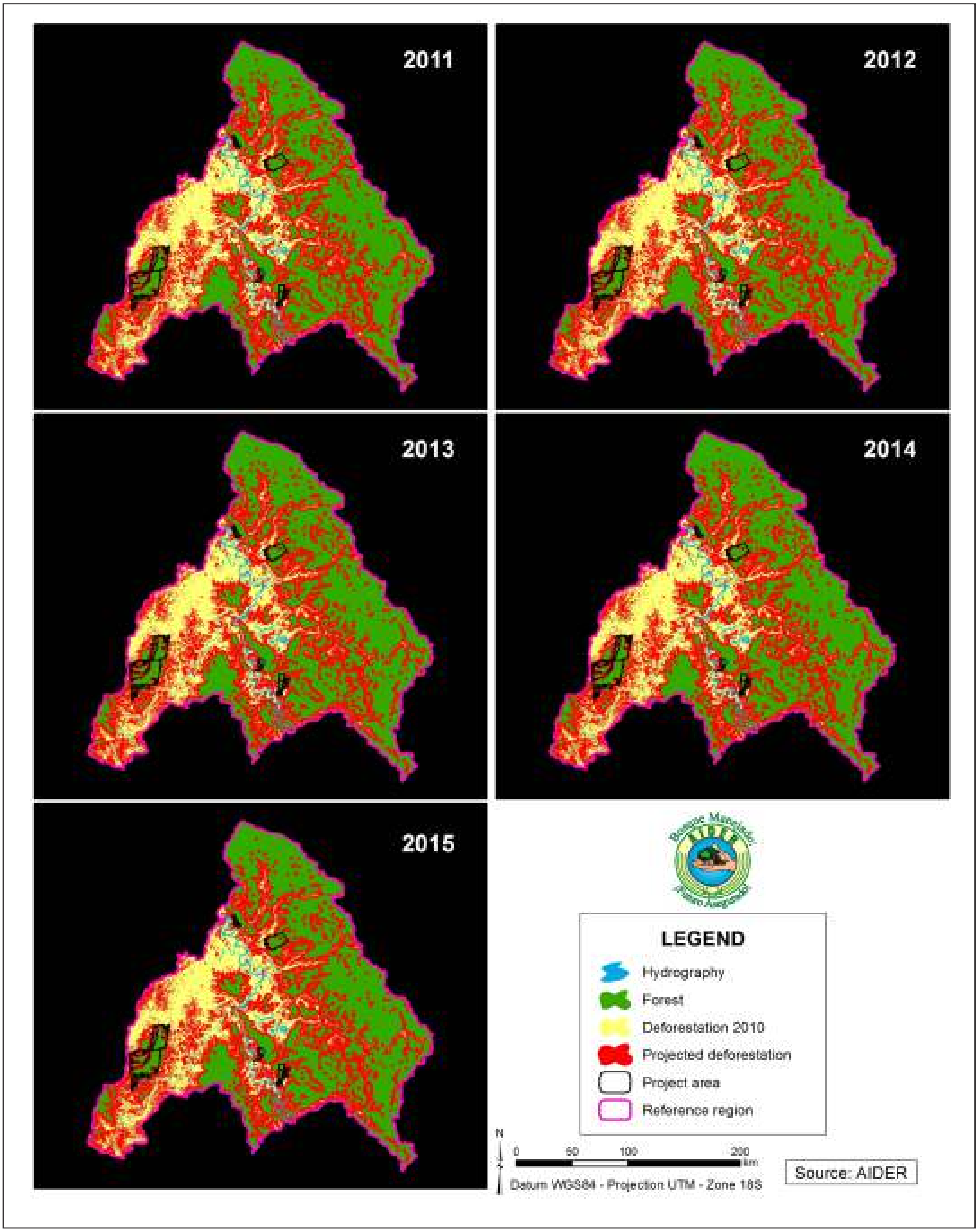

Figure 17. Projected deforestation for the reference region (2011 through 2015)

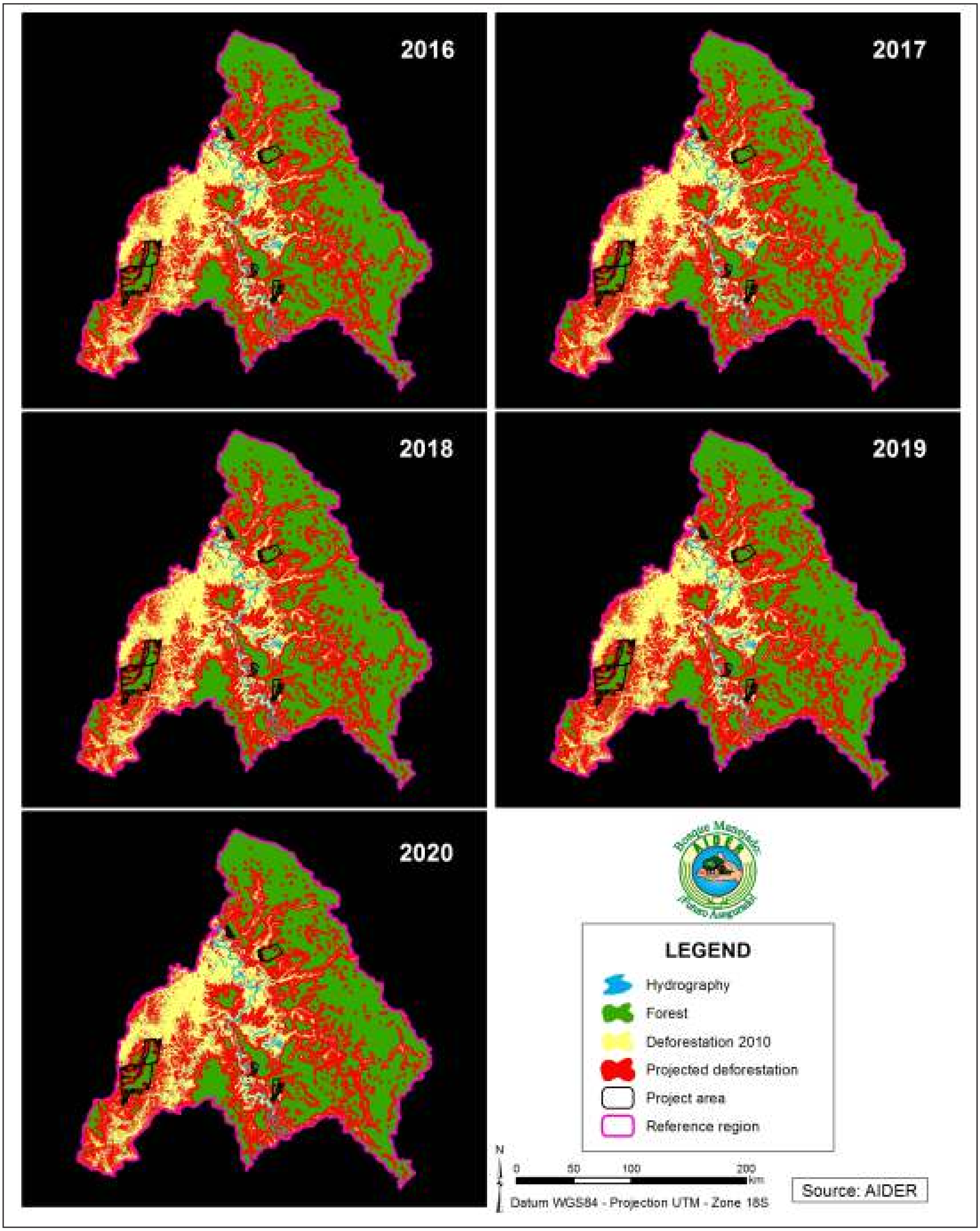

Figure 18. Projected deforestation for the reference region (2016 through 2020)

In figures 19 and 20 show the contrast between the total accumulated deforestation up to the starting year of the REDD+ project (year 2010) and the projected deforestation expected for the end of the reference scenario period (year 2020). With this comparison, it is estimated that there might be a loss of 18,260.3 hectares in the Project area and of 25,787.6 hectares in the leakage belt area in a scenario without the REDD+ project[75].

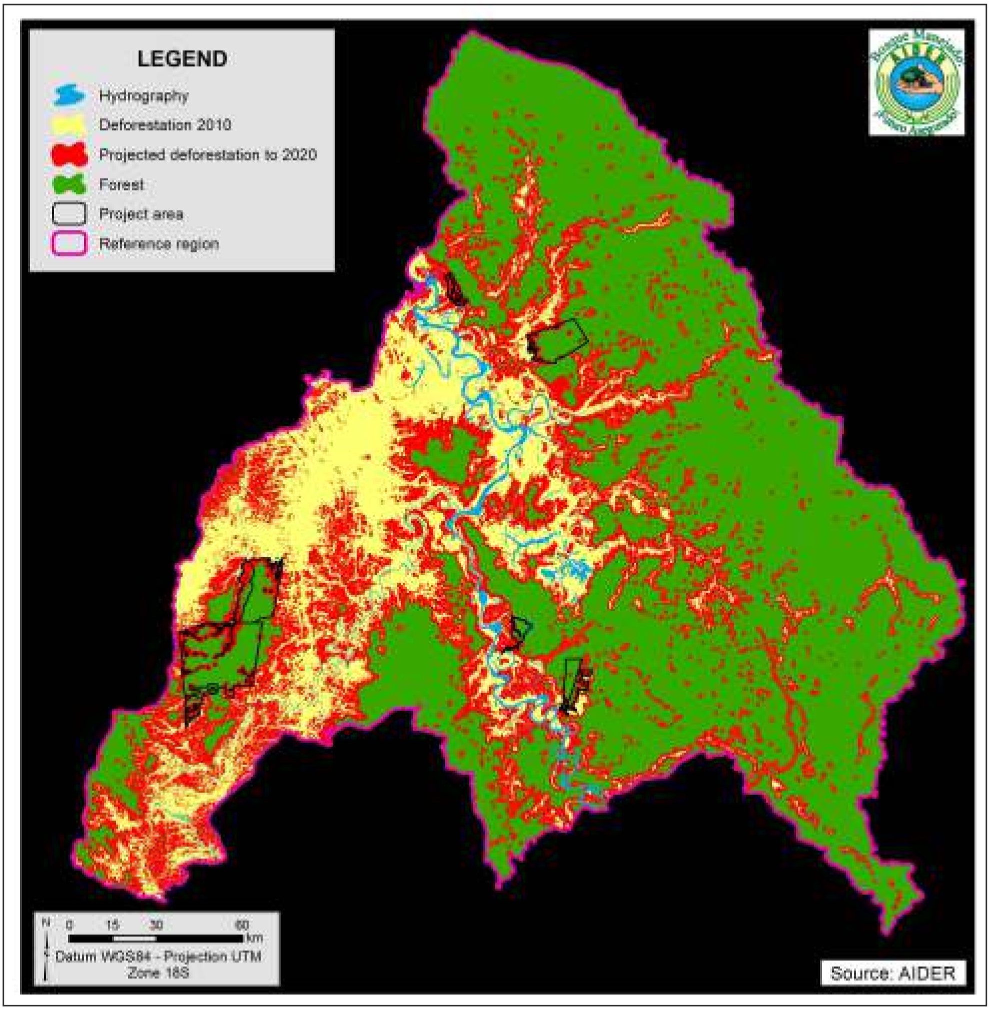

Figure 19. Map showing the total deforestation up to 2010 and the projected deforestation for 2020 in the reference region

[75] AIDER (2014a)

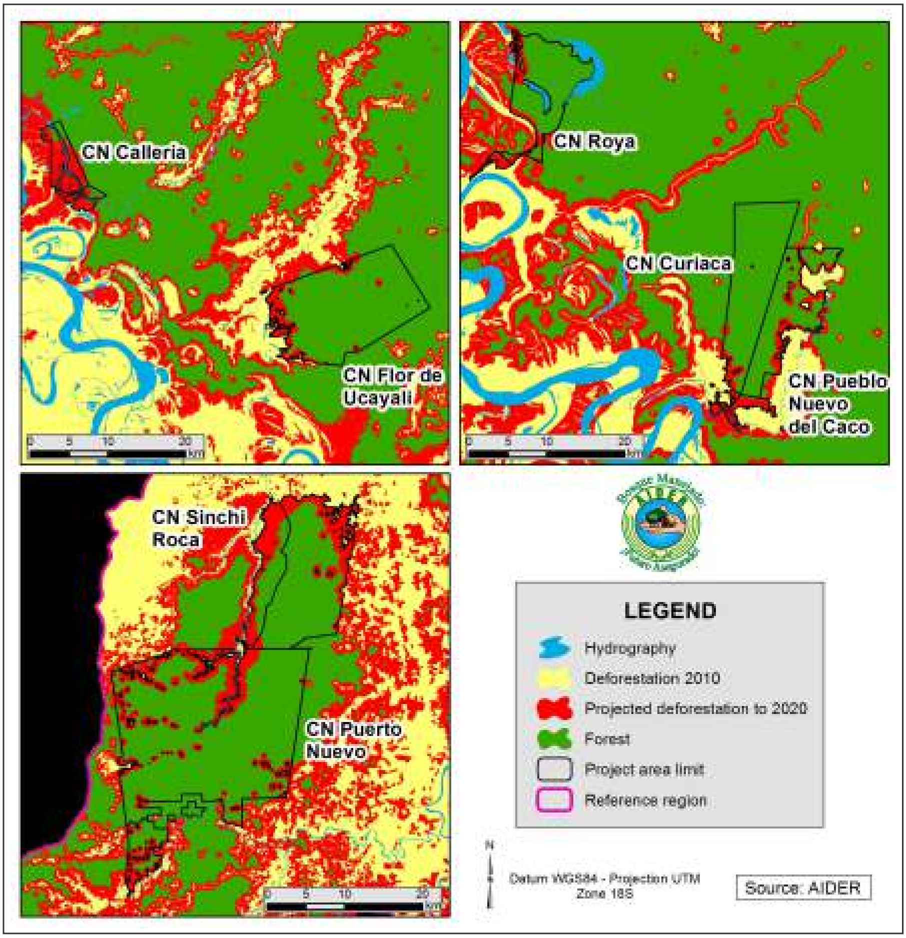

Figure 20. Map showing the total deforestation up to 2010 and the projected deforestation for 2020 in the project area

The results of the projected deforestation for the project area and leakage belt area can be seen in table 8. Having as the starting year of the REDD+ project 2010, and the ending year is 2020, the same as the final year of the reference scenario.

Table 8. Projected annual deforested areas (ex-ante)

Period	Deforestation (ha)	
	Project area	Leakage belt area
2010-2011	1,295.9	2,459.0
2011-2012	954.4	1,821.3
2012-2013	1,135.0	2,095.9
2013-2014	1,369.9	2,206.8
2014-2015	1,416.1	2,554.3
2015-2016	1,722.3	2,742.8
2016-2017	2,288.6	2,770.0
2017-2018	2,441.5	3,082.4
2018-2019	2,692.9	3,076.4
2019-2020	2,943.7	2,978.6

Source: AIDER (2014a)

The process followed to obtain the projected deforestation maps is shown in figure 21.

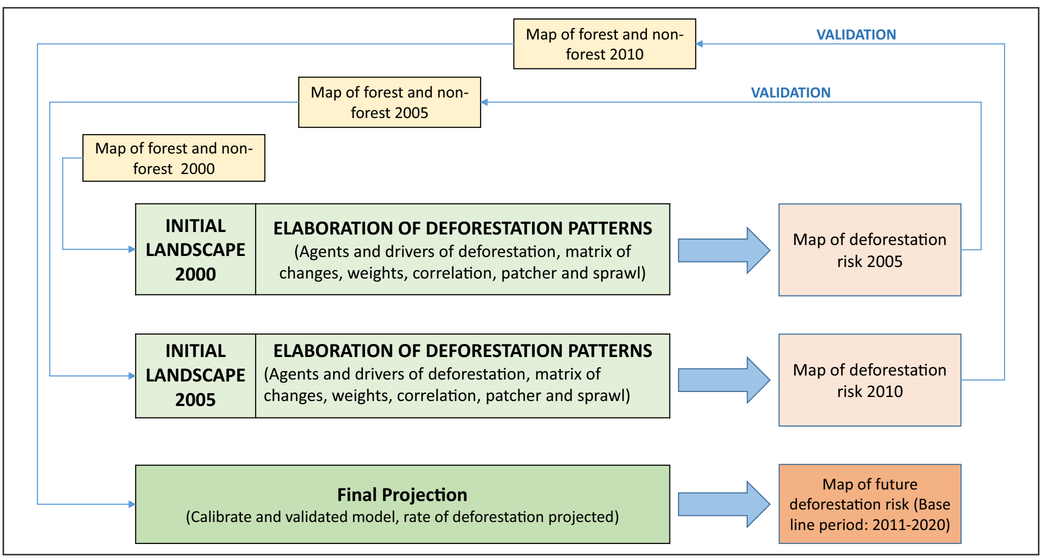

Figure 21. Flowchart illustrating the process for obtaining maps future deforestation

4.5. Avoided emissions estimate

The change in land use has consequences and impacts on the social, economic and environmental aspect, being the emission of greenhouse gases (GHGs) into the

atmosphere the main component of the latter. With the development of the REDD+ project, land use change is to be avoided, thereby avoiding the emission of CO_2-e.
To measure the efficiency of the REDD+ project in terms of emissions, the emissions to be avoided with the project in the reference scenario period were estimated. For this purpose, information on the amount of projected deforestation for each type of forest and the variation coefficients of carbon stocks for the initial forest classes (coefficients for aboveground and belowground biomass) were used; the result of this provides tCO_2-e emissions, which are presented in table 9.

Table 9. Estimated emission reduction or removal of CO_2-e on the project area

Year	Estimated emission reductions or removals		Estimated leakage emissions (tCO_2e) - iii	Net estimated emission reductions or removals of GHG (tCO_2e) - iv
	Reference scenario (tCO_2e) - i	Project (tCO_2e) - ii		
2010-2011	467,857.0	106 572.8	33,685.7	327,598.5
2011-2012	345,797.0	62 243.5	24,897.4	258,656.1
2012-2013	408,413.8	53 093.8	29,405.8	325,914,3
2013-2014	498,439.1	39 875.1	35,887.6	422,676.4
2014-2015	509,284.4	15 278.5	36,668.5	457,337.4
2015-2016	616,082.7	18 482.5	44,358.0	553,242.3
2016-2017	821,125.0	24 633.8	59,121.0	737,370.3
2017-2018	880,847.5	26 425.4	63,421.0	791,001.1
2018-2019	961,727.8	28 851.8	69,244.4	863,631.6
2019-2020	1,071,222.9	32 136.7	77,128.1	961,958.2
Total	**6,580,797.5**	**407 593.9**	**473,817.4**	**5,699,386.2**

Source: AIDER (2014a)

Where:

i= CO_2-e emissions in a scenario without a REDD+ project.
ii= CO_2-e emissions in a scenario with a REDD+ project.
iii= CO_2-e emissions due to leaks in a scenario with a REDD+ project.
iv= Estimate on the total tCO_2-e emissions to be avoided with a REDD+ project.

Table 10 shows the data used in the calculation of the amount of VCUs, for which the subtraction of the 13% of net annual emission reductions is performed, as this data comes to be the reservation of credits due to the non-permanence risk, calculated according to the non-permanence risk tool AFOLU (VCS version 3.2). The VCUs were also calculated for each native community that is part of the REDD+ project (See table 11 and figure 22).

Table 10. Voluntary carbon units (VCUs) – *ex ante*

Period	*Ex ante* Annual Total net GHG emissions reductions $\Delta REDD_t$ tCO_2-e	*Ex ante* buffer credits per year VBC_t tCO_2-e	*Ex ante* tradable VCUs per year VCU_t tCO_2-e
2010-2011	327,598.5	46,966.9	280,631.6
2011-2012	258,656.1	36,862.0	221,794.2
2012-2013	325,914.3	46,191.6	279,722.6
2013-2014	422,676.4	59,613.3	363,063.1
2014-2015	457,337.4	64,220.8	393,116.7
2015-2016	553,242.3	77,688.0	475,554.3
2016-2017	737,370.3	103,543.9	633,826.4
2017-2018	791,001.1	111,074.9	679,926.2
2018-2019	863,631.6	121,273.9	742,357.7
2019-2020	961,958.2	135,081.2	826,877.0

Source: AIDER (2014a)

Table 11. Voluntary carbon units per Native Community (ex – ante)

Years	Callería (tCO_2-e)	Flor de Ucayali (tCO_2-e)	Curiaca (tCO_2-e)	Pueblo Nuevo (tCO_2-e)	Puerto Nuevo (tCO_2-e)	Roya (tCO_2-e)	Sinchi Roca (tCO_2-e)
2010-2011	4,174.4	30,527.5	13,310.4	21,864.9	123,826.6	10,784.2	75,243.6
2011-2012	9,640.1	21,102.4	8,793.0	16,745.7	91,713.4	6,006.3	70,801.7
2012-2013	18,236.6	25,394.6	7,684.9	17,508.0	121,701.5	5,923.8	86,826.3
2013-2014	30,112.7	28,025.9	7,665.4	22,966.2	149,306.5	8,545.0	120,777.9
2014-2015	42,635.1	31,459.1	8,651.6	19,243.5	154,763.2	11,462.2	124,901.9
2015-2016	61,097.2	30,098.4	10,180.4	25,796.2	189,746.6	13,777.6	144,857.8
2016-2017	74,910.2	49,589.7	14,120.1	31,486.7	257,643.8	11,263.7	194,812.3
2017-2018	83,722.5	43,321.9	18,126.4	28,414.7	286,172.2	16,161.6	204,007.1
2018-2019	95,315.9	50,924.4	9,945.1	23,535.9	307,827.3	16,310.3	238,498.8
2019-2020	79,975.5	50,060.3	14,060.2	28,325.1	369,541.6	18,980.3	265,933.9

Source: AIDER (2014a)

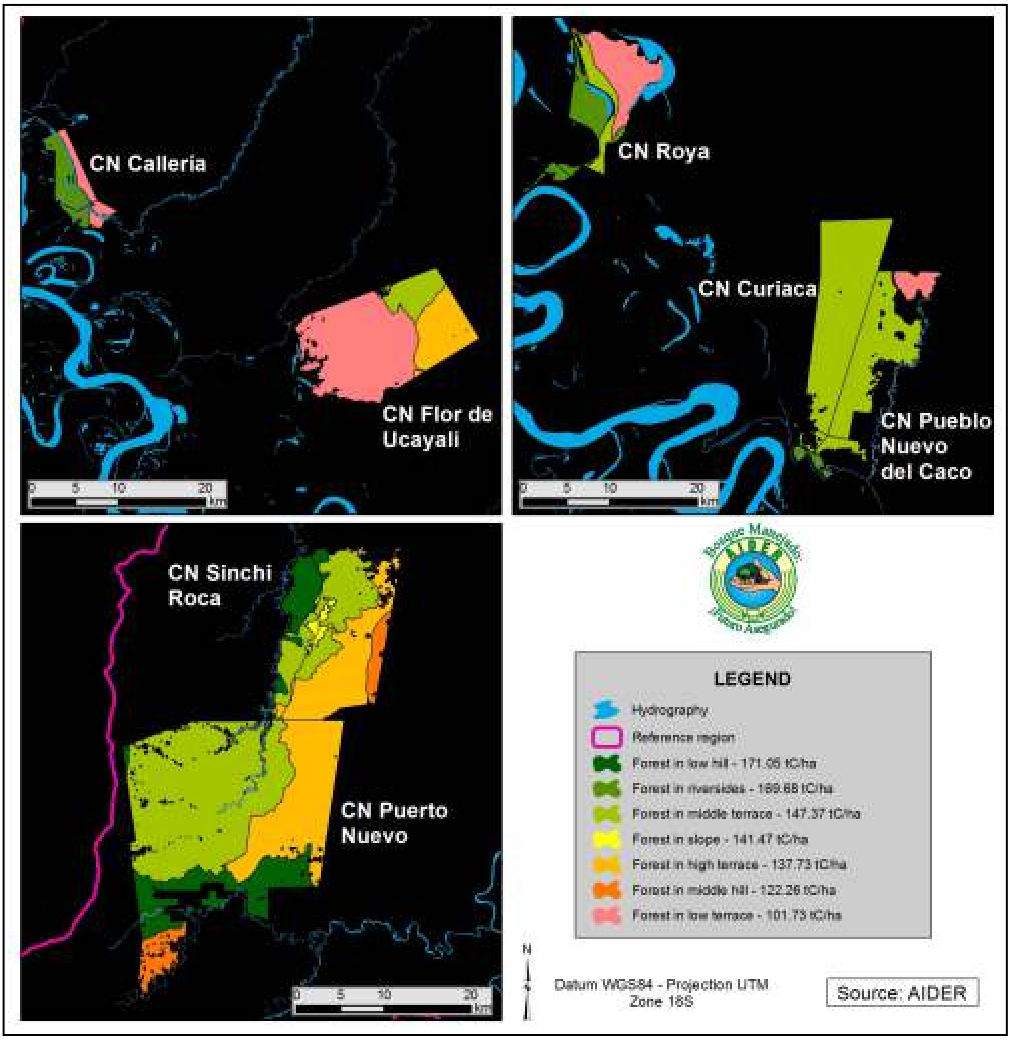

Figure 22. Maps showing carbon content according to type of forest in the REDD+ area

V. Project management

For the proper management of the REDD+ project, some documents that allowed and will allow fulfilling this purpose were developed. As main document, there is the REDD strategy, the REDD communication plan and the conflict resolution documents.

The **REDD strategy**, through which the project aims to avoid unplanned deforestation, is to be presented in the reference scenario through the implementation of the REDD strategy, consists of 4 components:

- **Appropriate environmental use of communal areas**, based on the micro-zoning of the communal areas and its land use zoning, this component will promote compatible economic and food security activities with the proper use of the communal areas, taking into account the capabilities and activities of interest of the identified deforestation agents.
  This way, the displacement of activities and the leakage potentially due to the REDD+ project, will be significantly reduced.

- **Generating skills for the management of the natural resources**, being REDD+ a long-term project, capacity building of the members of the communities is key for its sustainability; as it is them who will be responsible for the execution of the productive and food security activities, distribution of the benefits, and responsibility of the accomplishment of the objectives of the REDD+ project.

  This component will have different activities ranging from awareness to governance; all of them will be focused on making the villagers develop the proper skills for an adequate management of the natural resources.

Figure 23. Training in the communities

- **-Project funding and articulation with the market,** this component will focus on activities oriented towards the search of funding, through the articulation of fair market, strengthening of the financial capacity (search for loans and formulation of productive projects, among others) and partnerships with businesses and/or community organizations.

- **- Technical assistance and control by the state in native communities**, finally and to complement the search for sustainability in the other activities of the REDD+ strategy;

this component seeks to achieve strategic partnerships between the communities and the state to generate technical cooperation and training. Thus, the state will not only support the development of the strategic activities, but will also be involved in the implementation of the REDD+ project implemented by the 7 native communities.

Through the joint implementation of the 4 components, the pressure for the use of the land and resources on the project area will be reduced, resulting in benefits for the families living in the communities and for the biodiversity of the area.

- **The monitoring document of the REDD strategy,** it is a tool that will allow the monitoring team of the community to monitor and evaluate the REDD+ strategy in the 7 native communities.

- The **conflict resolution document**, it will enable community members part of the REDD+ project, with the help of their authorities, to solve conflicts that arise between the different stakeholders in a peaceful way, in order to accomplish a better management and use of the natural resources.

On the other side, the **REDD communication plan** was developed with the aim of contributing to the generation of communication tools between the different groups linked to the REDD strategy. Among the tools to generate are: training, generation of audiovisual material, lectures, community or public campaigns, press releases and internet use.

VI. Project monitoring

Monitoring activities allow measuring the extent or significance of the development of the activities or proposed goals, in that sense, the monitoring development for the main aspects that make up the REDD+ project is important:

6.1. Socio-economic monitoring

As part of the development of the methodology for the preparation of the project design document under the CCB Standard, a social diagnosis for the REDD+ project area was conducted. This study allowed to have a reference of the social situation found at the start of the REDD+ project, and it will be used as a reference when comparing with the results founf with the monitoring.

With the social base line evaluation, indicators for various social study variables were identified, as well as their current situation, besides indicating the way of measurement that was used. (See Annex 3)

6.2. Biodiversity monitoring

For biodiversity monitoring, an integrated monitoring plan was drafted, for which meetings involving local actors for the socialization and validation of the selected objects conservation took place. The pointers to be measured are replicable over time and their measurement does not involve higher costs or complications in the implementation of the monitoring system. Also, a document that addresses protocols and monitoring activities was developed, based on the conservation of the biodiversity objective of the project, which is to reduce the threat factors for the economically important species for the native communities.

An important aspect is to identify the significant species for their maintenance in the project area, based on their presence, ecosystem importance and conservation status. The monitoring frequency will depend on the selected monitoring components and on the expected results

The plan is aimed at measuring the use and threats posed to the biodiversity present due to the activities performed by the communities. The information generated is intended to be an early warning and provide the necessary information to implement intervention strategies in order to reduce the threat factors and contribute to the sustainable development of the project and the native communities involved, not leaving the local and regional strategies out of scopes.

Figure 24. Biodiversity monitoring

6.3. Climate monitoring

For climate monitoring, a document called “Greenhouse gases monitoring plan" was developed, which aims to acquire the necessary information in order to estimate the amount of emissions avoided during the crediting period of the project. For the period

2011 – 2013, the first monitoring (first report) has already taken place.

Monitoring activities included the use of Landsat 8 OLI satellite images of 2013, which were used to identify the changes in land use, plus on-site inspections were performed. The deforested area (in hectares) mainly within the project area and leakage belt area and also in the reference region was calculated; with this information (actual deforestation) and the projected deforestation data (with the modeling), the amount of avoided emissions with the REDD+ project was quantified.

The on-site monitoring was in charge of the forest control and monitoring team in each community; community members were trained, organized and eqquiped in coordination and collaboration with the community authorities. These forest control and monitoring teams are the main responsible ones for the collection of field data, for which they were trained, in addition of having technical assistance during the performance of the assigned activities.

As part of the REDD + implementation strategy, an initiative that has the participation of community members from the native communities involved in the project, the technical support of AIDER and the support of the Andean Amazon Conservation Initiative (ICAA) is underway. This initiative seeks to develop a participatory and inclusive community monitoring system, for which AIDER is responsible for training the monitoring teams (community members) in the proper handling of the equipment they will use and filling of formats, among others. The initiative is also the one that provides the control and monitoring team with the necessary equipment for this purpose.

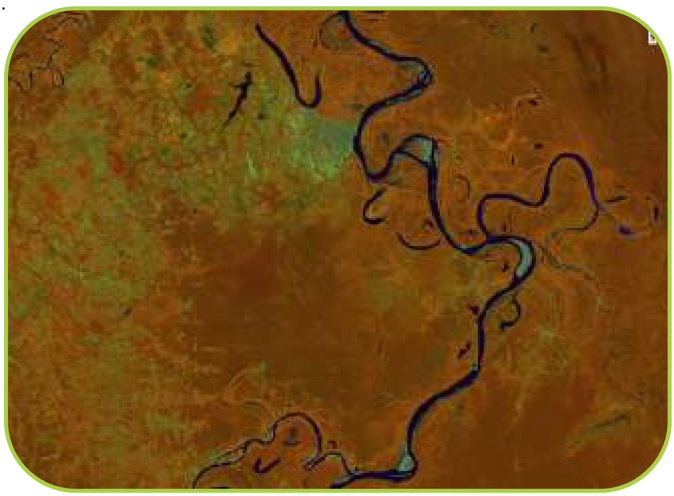

Figure 25. 2013 image captured by the Landsat 8OLI satellite, input for the monitoring of the land cover vegetation

Figure 26. In-situ monitoring activities

The objective of this monitoring system is to assess issues of interest for the community such as: forest cover, illegal crops, border conflicts and wildlife, among others that may arise. The results of this monitoring will allow for a better management of the resources and decision-making.

Figure 27. The community monitoring system acts as quickly before any event of interest

6.4. Monitoring of project activities

To monitor the REDD strategy, a document that considers a number of tools and procedures that allows the operator and the community monitoring team to identify problems within their territories since the beginning and make collective decisions to solve them or mitigate them, taking into account the ancestral knowledge and skills of the community members, was developed. The monitoring system for the REDD+ strategy takes into account the following characteristics: it must be participatory, promote gender equity, seek to develop local capacities and prioritize the information about the changes and results achieved with the actions performed.

Figure 28. Local capacity development concerning subjects related to project monitoring

Figure 29. Training in the use of required equipment for the monitoring activities of the project

Figure 30. The monitoring team must be participative

VII. Project results

7.1. Expected socioeconomic results

Because the monitoring of the social aspect of the project has not yet been developed[76], the results that are expected to be found are the only ones that can be mentioned: the results expected from the implementation of the REDD strategy are:

- Development of social skills for the management of natural resources by the authorities and community members.
- Get community members from the 7 native communities to be funded for developing sustainable production projects and articulated to commercialize their products in the market.
- Get state institutions to provide technical assistance and monitoring to the native communities.

Figure 31. Development of social capacities for the management of natural resources

7.2. Expected biodiversity results

It is expected that with the implementation of the biodiversity plan, the resources identified as important are preserved, as they play a role in satisfying the nutritional needs and generation of income of the communities involved.

[76] It will be given as of the third year of implementing of the project, so that the social changes can be measured

Biodiversity is also a part of the REDD strategy, through which it is expected to get the villagers of the seven native communities to make proper environmental use of their communal land by practicing good forest governance. To achieve this result the strategy contemplates the development of the following activities:

- Participatory development of the micro-zoning of the 7 native communities 1: 20,000. Use of soils and vegetation.
- Development of agroforestry and silvopastoral systems and good agricultural practices.
- Promoting community forest management (timber and non-timber harvesting).
- Designing and implementing a participatory training plan and manuals on productive and environmental aspects of the communities, based on the methodology of rural schools.
- Implementing a communication strategy to raise awareness on climate change and the conservation and management of natural resources (fire control and payment for ecosystem services).
- Enrichment of forest with tree species.

Figure 32. Promoting adequate forest management

7.3 Climatic results

To the date of this publication, the first climate monitoring was made, for which several Landsat 8 OLI 2013satellite images were used to classify the type of cover (forest and non-forest); the results obtained (deforested hectares) were divided by the number of years (3) covered by the period (2011-2013). In table 12 the amount of deforested area within the project area and leakage belt area is detailed, information taken from the results of the monitoring.

Table 12. Ex-post deforested areas per year

Spatial limit	Annual deforestation (ha)		
	2011	2012	2013
Project area	649.5	649.5	64.,5
Leakage belt area	567.6	567.6	567.6
Total	**1,217.1**	**1,217.1**	**1,217.1**

Source: AIDER (2014c)

Figures 33 and 34 show the location of the deforested areas for the 2011 – 2013 period, reference region and project area.

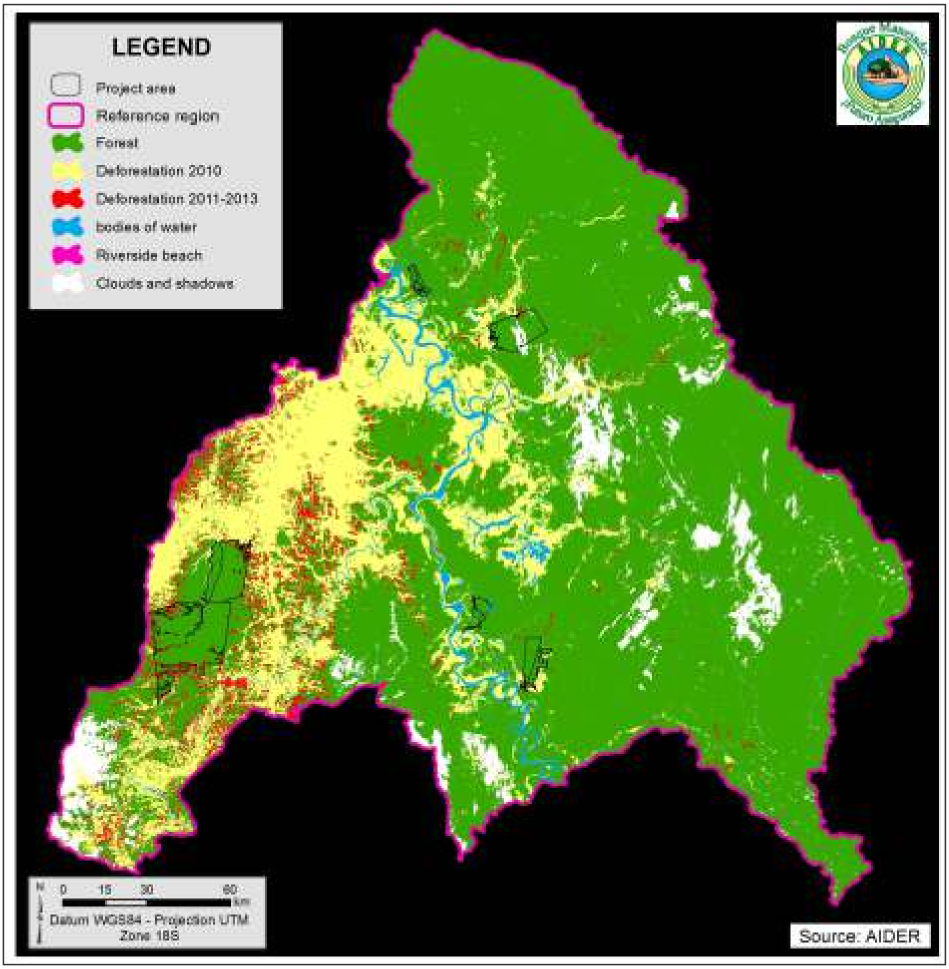

Figure 33. Deforestation results from the monitoring of the reference region (2011-2013 period)

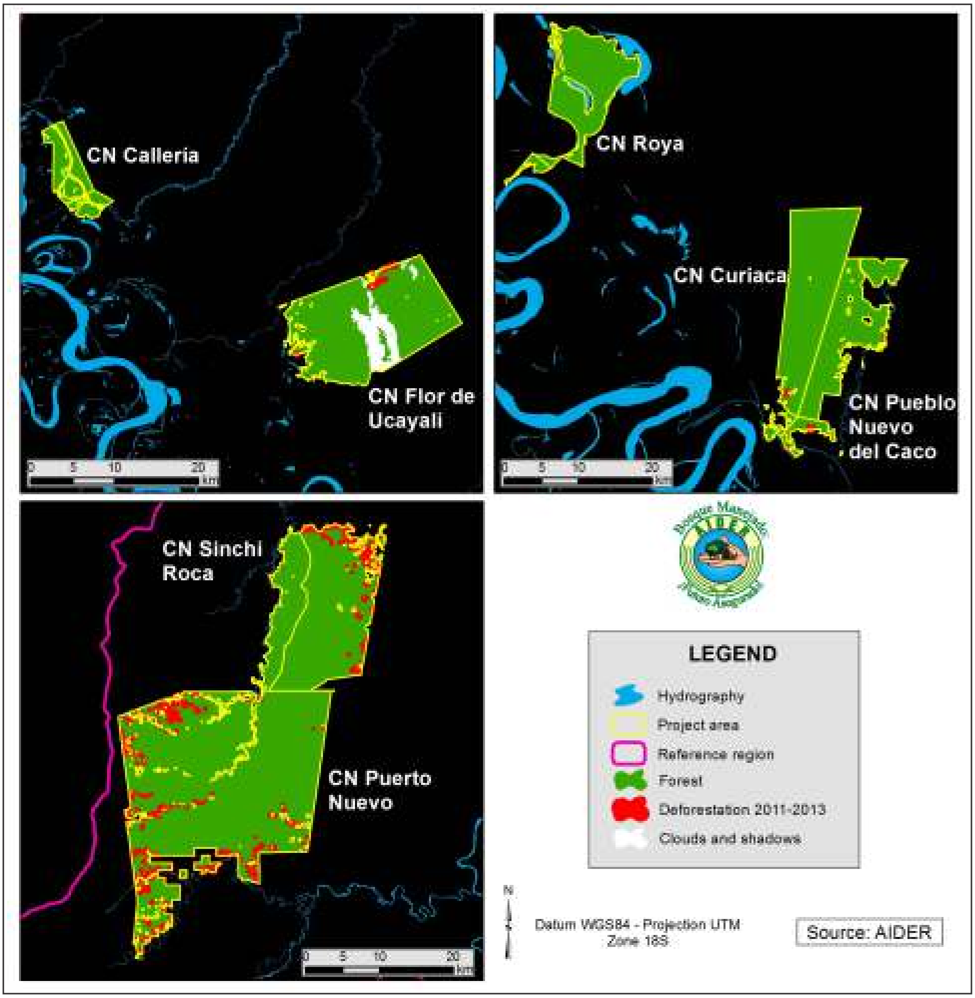

Figure 34. Results of the deforestation monitoring in the project area (2011-2013 period)

The information in table 12 (Ex-post deforestation), plus the Ex-ante emissions data, allowed to analyze to obtain the amount of VCUs for the monitored period of 2011-2013 (see table 13). The results show that on average 410,335 VCUs were generated in the first three years of the period established (having and stimated of 776,968 VCUs – *Ex-ante*). The amount of VCUs reflects that the REDD+ project is still new to the land of the communities, and that there are still strategies to be implemented, as well as strengthening the work done with the key stakeholders (community members). It is expected that for the coming periods to monitor, the gap between ex-ante and verified decreases.

Table 13: Ex ante and verified VCUs

Period	Ex ante VCUs tCO_2-e	Verified VCUs tCO_2-e
2010-2011	278,562.2	189,691.3
2011-2012	220,514.1	83,407.2
2012-2013	277,891.2	137,236.6
2013-2014	360,498.3	-
2014-2015	389,955.3	-
2015-2016	471,472.6	-
2016-2017	628,417.3	-
2017-2018	673,390.1	-
2018-2019	734,585.9	-
2019-2020	817,572.1	-

Source: AIDER (2014c)

One result that will be the starting point for this project is that the general assembly of FSC in Seville, 2014, will compensate its carbon footprint with carbon credits of Shipibo Conibo communities, certified under the principles and criteria of the FSC of the present REDD+ project.

VIII. Challenges and lessons learned

The main challenge encountered in this experience was to communicate the responsibilities and benefits that a REDD+ project involves to the key stakeholders, in this case, the community members of the seven communities that make up the project. In that sense, a communication strategy which allowed the multidisciplinary team to transmit the main concepts that should be considered in projects of this nature and make the communities accept the commitment required to successfully implement the proposed activities in the REDD strategy, was designed.

Another challenge encountered was to convey the concept of payment for ecosystem services for carbon stocks in the forest, which does not involve the sale of forest goods (the sale of ecosystem services for carbon storage does not involve the sale of the timber), to the communities, an aspect that was solved with the active participation of native Shipibo and Cacataibo technicians, who are a part of the team for this project.

IX. Further actions

- Sell carbon credits and implement the emissions reduction strategy in the 7 communities to gradually increase the efficiency of the project, until 100% of avoided deforestation is accomplished and the forests of the native communities are preserved and generate economic, social and climatic co-benefits.

- Institutions committed with indigenous communities, forest conservation and climate change can support this initiative or even make a replica in the 14 million hectares of remaining forests in native communities in Peru.

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Assisted natural regeneration in tropical dry forest

Percy Recavarren Estares and Manuel Llanos Aguilar

Summary

The present experience in tropical dry forest management is an alternative to mitigate the cause of degradation of this ecosystem, reducing the loss of natural regeneration impacted by grazing. The assisted natural regeneration management (RNA) helps tropical dry forest to regenerate and is a forest repopulation model alternative to the El Niño phenomenon in order to reforest this ecosystem. This model was designed by AIDER together with the Peasant Community Ignacio Távara Pasapera during the 90's and consisted in protect the natural regeneration and regrowths from their potential threats, among them, livestock of goats. The latter use trees natural regeneration as forage, totally destroying them.

This experience directly benefited 300 families, who developed their capacities participating in the management of assisted natural regeneration and silvicultural treatments. Also, 1,200 families at present enjoy the ecosystemic services from the managed forest (algarroba production, climate regulation, wind and dust barrier, shade for livestock, wood from branches for firewood, etc.) The managed forest area had an extension of 3,815.57 ha.

The present document is a summary of the experience in assisted natural regeneration management in the Peasant Community José Ignacio Távara Pasapera, carried out in 2013 and 2014.

I. Problematic

Tropical dry forests are ecosystems of strategic importance for the development of the north of Peru. The resources (wood and non-wood) represent a great potential to the economic activities currently developed in the area, they are: grazing, beekeeping, crafting, tourism and production derived from algarrobo fruit.

Figure 1. Grazing in the zone

The fragility of this ecosystem is due to the facts that El Niño phenomenon is occasional and the temporary rainfall. On the other hand, the illegal logging to produce vegetal carbon and the change of land use (from forest to small and big scale agricultural plots) have as consequence, several areas without parent trees (especially algarrobo) whose seeds would naturally reforest when El Niño phenomenon arrives. In addition, the pressure made by the extensive grazing of goats' livestock, completely destroys the regrowths, seeds and natural regeneration, leaving in many cases, desertified areas.

Figure 2. Forest clearing to change land use

Another anthropogenic activity affecting these forests are wildfires, which occur with frequency given the burning of vegetation to convert forest and thickets in cultivation plots, provoking the loss of all kind of propagation material. These cultivation plots are in their vast majority abandoned because the lack of water for agriculture.

Figure 3. Panoramic view of tropical dry forest vegetation

The above mentioned problems have increased the fragility of the ecosystem exposing this area to high probabilities of degradation and desertification.

II. Contributions to solution

Facing the problem of the tropical dry forest ecosystem solutions were looked, where AIDER with designing, formulating and implementing development projects experience and KINOME in developing financial proposals to generate incomes from ecosystemic services looked for an alternative. Both together designed and implemented the project "Assisted natural regeneration management in the peasant community José Ignacio Távara Pasapera", which is a proposal to adapt and mitigate climate change, under a scheme of payment for ecosystemic services. This project is oriented to conserve the tropical dry forests of the communities and peasant populations from the north of Peru, for which was proposed to assist the natural regeneration. This alternative is the cheapest and ensures the reforestation of this ecosystem, also developing a model of forest management with participation of the local people, according to their social, economic and environmental situation.

Figure 4. Collection of branches by the local people to build fences for the assisted natural regeneration

This project is been carrying out since December, 2011 to date. Two work campaigns were developed as follows:

- Campaign 1: December 1st, 2011 – November, 30th, 2012
- Campaign 2: December 1st, 2012 – April 20th, 2014

This project is funded by KINOME, under the mechanism of payment for ecosystemic services. The financial support is useful to expand the proposal to other communities of tropical dry forest.

III. Location and characteristics of the project

3.1. Location

The community Ignacio Távara Pasapera is located between Districts of Chulucanas (Morropon Province) and Tambogrande (Piura Province), covering a total surface of 52,269.1 ha. Figure 5 shows the location.

Figure 5. Location map of the Community Ignacio Távara Pasapera

3.2. Biophysical characteristics

The description of the biophysical characteristics of this experience can be found on the project "Reforestation and sustainable production and carbon sequestration in dry forests Jose Ignacio Távara." (Page 99 – 102), due to both experiences were developed in the same region reference.

3.3. Participants

In Table 1, are described the participants as well as their roles and functions in the project.

Table 1. Participants of the project

Participant	Role	Objectives/Benefits
Association for Research and Integral Development - AIDER	Designer and implementer of the project	Fulfill its institutional strategic mission by developing and validating an alternative method of natural regeneration in tropical dry forest and so, contribute to the fight against desertification.
KINOME	Funder of the project	Develop and implement a "payment for environmental services (PES)" proposal
Community	Provide labor. Owner of the forests and their improvement.	- Develop skills by participating in reforestation activities of assisted natural regeneration and silvicultural treatments. - Benefited from managed forest ecosystem services (production of algarrobo, wind and dust barriers, shade for livestock, wood branches for firewood, etc.)

IV. Methodology

To achieve the objectives of the project, the following methodology was designed.

4.1. Organization

The first step was to communicate the benefits and responsibilities of the community in regards to the project. This was known and approved in the communal board, from which the Coordination Communal Committee was conformed, constituted by local leaders and communal authorities. This committee was in charge of coordinate the implementation of the activities of the project in the community.

Figure 6 . Participant population in the activities of the project

4.2. Species selection

The most abundant forest species in this kind of ecosystem are algarrobo and zapote, because of their high capacity to regenerate and regrowth, as well as for their local use.

Figure 7. Trees of algarrobo (left) and zapote (right), main species of the ecosystem

4.3. Training

Training was mainly focused on the communal committee and authorities, developing it through two phases. The first was theoretical and the second one, practical. The latter was applied based on the “learn doing it” methodology.

Figure 8. Training of the population

The training was specifically directed to the promoters of each community and to the families interested in developing their skills in the assisted natural regeneration management. The following issues were treated during the training:

A) GPS operation and cartography, in this training was focus on the communal comitee membres to learn specifical tasks:

- GPS: calibrate GPS with the navigation system (UTM and Datum), locate reference points, generate tracks and determine the orientation and distances between two points.
- Cartography: equivalencies of scales between maps and fields, extract and incorporate coordinates UTM, extract distances between two points.

B) Protection of natural regeneration, the following issues were developed:

- Importance of the natural regeneration for conservancy and recuperation of forests.
- Location and selection of natural regeneration
- Determination of vulnerability and risks.
- Finality and characteristics of protective fences
- Extension of forests to be benefited with the assisted natural regeneration management.

C) Competition control, the training at this point was as follows:

- Competition and natural selection
- Inter and intra specific competition
- Justification of thinning
- Importance of pruning and types of pruning.

D) **Regrowth management**, for this case, the following issues were detailed:

- Definition of regrowth
- Advantages and disadvantages of regrowths as an alternative to the regeneration management.
- Selection of regrowths

E) **Natural regeneration and regrowths management**

- Pruning and thinning
- Prevention of wildfires
- Mowing and haymaking of naturals grasses.

4.4. Assisted natural regeneration management

A) **Protective fences for assisted natural regeneration and regrowths:** were constructed small and rustic fences of 1.2 m height, surrounding the natural regeneration of algarrobo and zapote, as well as fallen trees which presented regrowths. The objective of these fences was to avoid mechanical damage especially from livestock. The fences were built with overo (*Cordia lutea*) rods and by stacking dry material from thorny shrubs. Once the fences were constructed, was registered some of its information, as location and number of individuals per specie.

Figure 9. Fences for assisted natural regeneration

B) **Management of natural regeneration and regrowths:** It consists in applying pruning and competition control (thinning) over the forested areas with presence of natural regeneration, in order to favor their development. This also includes the replacement of dead regrowths and the maintenance of the protective fences. If it is necessary, guide sticks will be planted next to the regeneration needing it. These activities will be performed through communal labor. In the case of regrowths, if a competition was observed, those ones with malformation or retarded growth were eliminated.

Figure 10. Assessment of regeneration and regrowths

C) **Maintenance of natural regeneration and regrowth:** The maintenance was mainly focused on protective fences, which were built up with rods of Overo (way of reproduction of this specie) with the finality to have a live fence. Maintaining live fences consisted in replace the rods that did not grow, and to improve the conditions of the fences damaged by livestock.

V. Monitoring

The monitoring consists in conduct a weekly assessment of the assisted natural regeneration. The verification is through the weekly report made by the promoters.

VI. Results

6.1. Organization level

It was achieved the approval of the project of assisted natural regeneration, by the community and the directive board, given in a communal assembly on November, 2011. It was defined the hamlets and annexes of the community where the project would focus. The selected hamlets are Santiaguero Hamlet, Alto el Gallo Hamlet, Nueva Esperanza Annex, Km. 34 Annex, El Cerezo Hamlet y Km. 48 Annex. These hamlets and annexes can be observed in figure 11.

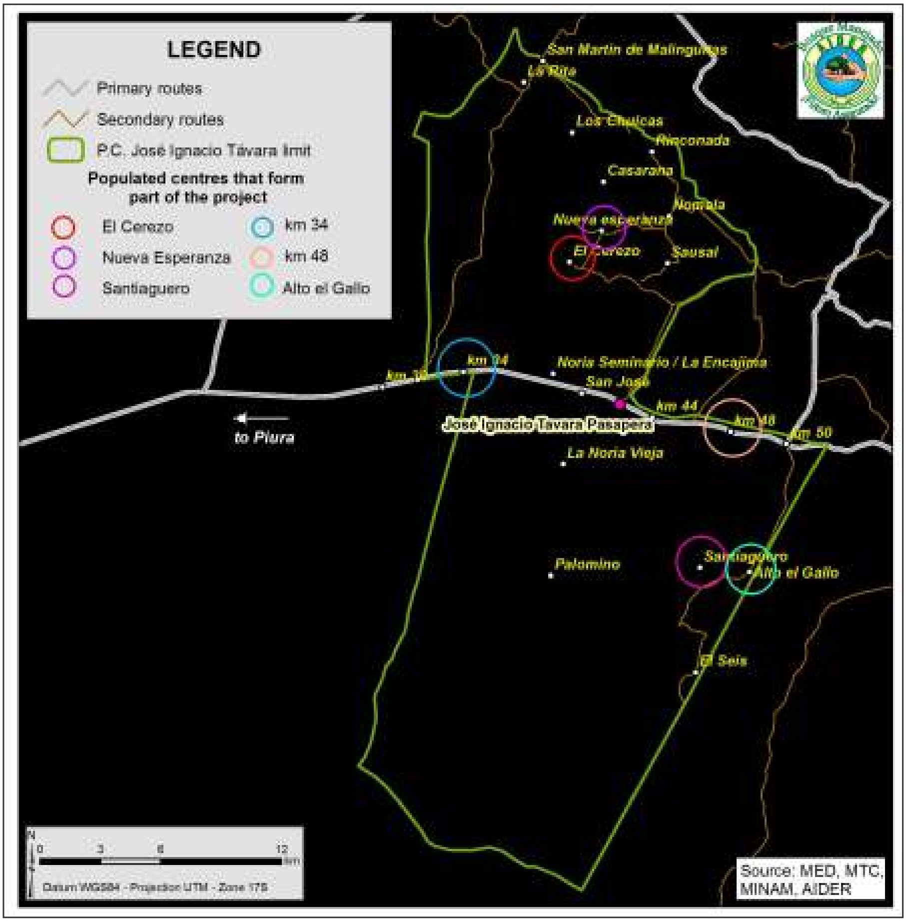

Figure 11. Location map of the participant hamlets and annexes

The Coordination Communal Committee of the project was conformed, constituted by the Secretary of natural resources of the community, delegates and lieutenant governor of each one of the hamlets and annexes involved.

The Coordination Communal Committee has the following tasks and functions:

- Supervise the adequate implementation of the assisted natural regeneration project.
- Coordination between the project direction and peasant families involved in the project.
- Inform periodically to the directive board and to the assembly of community delegates about the progress of the project.

- Ensure that peasant families which are participating in the project assume their commitment to surveillance and good maintenance of the protective fences which is protection algarrobo and zapote regrowth.
- Support the community promoters

The participation of the people from hamlets and villages was active, in sum, 396 people grouped in 78 brigades, as it is shown in table 2.

Table 2. Quantity of brigades and participants per hamlets and annexes where the project carried out

Annexes and Hamlets	Quantity of brigades	Quantity of participants
Santiaguero Hamlet	12	67
Alto el Gallo Hamlet	24	118
Nueva Esperanza Annex	12	62
Km 34 Annex	3	15
El Cerezo Hamlet	11	53
Km48 Annex	16	81
TOTAL	**78**	**396**

6.2. Definition of areas to manage assisted natural regeneration

The definition of areas included the recognition of forest within the annexes' areas, being their delegates a part of the team, as well as delegates from Hamlets. With them, were defined the work area where existed natural regeneration (stands) and regrowths especially from Algarrobo. These results are shown in Table 3 and Figure 13.

Figure 12. Management activities in the ANR areas.

Table 3. Hamlets and Annexes where the project was implemented

Hamlets and Annexes	UTM Coordinates WGS84		Quantity of families	Quantity of inhabitants	Electrical service	Water well
Santiaguero Hamlet	581184	9439137	35	175	YES	No
Alto el Gallo Hamlet	574247	9432231	40	200	NO	No
Nueva Esperanza Annex	585898	9422398	60	300	NO	No
Km 34 Annex	579582	9437605	38	190	NO	YES
El Cerezo Hamlet	588362	9422157	50	250	NO	YES
Km48 Annex	587482	9429134	70	350	YES	No

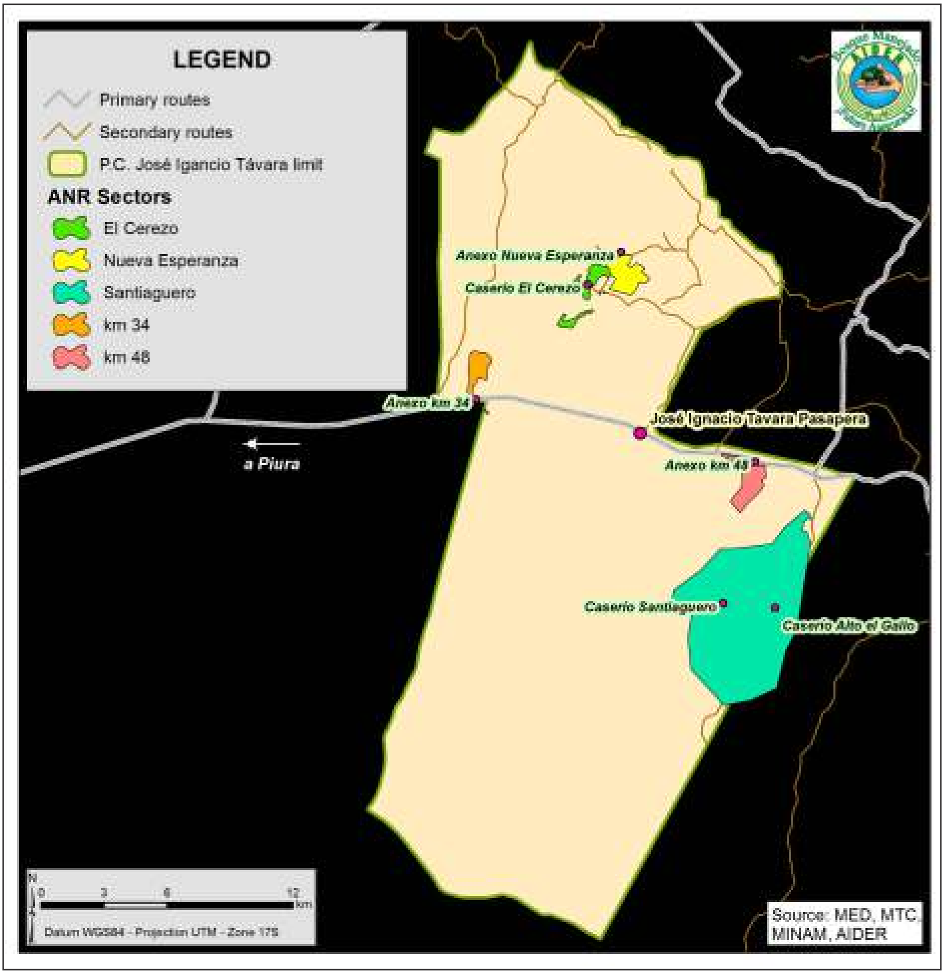

Figure 13. Defined zones for manage the assisted natural regeneration

6.3. Protective fences for natural regeneration and regrowths

The protective fences have been installed around 75 thousand saplings (30 cm height, less than 5 cm DBH) of natural regeneration of algarrobo (*Prosopis pallida*) and zapote (*Capparis scabrida*) in a rate 9 to 1, respectively. In addition, 4,891 trees (6% of the total population) have been protected to replace the loss caused by potential mortality.

Figure 14. Construction of protective fences for saplings

A total of 2,722 fences have been constructed to protect saplings. The dimensions of the fences are different one from each other, depending on the number of individuals contained inside. The surface covered by the fences is about 3,815.6 ha.

It has been observed that those fences built up in rainy season have regrowths supported by soil humidity, so becoming live fences. This represents a double reforestation, therefore it can be said that the project have propagated 30,000 overo shrubs as an additional result.

In the vast majority of cases, has been found natural regeneration of zapote next to overo shrubs, fact that support the use of this shrub as live protective fences.

Only in Km 34 Annex, from the six involved in the project, could be found isolated regeneration of Algarrobo. However, given the low number of trees per hectare in this Annex, the survival of this specie under assisted natural regeneration management is of vital importance for forests conservancy.

Figure 15. Natural regeneration of algarrobo inside its fence

The result of this project encloses 3,815.6 ha under assisted natural regeneration management, which ensures their conservation. To achieve this result, 2 722 protective fences were installed, protecting 79,891 sampling of Algarrobo and Zapote, as shown in table 4.

Table 4. Number of fences, protected trees, additional trees and forest surface under natural assisted regeneration management (NAR)

Annexes and Hamlets	Quantity of fences	Quantity of protected trees	Additional trees	Forest surface under NAR management (ha)
Santiaguero Hamlet	1,165	27,011	1,026	3,061.5
Alto el Gallo Hamlet	486	8,799	1,227	
Nueva Esperanza Annex	194	17,601	1,002	236.5
Km 34 Annex	319	2,073	92	138.5
El Cerezo Hamlet	208	12,568	836	161.5
Km48 Annex	350	6,948	708	217.6
TOTAL	**2,722**	**75,000**	**4,891**	**3,815.6**

6.4. Economic, social and environmental Impacts

A) Economic Impacts

As a direct impact, the participant families have received additional income for labor. However, the main economic impact will be perceived from the fifth year, when the new trees begin to produce fruits, therefore, additional incomes for peasant families.

Figure 16. Maintenance of the protective fences

B) Social Impacts

The generation of additional incomes has allowed families to keep joined, given that there was no need for the integrants to shift looking for eventual jobs, as it occurs in droughts season.

The implementation of the project has strengthened the communal organization (Secretary of Natural Resources, community delegates, Lieutenant Governors).

The implementation has also wake the interest of population of the community to protect the natural regeneration manifesting their will to be considered as beneficiaries in future projects.

Figure 17. Participants training

The peasant communities, as well as the project designers, received recognition from their respective institutions, like Regional Government, Universities and civil institutions. The assisted natural regeneration management constitutes a contribution against desertification and drought, as it is also to the climate change. This experience has been useful to Regional Government of Piura, who has replicated the experience achieving positive results.

300 families were directly benefited, all of them performing activities related to assisted natural regeneration management and silvicultural treatments, from which gain and strengthen their skills.

C) Ecological impacts

Promote the sustainable management of dry forests enforce the efforts to reduce desertification and drought. Promote dry forest native species reposition contributes to biological diversity conservancy. Promote the conservation and recuperation of forest lands contributes to the mitigation and adaptation to climate change.

Figure 18. Communal work inside forest

1,200 families located in the surroundings areas of assisted natural regeneration were benefited. They will enjoy the ecosystemic services from the managed forest (algarroba production, climate regulation, wind and dust barrier, shade for livestock, wood from branches for firewood, etc.)

An important contribution of the project is to demonstrate that through the assisted regeneration management it is possible to help regeneration to recover dry forests, as an alternative of long periods without El Niño phenomenon.

VII. Lessons learned

- The assisted natural regeneration management constitutes a low cost alternative to recover degraded lands of tropical dry forest ecosystem, through basic and easy to replicate technology.
- The assisted natural regeneration projects must go hand in hand with social awareness for the environment conservancy, especially through schools at all levels.
- The organized work between peasant community, local and regional governments and civil institutions facilitates the development of activities against desertification and drought.

VIII. Next steps

- Replicate the experience in the other 35 peasant communities to recover degraded forests, incorporating financial schemes of payment for ecosystemic services.
- Communicate this experience to other areas, as an alternative of management to conserve dry forests.
- Prepare the local population for them to continue with the project approach after the transfer process and funding period have ended.

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Experiences in forest protection

REDD+ project "Reducing deforestation and forest degradation in tropical dry forests located in Piura and Lambayeque."

Cesar Samaniego Minaya

SUMMARY

This experience is located in the tropical dry forests of northern Peru, in the regions of Piura and Lambayeque. The populated areas located in the Regional Conservation Area "Salitral-Huarmaca Dry Forests" (RCA SHDF) and the Santo Domingo de Olmos peasant community (Olmos PC) are involved in the project. Both areas have different realities and socioeconomic and cultural practices, as well as a wide variety of natural resources in their territories.

The project area consists of 38,355 hectares of dense and semi-dense tropical dry forests located in the RCA SHDF and in the Ñaupe-Racalí area in the Olmos PC. The purpose of the project is to protect the tropical dry forests from advancing deforestation and forest degradation. The idea is to reduce land use change pressure in the project area with 3 components: a) sustainable land use, b) sustainable business promotion, and c) development of organizational, social and technical skills for natural resources management. This set of activities are known as the REDD project strategy.

These actions are aimed to avoid further deforestation. To accomplish this, alliances will be established and permanent coordination with organizations that are currently conducting conservation activities in the area will be held. Sustainable production systems, control and surveillance systems in the area will also be strengthened through the creation and operation of participatory monitoring.

With these actions, the project expects to reduce 46,803 tCO2-e and generate an average of 39,826 carbon credits per year, according to the reference scenario projected for the first period 2013-2023. This emissions reduction will allow to finance the REDD strategy activities. The project includes benefits for the populations involved and for the conservation of biodiversity, which are verifiable by having used the Climate Community & Biodiversity Association (CCBA) standard, applying for the *gold* level for endangered species protection, such as the pava aliblanca (Penelope *albipennis*)

I. Location and characterization of the communities

This REDD+ project is located in the tropical dry forests of northern Peru, in the districts of Salitral and Huarmaca in the Piura region, and in the district of Olmos in the Lambayeque region. The project area is part of the pava aliblanca biological corridor and belongs to the SCR BSSH in Piura, with an area of 15,155 hectares; and also covers part of the proposed Private Conservation Area "Ñaupe-Racalí" in Olmos PC in Lambayeque and Piura with an area of 38,355 hectares.

Figure 1. Location map of the project

1.1. Biophysical characteristics

The project area has a temperature range from 10 to 34 °C. Temperature exhibits a seasonal behavior and varies according to the geographical gradient, being influenced by phenomena such as El Niño.

Two seasons can be distinguished when it comes to rainfall; the rainy season (January-April) accounts for 85% of total annual precipitation, while the remaining months of the year present an extreme aridity for having almost no precipitation. Likewise, rainfall can be seen strongly affected by the El Niño phenomenon.

In the area corresponding to RCA SHDF in Piura, the project area has a maximum average annual rainfall of 500 mm and a minimum annual average of 200 mm. The total average potential evapotranspiration per year varies between 2 and 4 times the precipitation.

In Lambayeque, based on 19 years of records from the Olmos weather station, Rivas-Martínez et al (1988) pointed out that the average annual rainfall corresponding to the project area is of 160 mm.

In the area corresponding to RCA SHDF in Piura, hydrography is defined primarily by the Piura river. Among the main tributaries, the following streams can be mentioned: Seca, Pasmarán, La Tranca, El Garabo, and several tributaries of the Chignia river. Among the tributaries of the Seca stream, del Medio and La Cría streams are to be mentioned; as well, the Las Pavas, Limón and Frejolillo streams are part of the Sávila watershed, and are tributaries of the Ñaupe[77] stream.

In the Ñaupe-Racalí area in the Olmos PC, hydrography is composed mainly by the seasonal Olmos river; the San Cristóbal river, which does not have a permanent water flow; the Cascajal river, which has a permanent but reduced riverbed; and the Insculás and Ñaupe rivers, fed by the Piedra Blanca and Querpón streams.

The predominant soils in the Olmos[78] area belong to vertisols, yermosols and in a lesser extent, to lithosols. Vertisols are generally black soils with reddish brown hues that have a great presence of clay (montmorillonite); they are morphologically homogeneous, extremely deep, poor in organic matter, slightly basic (pH 8 and 8.5); and are considered to be fertile soils with agricultural possibilities. Yermosols have a light tone and poorly developed surface horizon, with the presence of calcium and calcium sulfate layers of in the first 10 cm of depth and a subsoil rich in clay or similar to the surface layer; sometimes having a tendency towards salinity. When they present a grassland cover with some shrubs, livestock farming is possible with a moderate to low yield. Lithosols

[77] Regional government of Piura, 2009
[78] Regional government of Lambayeuqet & Landscape Biodiversity Institute, 2013.

are shallow soils whose depth is restricted by hard rocks and are located in the mountains, on the slopes, canyons and badlands, as well as in hillocks and flat areas. They are characterized by a high salinity, and may present calcic horizons, they can be fertile or infertile, with a sand or clay texture; their susceptibility to erosion depends on the area where they are located, to the topography and the soil itself.

In the north block of the RCA SHDF, soils with a 30-50 cm thick, sandy-loam to silty-loam texture A horizon, resting on a sandy-thick C horizon, have been identified[79]. This horizon in most cases presents a high percentage of boulders and pebbles that reach up to 60-70% of the volume. Soils have a rapid infiltration rate with a fast to excessively fast natural drainage. In the south block of the RCA SHDF, soils are characterized by having a sandy-loam to silty-loam texture, with a C horizon presenting a high percentage of boulders and pebbles that reach up to 60-70% of the volume.

According to the major land use capacity map, the area mainly includes protection land and temporary pastures. Agricultural quality is low (Regional Government of Piura, 2010b).

The physiography mainly corresponds to a hilly relief with some low altitude clusters, it is characterized by a hilly landscape with steep slopes and medium sized valleys where seasonal streams run. The physiographic criteria for categorizing the dry forests (INRENA, 2003a y b) are based on the generalization of three types of landscapes according to their altitude: Plain (less than 250 m), Hill (250-1,000 m) and Mountain (1,000-1,600 m).

Figure 2. Dry semi-dense hill forest

[79] Regional Government of Piura, 2009

1.2. Ecology and biological diversity

The project area belongs to the tropical dry forest biome. According to INRENA (INRENA, 2003a and b), the following forest types are distinguished: dry dense hill forest, dry dense forest of plains, dry very sparse hill forest, dry very sparse forest of plains, dry sparse mountain forest, dry sparse forest of plains, dry sparse mountain forest, dry semi-dense hill forest, dry semi-dense forest of plains and dry semi-dense mountain forest.

The project area has a very strong seasonality, which allows for the development of an abundant vegetation during the wet season in the forests. Many species of flora and fauna, some of them endemic, are present in the area.

Regarding the flora of the area, there are 52 families, 129 genera and 171 species that have been identified. Important tree species within these ecosystems are algarrobo (*Prosopis pallida*), huarango or faique (*Acacia macracantha*), hualtaco (*Loxopterigium huasango*), palo santo (*Bursera graveolens*), pasallo (*Eriotheca ruizii*), palo blanco (*Celti iguanes*), almendro (*Geoffroya striata*); polo polo (*Cochlospermun vitifolium*); porotillo or frejolillo (*Eritrina smithiana*), chaquiro (*Pithecelloboium excelsum*); angolo (*Pithecelloboium multiflorum*), and ceibo (*Ceiba trichistandra*). In the lower parts, zapote (*Capparis scabrida*) and shrub species like overo (*Cordia lutea*) are also present.

Figure 3. Ceibo tree (*Ceiba trichistandra*)

Regarding the fauna[80] of the area, there are 69 families, 27 orders and a 175 species that have been identified; with 28 mammals belonging to 18 families, 122 species of birds of 38 families, 19 species of reptiles of 8 families and 6 species of frog of 5 families.

The project area is part of the seasonal dry forests of southwestern Ecuador and northwestern Peru or Tumbes region, one of the most important places worldwide regarding endemic bird species. The most important endemic specie on the area is the pava aliblanca (*Penelope albipennis*). In the case of amphibians and reptiles there are also endemic species, three belonging to Peru and two specifically to the tropical dry forest. As for endemic mammals, there is one for Peru and four that belong to southwestern Ecuador and northwestern Peru specifically.

The project area is part of one of the biological corridors that includes biodiversity of worldwide significance. One of the identified biological corridors is "Pava Aliblanca Ñaupe-Recalí". The project area not only provides direct use resources but also provides potentially important services. These forests provide important ecosystem services such as biodiversity conservation, carbon sequestration, oxygen release, climate regulation, water production and soil nutrient maintenance.


Source: GORE Piura, 2013

Figure 4. Pava aliblanca (*Penelope albipennis)*, main conservation object of the biodiversity present in the project area

[80] Regional Government of Piura, 2013

1.3. Socio-economic characteristics

In Piura, the districts of Salitral and Huarmaca have 14,209 and 41,193 inhabitants, respectively, grouped in 15 populated areas. In Lambayeque, Santo Domingo de Olmos peasant community has an estimated population of 36,500 inhabitants. The dominant economy of the rural population is subsistence and the main economic activities according to the annual income earned by households are agriculture (38%), manual labor (32%), cattle and goat farming (18 %), forestry (8%) and beekeeping (4%) (AIDER, 2014b).

Major land use capacity in the project area is mostly protection, however, land is given other uses such as farming that requires technology, and pastures for livestock with low levels of productivity and performance.

The main crops grown are rice, corn, cowpea beans, trifles and soya, usually sown two seasons a year; and perennials such as banana, lemon, mango, plum, avocado, orange and passion fruit. Also, two types of agriculture can be distinguished; subsistence, characterized by low yields and the use of inappropriate technology, and the one destined for marketing purposes, which has capital investments and technology that allows the availability of water for irrigation, which is the main limiting factor for the development of agriculture in the area. The demand of manual labor is for agroindustry and fishing; some families migrate to nearby cities to engage in fishing activities and work in banana and coffee plantations.

Peasant communities in Piura and Lambayeque have the largest area of dry forests in their land. These communities occupy more than 50% of the total area, and the management of these forests lies in their ability to manage them properly. The inhabitants of the project area have a close relationship with the forest, as it provides them numerous timber and non-timber products. Many of these products are used for consumption or used for trade, and only very few of them reach the market. Among the products that are obtained are: timber for construction, poles, firewood or coal; edible plants and fruits, seeds, fibers; grass as fodder for goats and cattle.

However, forestry is characterized by a high index of illegality. The population of the project area extracts various environmental goods and services from the forest, being wood and coal the main products collected and used for self consumption and/or sale by the local people. Firewood is used as an energy source for self consumption and its sale is for domestic and industrial use (brickworks, bakeries, roasted chicken restaurants), being protected tree species like algarrobo, faique and hualtaco, the ones preferred. Obtaining coal from these species is an activity that many families do to earn income, and despite its illegality, it has been promoted by the logging permits given by the forest authority, according to forest management plans that are not implemented nor audited and the widespread law-breaking.

II. Problematic

Throughout history, tropical dry forests have undergone reduction and increment processes due to favorable and unfavorable climatic periods and pressure from economic activities such as agriculture, mining, industry and forestry (Hocquenghem, 1999). However, since the 70s, an intense exploitation of the forest has been observed through nomadic herding of goats, the selective logging of trees for firewood and for making wooden floors and coal, which have increased the intensity of conversion, destruction and degradation of this ecosystem due to population expansion and immigration (Linares Palomino *et al.* 2010;. Zorogastúa *et al*. 2011.).

Currently, tropical dry forests are among the most threatened ecosystems in the world as a result of intensive anthropogenic disturbance. (Janzen, 1988; Hoekstra *et al*., 2005; 2013 Portillo *et al*.). This ecosystem supported high density populations throughout history because of its edaphic and climatic characteristics, which are attractive for the establishment and development of populations (Sánchez-Azofeifa *et al*., 2005). Being located near Tumbes region, it is recognized worldwide for its high biological value, especially in terms of endemic species, as well as its high degree of forest degradation and deforestation, making its conservation a global priority.

Despite of the awareness of the accelerated degradation of the dry forests, very little is still known about their true extent and its degree of deforestation and forest degradation. There are gaps in the knowledge of basic aspects of the species present in them, for example, alternative forms of propagation rather than natural regeneration, pre-germination treatments, specific growth studies and silviculture, studies on physical and mechanical properties of the wood, wood anatomy and potential of the non-timber products of the tropical dry forest. As a direct consequence of the limited scientific knowledge, no sufficient technical criteria has been developed for a sustainable management of the tropical dry forest; the criteria used, the Minimum Logging Diameter, has no scientific basis or has been transferred from other realities without much technical justification .

It is estimated that tropical dry forests provide ecosystem goods and services for about 415,000 families. The results of the study pointed illegal loggers as the main agents of deforestation (AIDER, 2014b), followed by livestock and migratory agriculture. The agents of deforestation identified timber harvesting, the expansion of the agricultural frontier and livestock development as the main reasons of logging. This pressure on the forest intensifies in times of drought, when usually there are not many working possibilities in the area.

Figure 5. The dry tropical forest is the mail fuel source for the peasant communities of the area

The drivers of deforestation in the reference region of the project, in terms of quantity, are the low rural wages, the rising prices of agricultural products and an increase in the price of wood and byproducts. While the drivers of the location of the deforestation in the reference region are the proximity to highways and access roads, proximity to population centers and villages, and the ownership and security of land tenure and physiographic terrain features (AIDER, 2014b).

Characteristics of the agents and their decisions regarding land use are determined by broader forces, which are denominated the underlying causes of deforestation. These were determined according to the participatory workshops held in the reference region, surveys and interviews made to different agents of deforestation, points of view of experts with extensive field experience in the reference region of the project and the review of verifiable sources of secondary information.

Interviews made in the reference region identified: poverty (75% of the interviewed), need for agriculture to meet food needs (38%), demographic pressure (26%) and logging activities in the forest (6%) as the underlying causes of deforestation. 20% of the people interviewed did not specify or knew the underlying cause of deforestation and considered that these did not exist (AIDER, 2014a).

Figure 6. Illegal logging is intensified in periods of drought when there is a shortage in working opportunities

The processes of deforestation and forest degradation are not homogeneous. They transcend political boundaries and belong to different scenarios related to ecological conditions, accessibility, migration flows, market demands and security in land tenure, which shape human pressure. In this context, the main threats to the conservation of the existing dry forests in the reference region of the project must be addressed. That is why the development of mechanisms that will allow the valuation of the forest ecosystem services, allowing its conservation and the generation of goods and services for local people are considered essential.

Figure 7. Coal production is one of the main reasons of tropical dry forest degradation

III. Project design

3.1. Conceptualization and pre-feasibility evaluation of the project

Defining the project's objectives and the activities to develop was one of the main steps in the design of the REDD+ project. Participants and partners were identified for the implementation. At this stage, the preliminary definition of the key project interventions that would lead to emissions reduction was important, for which consultation with potential participants and evaluation of the background and conditions of the project area was essential.

Once the potential activities for the project's implementation were preliminarily defined, the Project Idea Note (PIN) was developed; this contains a summary and the basic assumptions. For this, the project included an analysis of the historical deforestation processes in the project area in order to analyze the feasibility of the REDD+ project in tropical dry forest ecosystems.

The development of the PIN allowed a preliminary assessment of the viability of the project on economic and technical aspects. Economic viability was determined mainly by carbon credit prices under various scenarios and the cost of implementation of the project's activities, while the technical viability was determined by the applicability of the project to the standards and available methodologies for its development. Furthermore, the viability assessment involved the consultation and evaluation of the assumptions of the project with the local stakeholders.

The findings of this analysis allowed contemplating the viability assessment of a REDD+ project in tropical dry forest ecosystems as an alternative to battle deforestation and forest degradation. Thus, funding from the carbon credit commercialization is considered a key tool for obtaining the economic revenue required to ensure the long term viability of the project and its sustainability.

However, the economic revenue of the project does not solely need to come from the sale of the carbon credits, so the creation of more than one source of income that allows the design of the project to be more attractive and resilient is considered important.

The overall objective of the REDD+ project is to contribute in climate change mitigation by generating social and biodiversity benefits; the objectives have been differentiated in climate, community and biodiversity, as can be seen below:

- **Climate objective:** Prevent the emissions of greenhouse gases caused by deforestation and forest degradation, and increase the carbon stocks in the forests, contributing with the fight against global climate change.

- **<u>Community objective</u>:** Contribute with quality of life improvement for the communities and populations involved in the project through the implementation of sustainable productive activities and the enhancement of forest goods and services.

- **<u>Biodiversity objective</u>:** Contribute with the conservation of the biodiversity present in the dry forests of the project area that is part of the “Pava aliblanca Ñaupe-Racalí” biological corridor, considering the pava aliblanca (*Penelope albipennis)* as the main conservation object, being currently in critical threat.

3.2. Design

The analysis of the characteristics of the project area, historical deforestation processes, and agents and drivers of deforestation and forest degradation of the dry forests, led to the conclusion that the project area is characterized by forests subject to a high degree of deforestation and degradation threat, low growth rates due to low precipitation conditions and and reduced natural forest regeneration due to the pressure caused by intensive grazing. Thus, the main activity for emissions reduction or removal through a forest carbon project in the area is Reducing Emissions from Deforestation and Degradation (REDD+) in dry forests, complemented by activities that will allow the natural regeneration of the forests and the increase in the carbon content of the forests through a sustainable forest management.

3.3. Participants

The successful implementation of the project required the involvement of local, departmental and national stakeholders that allowed covering the different roles and experience in technical aspects, forest management and rural development that were needed. The definition of roles and responsibilities from an early stage in the project design allowed to obtain efficient processes and to avoid potential conflicts.

In this aspect, the project relies on the involvement of two local populations; the populations that are part of the RCA SHDF, and the populated areas of the Olmos PC, found in the vicinity of the project area.

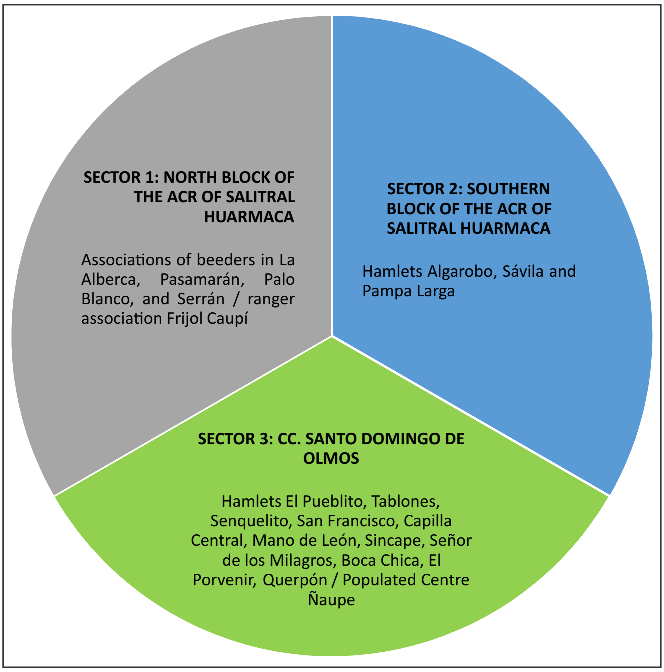

Figure 8. Subdivision of the populations involved in the project

The roles of the local key stakeholders in the realization of the project are: active involvement in productive and conservation activities of the REDD+ project, give support in monitoring, reporting and verification activities of the project and managing the distribution of the benefits generated with the project. The benefits obtained are work opportunities and income for participating in conservation and sustainable productive activities and strengthening of technical and management of natural resources skills.

At a departamenal level, strategic alliances have been made with Piura and Lambayeque regional governments for political support of the REDD+ project. Regional environmental management will be benefited through the financing of conservation actions in RCA and the strengthening of local skills for conservation and sustainable economic activities.

AIDER is in charge of the technical advice and management support of the REDD+ project, for which it has a specialized technical team. It benefits by achieving its strategic objectives and by having the opportunity of implementing sustainable productive activities and forest management.

Figure 9. Project design elaboration with the inhabitants of the RCA SHDF and Olmos PC

3.4. Project Design Document (PDD) elaboration

Based on the characteristics of the project, the projected carbon benefits, location and applicability to the available methodologies for REDD+ projects, the VCS and the CCB standard were chosen, which are accepted and recognized internationally.

VCS is the preferred carbon quantification standard in the voluntary market and the one capturing most forest carbon transactions. Also, the CCB is the most prominent standard in ensuring social and biodiversity benefits for the project.

VCS approved methodologies and their applicability to the project's conditions were evaluated; as a result, the VM0015 methodology version 1.1 to avoid unplanned deforestation was used. The choice of methodology is the core of the carbon benefits quantification and it includes instructions for the establishment of the baseline scenario, measurement and monitoring of changes in carbon stocks and evaluation of leakages and project emissions.

A) Spatial limits of the project

The spatial boundaries of the project defined according to the methodology are:

- **Reference region.-** It is composed of the La Matanza, Buenos Aires, Salitral and Huarmaca districts in Piura region, and the district of Olmos in Lambayeque region; having a total area of 463,826 ha.

- **Project area.-**The REDD+ project area includes the management and conservation of 38,355 hectares of dry forest that make up part of the pava aliblanca (*Penelope albipennis)* biological corridor, belong to the "Regional Conservation Area Salitral-Huarmaca Dry Forests" in Piura, and to the Santo Domingo de Olmos Peasant Community in Lambayeque. By the start date of the project, 100% of the project area classified as forest according to the national definition applied by the National Forest Inventory for dry forests.

- **Leakage belt area**. It is defined by a mobility analysis of the agents of deforestation according to the areas that present the greatest potential for deforestation and degration drives mobility, havinf an area of 20,034 hectares.

- **Leakage management area.** It is located in the borderline forest areas that are close to the involved populations.

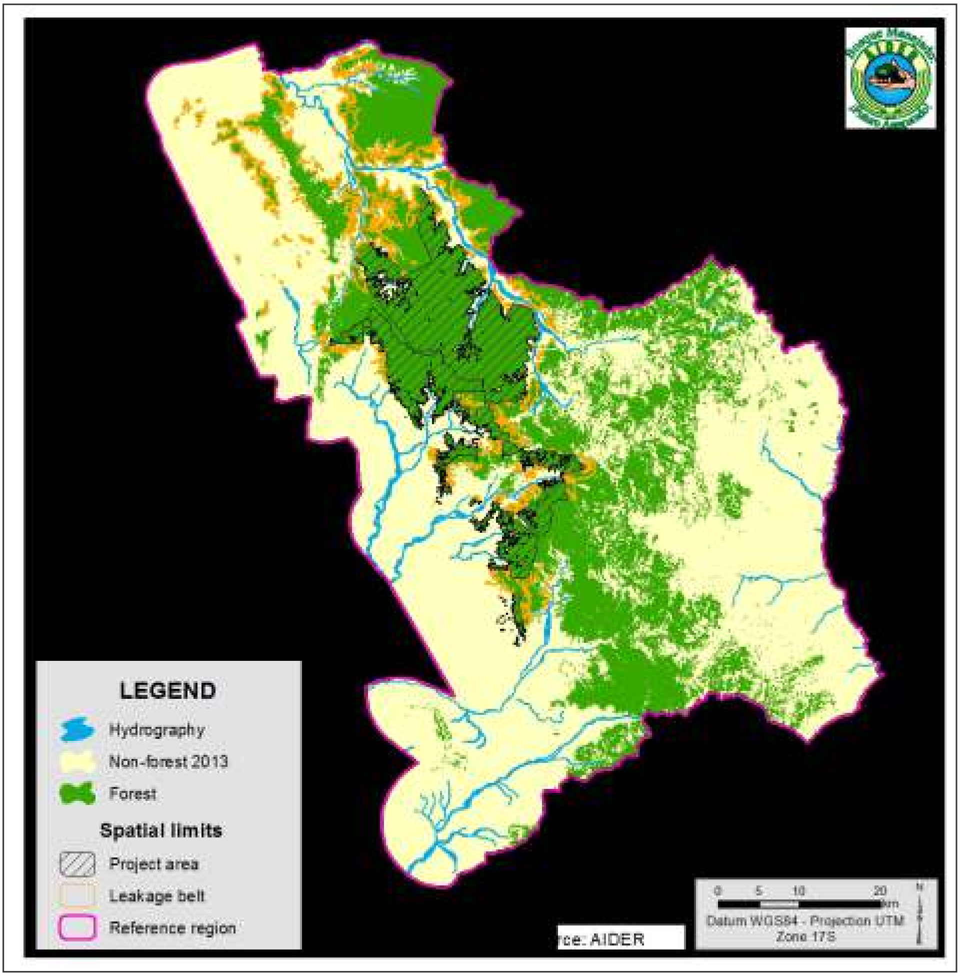

Figure 10. Spatial limits of the REDD+ project

B) Temporal limits of the project

The project looked at a 13 year period (2000-2013) for the analysis of historical deforestation in the reference region. The project's start date is April of 2013 and a period baseline of 10 years was established until the year 2023, for the analysis of future deforestation and the emissions reduction volume estimate for the project. The renewable crediting period is for 20 years.

The minimum duration of the monitoring period is of one year and it shall not exceed the baseline period. Monitoring reports will be issued preferably annually, in order to evaluate the effectiveness of the implementation of the project's activities.

IV. Deforestation and avoided emissions estimate

The main objectives for this stage were the characterization of the baseline of the project regarding the analysis of historical deforestation and degradation and historical of land use change patterns in the area, the estimated carbon content, the projected future deforestation and the preliminary estimate of the carbon benefits.

This evaluation was performed in a conservative way, including a susceptibility analysis of the key assumptions. The procedures and estimates have been made according to the VM0015 methodology version 1.1, to avoid unplanned deforestation.

4.1. Historic deforestation

The forest cover in the reference region of the project was analyzed for the 2000, 2007 and 2013 periods, with the help of medium resolution Landsat satellite images, acquired with a range of one year around the year the study was conducted (± 1 year). The study included a validation stage for the information generated with high resolution images and field verification points. It is noteworthy that the acquired images analyzed for the mentioned periods presented a high occurrence of clouds and shadows due to the location (northern Peru). Therefore, it was decided to carry out a multi-temporal analysis, with images ranging from December to March (wet season) and May to November (dry season).

This study used the National Forest Inventory definition of dry forests, which determines a minimum surface area of 0.5 hectares, with a minimum tree crown cover of 10% and a minimum tree height of 2 meters at maturity *in situ*
This definition determined the eligibility of the forests for the REDD+ project, categorizing dry dense forests and dry semi-dense forests as "eligible forests", and dry sparse forest and dry very sparse forest as "non-forest", taking into account the stratification of dry forests applied by the Algarrobo Project (INRENA, 2003a and b), which used the crown coverage criteria.

To ensure a high quality, the pre-processing, interpretation, classification and post-processing stages were performed according to the treatment and correction guidelines for the corresponding spatial sensors (for example Landsat 8 OLI / TIRS[81]), and image analysis and classification guides[82].

From the types of cover and land use identification analysis performed in the reference region, four categories of coverage and land use were defined: dry dense forest and dry semi-dense forest (initial classes) and non-forest vegetation and bare soil (post-deforestation classes).

The results of the historical deforestation analysis indicate an annual average deforestation rate of 2,237 hectares in the reference region, which corresponds to an annual loss of 1.32% of the existing forest cover, which is of 156,819 hectares to the start date the project.

[81] Using the USGS Landsat 8 Product (http://landsat.usgs.gov/Landsat8_Using_Product.php)

[82] Richards, J., Jia, X. (2013)

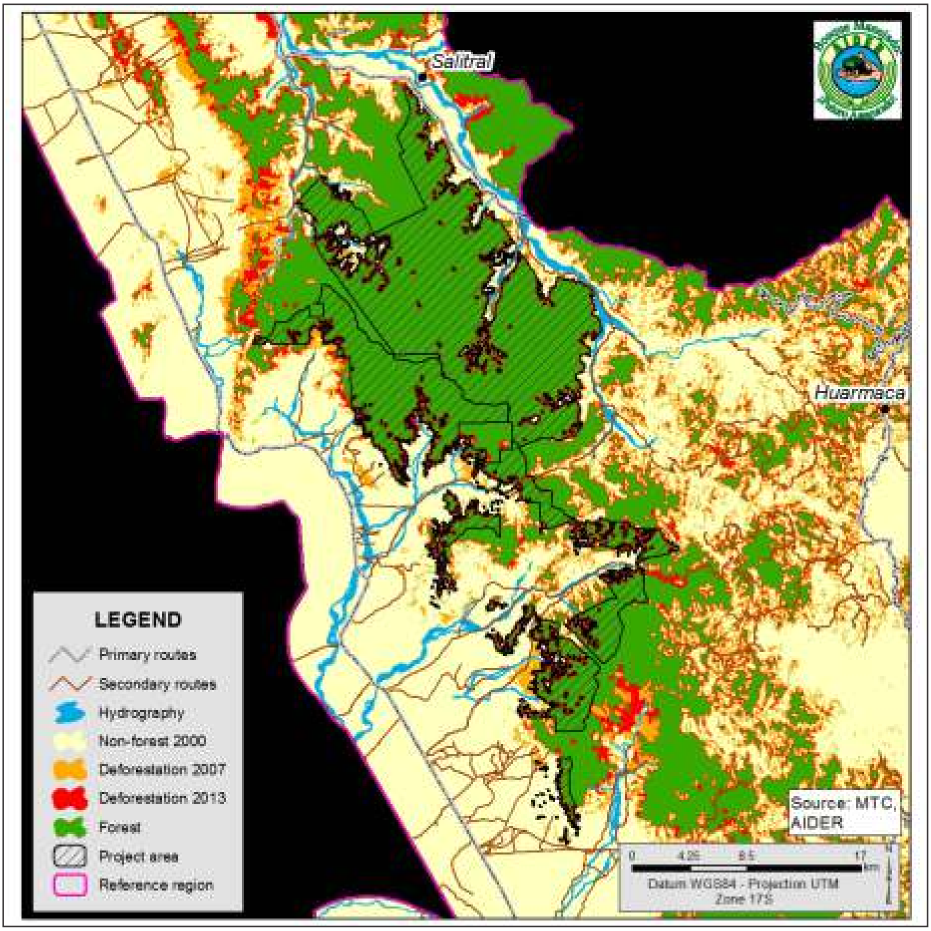

Figure 11. Historical deforestation map (2000-2007-2013) in the project area

4.2. Carbon content estimate

The criteria applied for defining land use classes was the homogeneous carbon content within a class, also called carbon density (tCO_2-e ha^{-1}). There are four land use classes and covers defined for the project: dry dense forest and dry semi-dense forest (initial classes) and non-forest vegetation and bare soil (post-deforestation classes).

The inventory performed to determine the carbon content was exploratory with an optimum stratified sampling design and a random systematic distribution in the identified classes in the study area. The sampling units were constituted by: temporary rectangular plots of 0.5 ha and circular nested sub plots of 5, 20 and 30 m radius. The aerial biomass of all woody tree and shrub vegetation in the plots was measured, including the destructive sampling for the smaller diameter classes.

Figure 12. Local inhabitants participating of the carbon inventory for determining the carbon content

For the biomass estimates, the direct method was used. Allometric equations developed for the main dry forest species as algarrobo[83], overo and faiqu[84]e and shrubs such as vinchayo, cuncuno and canutillo were applied. The allometric equation for the mentioned shrubs is detailed in this publication on the Pomac Forest Historical Sanctuary experience. For the other tropical dry forest tree species, a default allometric equation for tropical dry forest[85] species was used.

The carbon stored underground by the trees and shrubs was estimated by the underground/aerial biomass ratio (R), default value established by the IPCC (2006) for tropical dry forest species (0.28)[86] and for tropical shrubs (0.40)[87].
Also, for estimating the carbon content in the biomass, the default value for the carbon fraction of 0.47 $tC(dm)^{-1}$ proposed by the IPCC (2006[88]) for aerial forest biomass, was used. The conversion of carbon tons (tC) to equivalent carbon dioxide tons (tCO_2-e) was made using the conversion factor of 44/12[89], which corresponds to the molecular weight ratio of carbon to carbon dioxide.

83 Llanos, M. (2011)
84 Recavarren *et al*. (2009)
85 Brown, S.; Iverson, L. (1992)
86 Mokany, K. *et al*. (2006)
87 Poupon, H. (1980)
88 McGroddy, M. *et al*. (2004)
89 IPCC. (2003)

The measurement of the 127 plots in the dry dense forest (27), dry semi-dense forest (60) and non-forest vegetation (40) classes, resulted in the estimate of the carbon contents seen in table 1.

Table 1. Carbon content per strata and reservoir

Strata	Aerial reservoir ($tCO_2\ ha^{-1}$)	Underground reservoir ($tCO_2\ ha^{-1}$)	Total ($tCO_2\ ha^{-1}$)
Dry dense forest	390.9	107.8	498.7
Dry semi-dense forest	137.9	40.0	177.9
Non-forest vegetation	35.4	11.7	47.3

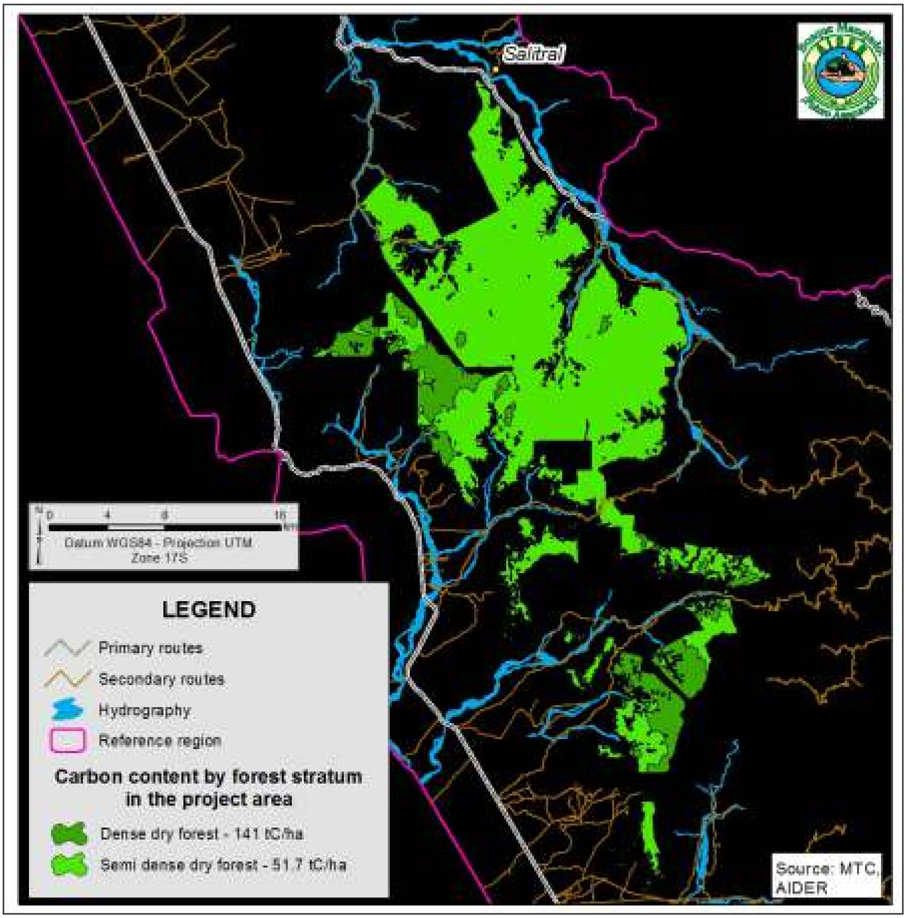

Figure 13. Carbon density map for the tropical dry forest

4.3. Deforestation rate

After the analyses of historical deforestation, agents and drivers of deforestation, field studies to generate primary data (participatory workshops, surveys and interviews) and consult of secondary sources were carried out, it can be confirmed that the collected evidence regarding the most likely deforestation trend in the reference region and the project area is conclusive.

The weight of the evaluated variables indicates that the general baseline trend of future deforestation will be increasing. This statement is conclusive by demonstrating the relationship between groups of deforestation agents, driving variables and underlying causes, which can be verified by statistical values (AIDER, 2014b).

In this sense, the baseline adopted a modeled approach for project, in which the baseline rate of deforestation is estimated using a model that expresses deforestation as a function of a selected driving variable: projected population growth rate for the populated areas that make up the reference region of the project. This variable is consistent with the agents and drivers of deforestation analysis (AIDER, 2014c).

Once the variables of the model were defined, the next stage was the systematization of the sources and the historical data used for the extrapolation and its projections until the year 2023. The historical data sources from the "Instituto Nacional de Estadística e Informática" were used for the population variable, and the study of historical deforestation was used for the forest cover variable. Three types of bivariate regressions were made: linear, exponential and potential.

The results were analyzed in order to represent a similar trend to that analyzed in the reference region of the project, in which a high projected population growth is expected for the years of the baseline. This is due to migration that will happen when the Olmos Irrigation Project is implemented, which will promote the establishment of new populated areas in order to promote and encourage manual labor availability.

The linear regression equation selected for the project is:

$$Y=-410774X+213486 \text{ c}$$

With a R^2 = 0.9098

Where: "Y" represents forest cover and "X" the population density of the populated areas within the project's reference region.

With an average deforestation rate of 1.57% for the base line period of the project.

Table2. Increasing linear deforestation rate for the baseline of the project

Deforestation rate	
Period	**Increasing line**
2013-2014	1.23%
2014-2015	1.28%
2015-2016	1.34%
2016-2017	1.41%
2017-2018	1.47%
2018-2019	1.55%
2019-2020	1.62%
2020-2021	1.70%
2021-2022	1.79%
2022-2023	1.88%

4.4. Projected deforestation

With the defined baseline approach and the constructed model, the projection of deforestation for subsequent years and the corresponding rates of change can be performed. The portion of the annual deforestation areas for the forest classes was determined using geographic information systems.

To obtain the projected location of future deforestation, the following inputs and tools were necessary: forest and non-forest maps for the historical period (2000, 2007 and 2013), spatial variables considered to influence in the location processes of deforestation, calculated future deforestation rate and modeling software.

Deforestation maps for the historical period are important inputs since they allow determining an actual forest cover change pattern for the historical reference period. As for the variables that influence in deforestation processes, all of those that could influence favorably and unfavorably were collected. The variables come from official sources such as regional governments, ministry of education, ministry of transport, and the Geological Mining and Metallurgical Institute, among others.

Finally, with the use of inputs and modeling tools (software), the risk maps or suitability areas for the transition from forest to non-forest cover were obtained. Then, the most accurate deforestation risk map was selected through the calibration and confirmation of the simulated map, using two historical sub-periods or real deforestation maps. The evaluation technique that was used is "Figure Of Merit" (FOM) which confirms the prediction model in a statistical manner, as indicated in the methodology to avoid unplanned deforestation VM0015 v1.1.

From the validation analysis performed, it is concluded that the calibration performed with the model allows representing the historical deforestation within the expected accuracy parameters, therefore, adequate results for projecting the location of future deforestation in the reference region area are expected (AIDER, 2014c).

Taking the calibrated and validated model and other inputs, other maps representing the areas that will most likely be forested by the interaction of the various variables in the base line period of the project were generated, as shown in figure 14. Similarly, the projected future deforestation in the project area for the 2013-2023 period can be seen in figures 15 and 16.

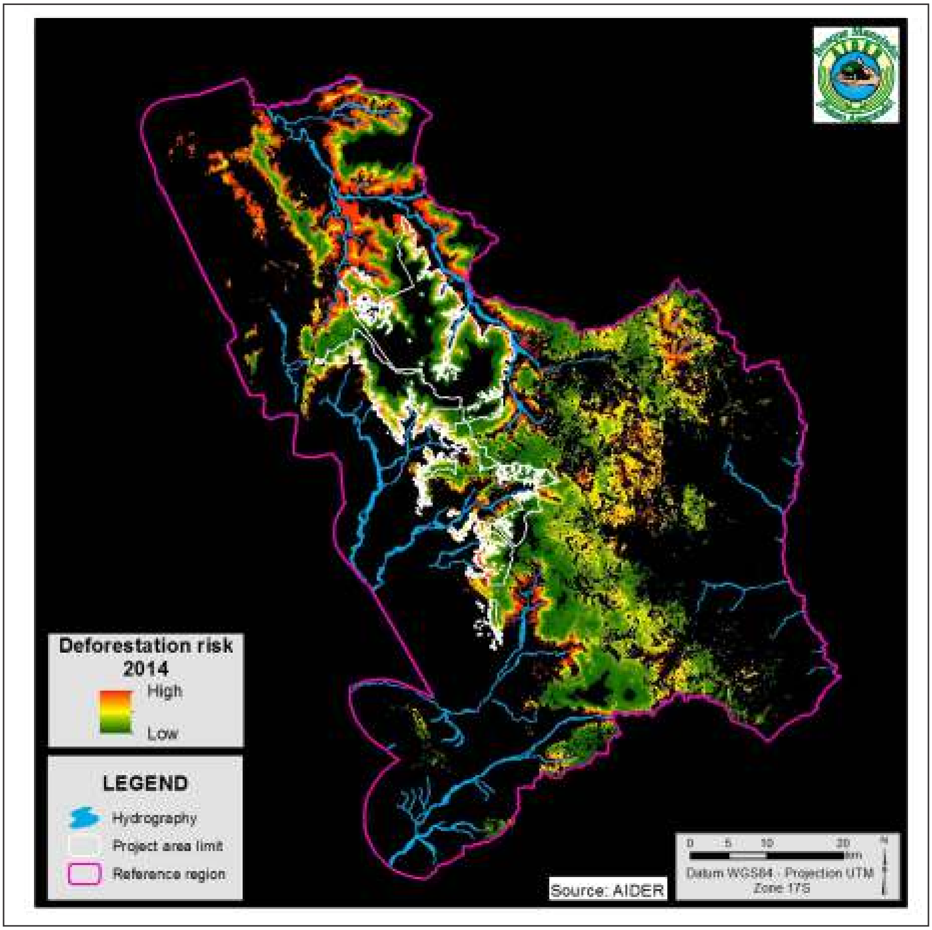

Figure 14. Deforestation risk map for 2014

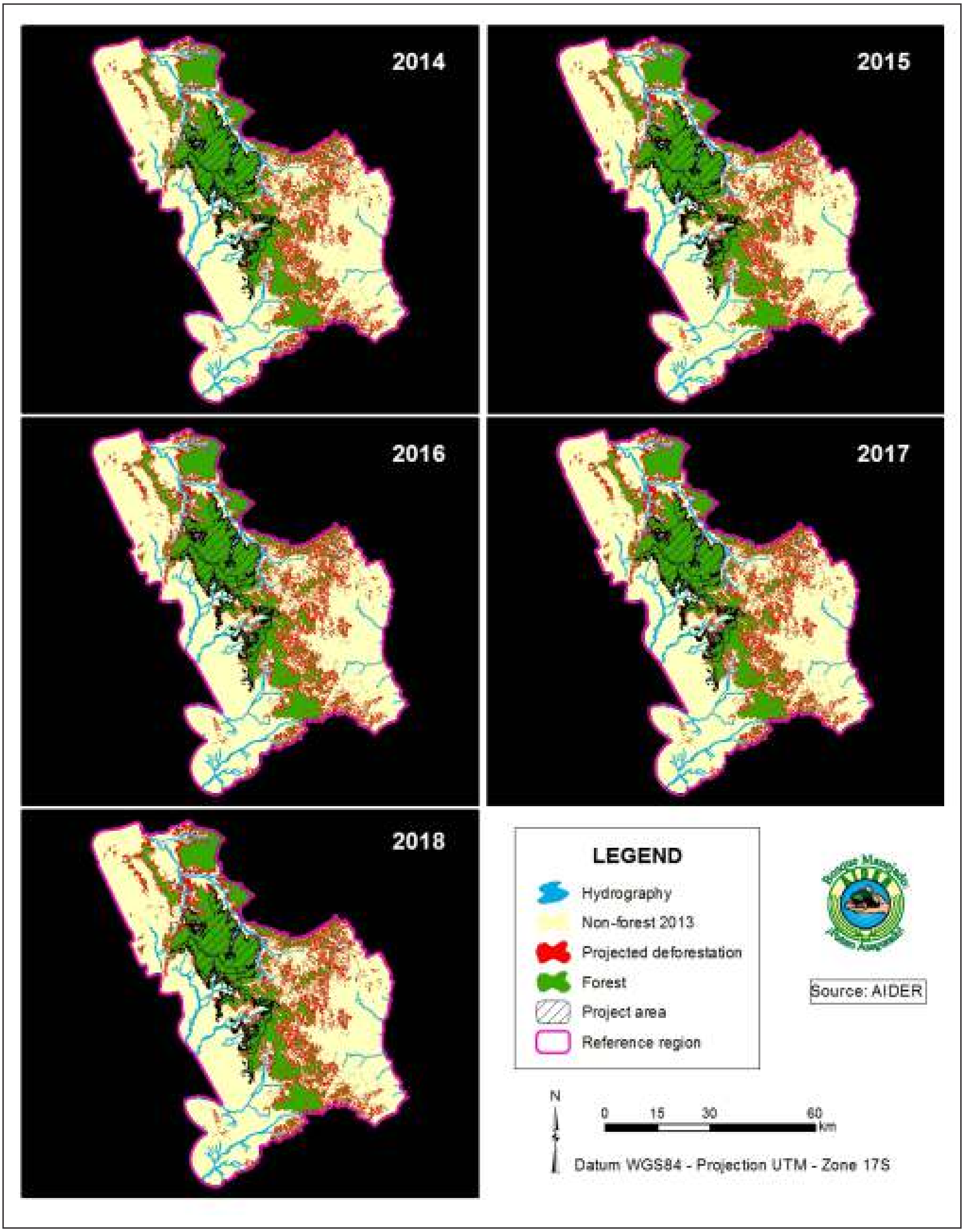

Figure 15. Projected future deforestation map for the base line period 2014-2018

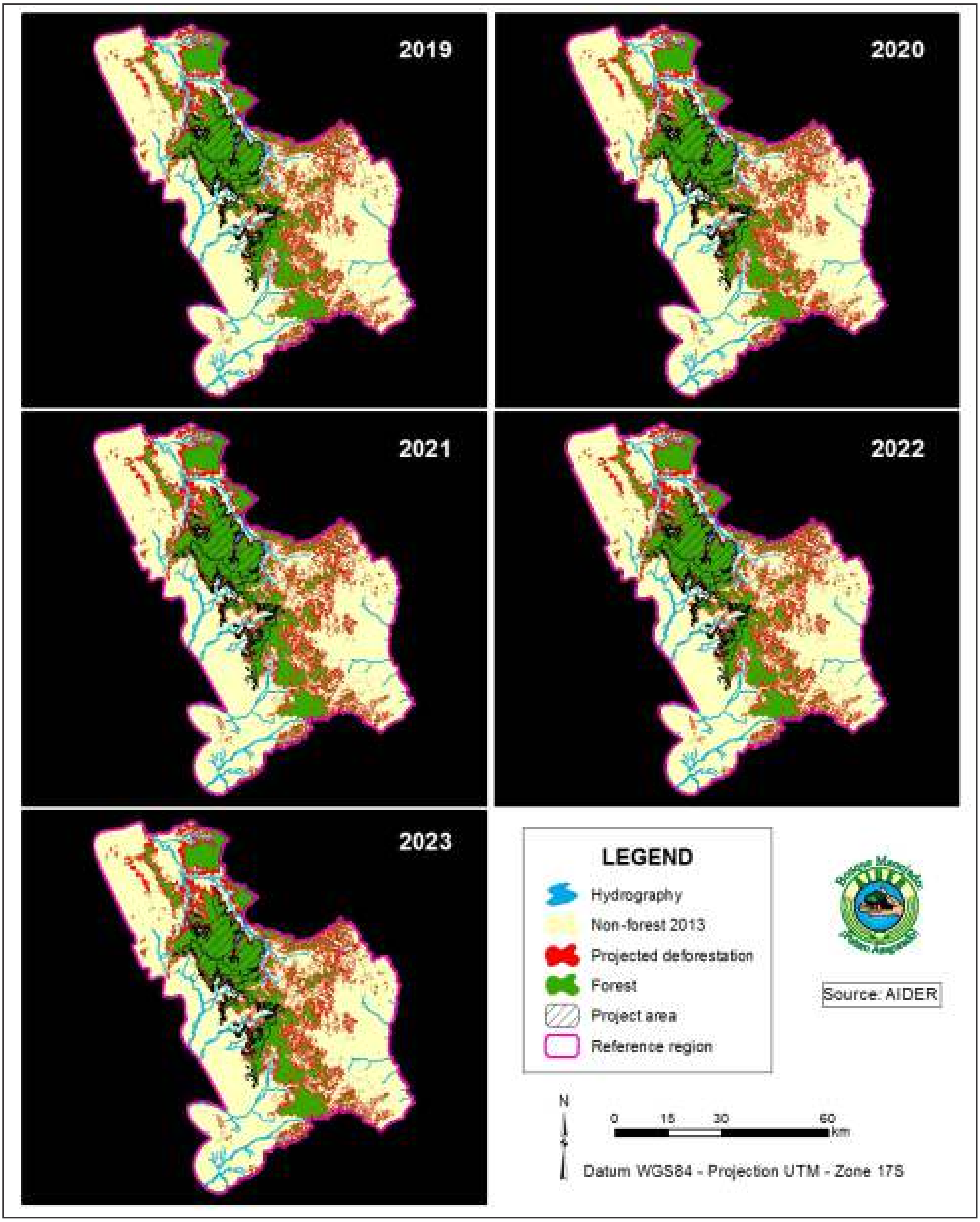

Figure 16. Projected future deforestation map for the base line period 2019-2023

4.5. Avoided emissions estimate

The ex ante carbon benefits are projected and quantified based on the VCS standard specifications and the applied methodology. Fundamentally, the estimation considers the projection of future deforestation in the project area and the carbon stored according to land use under the baseline scenario and comparing it with the carbon stored according to land use under the project scenario.

The exact carbon credits volume to be generated based on the benefits for reducing GHGs will depend on the performance of the actual project and the monitoring results that are verified by an independent auditor. In this sense, the project considered important making solid, transparent and credible assumptions for the *ex ante* avoided emissions.

The risks of leaks due to the displacement of activities that cause deforestation outside of the project area have been considered as a requirement for the methodology and a solid risk analysis has been performed in order to properly design the project's activities and evaluate the social impacts. However, leaks that cannot be avoided through the design of the project are quantified and subtracted from the total project benefits by applying a discount leak factor, which is directly related to the percentage of agents of deforestation that are not involved in the project's activities and that in the case of this project is of 11.5%.

Likewise, a non-permanent risk assessment of the project is required through the use of the non-permanent risks VCS AFOLU tool, which considers an analysis of external, internal and natural risks to which the project is exposed in order to determine a buffer that guarantees the permanence of the GHG benefits generated by the project. For this project, a buffer of 13% of total net avoided emissions has been considered.

Table 3. Net emissions reduction of anthropogenic GHG attributable to the project's activities

Year of the project	GHG emissions due to deforestation in the base line scenario		GHG emissions due to deforestation in the project scenario		GHG emissions due to deforestation in the due to leaks		Net emissions reduction of anthropogenic GHG	
	annual tCO_2-e	accumulate tCO_2-e	annual tCO_2-e	accumulate tCO_2-e	annual tCO_2-e	accumulate tCO_2-e	annual tCO_2-e	accumulate tCO_2-e
2013-2014	63.343	63.343	10.694	10.694	7.284	7.284	45.364	45.364
2014-2015	55.861	119.203	9.431	20.125	6.424	13.708	40.006	85.370
2015-2016	57.900	177.103	9.775	29.900	6.658	20.367	41.466	126.836
2016-2017	57.373	234.476	9.686	39.587	6.658	26.965	41.089	167.925
2017-2018	60.925	295.401	10.286	49.873	7.006	33.971	43.632	211.557
2018-2019	55.783	351.184	1.920	51.793	6.415	40.386	47.448	259.005
2019-2020	65.456	416.640	2.253	54.045	7.527	47.914	55.676	314.681
2020-2021	63.063	479.703	2.170	56.216	7.252	55.166	53.641	368.322
2021-2022	60.540	540.244	2.084	58.299	6.962	62.128	51.495	419.817
2022-2023	56.684	596.928	1.951	60.250	6.519	68.647	48.215	468.031

V. Management documents

The implementation and financial management of the project requires the design and implementation of management plans that clearly define the objectives, roles, responsibilities and the management structure of the project. Planning for a management with an effective participation the local stakeholders requires investing in strengthening local governance and management capabilities to ensure transparency and effectiveness.

In this context, under the REDD+ project a series of management documents were developed, the ones that would ensure effectiveness, efficiency and equity on the development of the proposal.

5.1. REDD strategy

It is the management document for the implementation of the REDD+ project activities, its design and planning considered the involvement of all local and regional stakeholders, allowing the construction of a strategy whose main objective is reducing deforestation and forest degradation of the dry forests within the project area, through the development of three key components: sustainable land use, sustainable business promotion and organizational, social and technical skills development.

5.2. VCS Project design document

Provides key information about the project design. It focuses on the processes and procedures to follow for quantifying the carbon benefits and establishes the essential information to be monitored and verified during the lifetime of the project for estimating the emissions reduction.

5.3. CCB Project design document

It is the management document that aims to determine the procedures and processes to ensure and monitor the net positive impacts of the REDD+ project in the social and biodiversity aspects. It integrated conflict management plans, human resource management plans and biodiversity management to ensure the co-benefits of the REDD+ project.

5.4. Management plan for local stakeholders training

It is the plan that comprises the strengthening of the capabilities and the knowledge of the members of the populated areas involved in the implementation of the REDD+ strategy activities. It considers the development of organizational, social and technical skills for managing natural resources, integrating the knowledge and experience of the people of the area of influence of the project. The categories established by the plan are: organizational strengthening, agro-silvo-pastoral resources at communal level, protected areas management and business management.

5.5. Conflict management plan

It is the document that establishes the procedures for addressing claims and resolving conflicts that may arise during the planning and implementation of the project regarding consultation processes, rights over land, territories and resources, benefit distribution and participation. It considers feedback procedures and addressing project related claims.

5.6. Occupational safety plan

The plan considers the occupational safety measures required for the development of data collection activities in the forest (biodiversity assessments, monitoring forest cover and control and surveillance of the project area), data collection in populated areas (monitoring the project's activities and the socio-economic impacts) and activities such as training workshops, technical assistance and promotion of activities in populated areas.

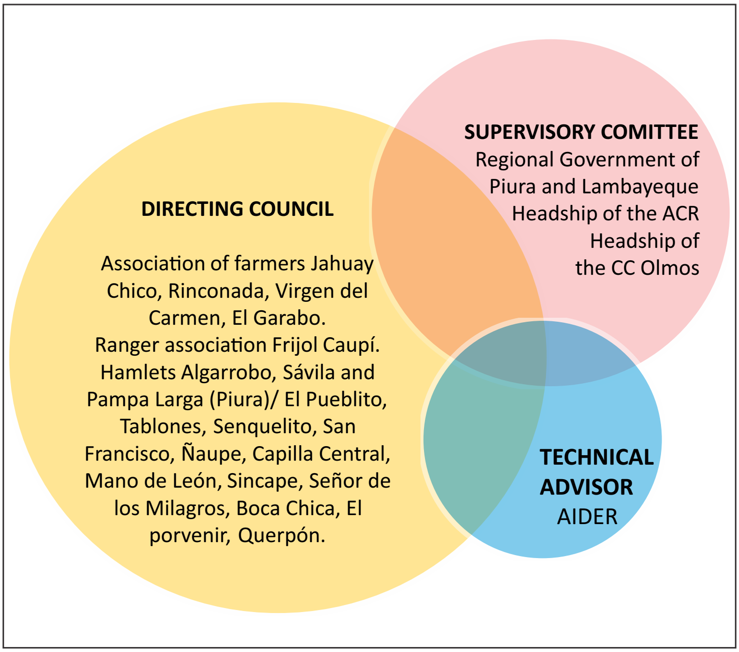

Figure 17. Governance and management structure for the REDD+ Project

VI. Monitoring

Monitoring is considered one of the key activities in obtaining the climate, biodiversity and social benefits of the project. The documented monitoring results represent the evidence of benefits generated by the REDD+ project. In this context, the design of quality monitoring plans that are feasible of being implemented in the area has been considered of vital importance. The monitoring of the project's activities and avoided emissions reduction that are contemplated in the project design document under the VCS standard, as well as the monitoring of social impacts and biodiversity according to the project design document under the CCB Standards, are considered.

Monitoring plans have been developed in a participatory way with local stakeholders; these will allow defining the indicators to be evaluated according to the logical framework and baseline of the project, identifying the ones responsible for its implementation, the gathering of information and the design of formats and tools for the systematization of the information.

Project monitoring involves the use of qualitative and quantitative tools for the evaluation of progress and the detection of problems, which could be implemented to fulfill the results and the proposed objectives. Impact, outcomes and processes indicators are to be monitored, using tools of information gathering and evaluation as interviews, focus groups, direct observation of the implemented activities, perception surveys, cost analysis in the case of the development of economic activities and evaluation surveys to see the quality of the activities.

6.1. REDD strategy monitoring

Is the monitoring of the implementation and results of the project's activities according to the logical framework of the REDD+ strategy. It considers the participation of the Chief of the RCA SHDF and the conservation and environmental management committee of the Ñaupe-Racalí sector of the Olmos PC, responsible for monitoring the implementation activities of the populated areas involved in the project with the technical assistance from AIDER.

Also, AIDER has a Planning, Monitoring and Evaluation (PM&E) system applicable to environmental projects, the same that has many tools and methodologies that allow effective control over the project's activities.

Monitoring of the REDD+ strategy is performed based on its 3 components:

A) Sustainable use of the land by land management activities, reduction and optimization of fuel wood consumption, training in good environmental practices, ecosystem recovery and control, surveillance and monitoring.

B) Promotion of sustainable businesses in the dry tropical forest, through technical training and transfer of technology packages for agroforestry and silvo-livestock, promotion of partnerships with the private sector, diversification of the production and use of tropical dry forest products and services.

C) Development of local capacities, through training, organizational strengthening, environmental education and strengthening of social capital.

The main measurable indicators for monitoring the activities of the REDD+ strategy are: (i) people who develop capabilities, (ii) families that implement activities, (iii) hectares of forest under management, (iv) trained and implemented rangers, (v) training workshops, (vi) management documents implemented and others deemed relevant and allow measuring the effectiveness and efficiency of the implementation of the activities of the REDD+ strategy.

6.2. Deforestation and GHG monitoring

The main purpose of the deforestation and greenhouse gases monitoring plan is to obtain the necessary information to estimate the amount of avoided emissions during the crediting period of the project. It is integrated with the REDD+ strategy monitoring plan to evaluate the effectiveness of the project's activities that ensure the achievement of the emissions reduction objectives.

Field monitoring is in charge of the professional monitoring team and is performed in coordination and collaboration with the rangers and community members that belong to the monitoring activities. The active participation of local stakeholders is encouraged; they are the ones responsible for the field data collection, being trained for this purpose and with technical advice during the assigned activities.

6.3. Land use change monitoring

Land use change monitoring activities are performed once a year and include the use of Landsat 8 remote sensors as well as field inspections; combining both sources results in the deforested area estimate for the reference region, project area and leakage belt area to quantify the reduction in deforestation compared to the baseline. The deforestation map generated is validated through systematic unaligned sampling on the field.

All monitoring activities are implemented using Standard Operating Procedure (SOP) prepared by the technical team of the project. The staff is constantly trained to ensure quality in the collection and systematization of data. Also, the Assurance and Quality Control Group programs audit visits to verify compliance with the SOPs, selecting random processes to verify the correct implementation of SOPs.

6.4. Carbon stock change monitoring

Changes in carbon stocks caused by land us change from forest initial classes to non-forest classes are monitored by the project. Carbon stock change is equal to the difference between the carbon content of the initial forest classes (dry dense forest and dry semi-dense forest) and the carbon content of the final post-deforestation classes (non-forest vegetation and bare soil).

For the project, it has been assumed that carbon stocks for land use classes will not change over the established base line period and therefore carbon stock monitoring is not required. However, in the project area and leakage management area, conservation and enhancement of carbon stocks are promoted through assisted natural regeneration activities in order to enrich the dry forests and increase the carbon stocks. Therefore, for the project, it is conservative not to account for increases in carbon stocks for the classes present within the project area and leakage management area.

Furthermore, field monitoring performed by local stakeholders with advice from the professional team takes into account the detection and evaluation of natural disturbances or anthropogenic events. In case either of them takes place, they must be documented as they may cause potential impacts on carbon stocks due to the occurrence of catastrophic natural or anthropogenic events.

6.5. Social monitoring

Monitoring of the social impacts of the project's activities is integrated into the REDD+ strategy; the impacts are evaluated relative to the baseline original conditions of the project.

The community monitoring plan focuses on the populated areas present in the RCA SHDF and Olmos PC that are a part of the project's activities. Monitoring variables are directly related to the objectives of the project and can be grouped into: economic and community organization level, productive activities and employment generation, family income level, access to forest resources and technical and management capabilities of the natural resources.

The measurement of indicators is directly performed through the application of information gathering tools such as: direct observation, surveys, interviews, reports, focus groups and technical reports. The reporting and monitoring frequency of the indicators quarterly, semiannual and annual according to the variables and the implemented activities.

6.6. Biodiversity monitoring

Monitoring of biodiversity is directly linked to the biodiversity targets and the project's activities in order to ensure the achievement of the desired outcomes and identified impacts in the logical framework of the REDD+ intervention.

In this sense, one of the main biodiversity conservation targets of the project is the pava aliblanca (*Penelope albipennis*), endemic to the tropical dry forest and categorized as in critical threat under national and international law.

The number of individuals for this specie is monitored to acquire information of its area of distribution. A plus for monitoring, is that the specie has a territorial behavior, so the risk of performing a repeated count of the same individuals is avoided. The frequency of monitoring, considering a marked seasonality of the specie, is to be four times per year in order to register the mentioned variability; being the wet season from January to April and the dry season from July to November.

Major streams were selected to be monitored, taking into consideration two main criteria: streams that have a large concentration of individuals and streams that have a high degree of threat. Also, every four years a total census of pava aliblanca will be held. The nesting activity of the specie will also be monitored. For this, during the January evaluation, the number of nests in use will be counted in the in major streams. The monitoring of eggs in the nests will not be considered to avoid disturbing the specie.

On the other hand, as the pava aliblanca is a specie that feeds on fruits and leaves of different tree species, the monitoring of the phenology and percentage coverage of these species is to be performed. For this, permanent plots will be installed, palatable tree species for the pava aliblanca will be marked and for which percentage coverage and phenological stage (vegetative, flowering, and fruiting) will be measured and registered. In these same plots natural forest regeneration monitoring will be performed.

Water, as the determining factor for the development of biodiversity, it is necessary to monitor the flow of water coming from the jagüeyes. Monitoring of productive activities that could potentially have an impact on the conservation targets, has also been considered important; for example livestock, monitoring the following indicators: head of cattle in the area of the project, head of cattle under management and number of hectares under livestock management.

VII. Expected results

7.1. Climate

The expected result is a net emissions reduction from unplanned deforestation in the project area. For the first baseline period (2013-2023) emissions are to be reduced by a total of 468,031 tCO_2-e.

In terms of verified carbon credits (VCUs), having estimated the buffer credits according to the non-permanent risks analysis, an average annual generation of 39,826 carbon credits that can be sold on the voluntary carbon market is expected. Additionally, the climate benefits from the implementation of project's activities that reduce forest degradation and increase carbon contents are not quantified in carbon credits.

Table 4. Ex ante Verified Carbon Units (VCU) estimate

Year of the project	Net emissions reduction of anthropogenic GHG		Ex ante tradable VCUs		Ex ante Buffer credits	
	annual	accumulate	annual	accumulate	annual	accumulate
	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e	tCO_2-e
2013-2014	45,364	45,364	38,520	38,520	6,844	6,844
2014-2015	40,006	85,370	33,970	72,490	6,036	12,880
2015-2016	41.466	126,836	35,210	107,700	6,256	19,136
2016-2017	41,089	167,925	34,890	142,589	6,199	23,336
2017-2018	43,632	211,557	37,049	179,638	6,583	31,919
2018-2019	47,448	259,005	40,446	220,084	7,002	38,921
2019-2020	55,686	314,681	47,460	267,544	8,216	47,137
2020-2021	53,641	368,322	45,724	313,268	7,916	55,053
2021-2022	51,495	419,817	43,895	357,164	7,599	62,653
2022-2023	48,215	468,031	41,099	398,263	7,115	69,768

7.2. Biodiversity

The benefit is the conservation and improvement of the situation of endemic tropical dry forest species present in the project area, which have been identified as conservation objects. Is expected to establish a pava aliblanca monitoring system that will allow to check-up of the specie status, to take actions that will favor its development by improving the conditions of their nutrition and habitat, as well as the

ecosystems they require for nesting. In this way, there is also a contribution to the conservation of the "Pava aliblanca" biological corridor, which is part of the project.
Regarding the conservation of endemic forest species, it is expected to improve the population's conditions of the threatened forest species through assisted natural regeneration techniques for the tropical dry forest. The project estimates to avoid deforestation an annual average of 356 ha / year of tropical dry forest to the first baseline period (2013-2023).

Measures to reduce degradation pressure of the tropical dry forest are being implemented: reduction in fuel wood consumption of the local population through the implementation of improved stoves and goat farming regulation, allowing the natural regeneration of the forest. Restoration activities for the tropical dry forest are developed by promoting assisted natural regeneration of endemic forest species. As a result the conditions of tropical dry forest in the project area were improved fostering conservation of flora species which are critically endangered as hualtaco (*Loxopterygium huasango*), palo santo (*Bursera graveolens*), sapote (*Colicodendron scabridum*), margarito (*Capparis eucalyptifolia*), faique (*Vachelia macracantha*) and algarrobo (*Prosopis pallida*).

7.3. **Socioeconomic**

The expected socioeconomic results are related with the implementation of the REDD+ strategy activities, which were:

A) **Sustainable use of the land**

- Associations and families recognize and develop their activities using the zoning criteria according to major land use capacity.
- Livestock associations trained and implemented in techniques for the management and improvement of cattle with silvopastoral systems.
- Families reduce and optimize firewood consumption by implementing improved stoves.
- RCA SHDF has funding for control and monitoring of the dry forests, they are involved in the biodiversity monitoring and reward the volunteer rangers.
- Natural assisted regeneration and reforestation are implemented, that will allow the restoration of the tropical dry forest and the generation of employment opportunities for local actors.

B) **Sustainable business promotion**

- Families who set up agroforestry, livestock and beekeeping businesses, among other activities, for improving their revenue.
- Ecotourism activities that generate income for local populations are developed in the area.

- Partnerships between communities, businesses and the State for investment in value chains.

C) **Development of local skills on the administration of their natural resources**

- Local population conscious on the importance and conservation of their dry forests and how to make a proper use of their land.
- Committees and associations of producers organizationally strengthened and leadership develop for the management of their land.
- Local populations improve their coordination mechanisms with local and regional governments.
- RCA SHDF and Olmos PC have management documents for managing their natural resources.

VIII. Lessons learned

- It is important to clearly determine the limits and extent of the forest cover which classifies as forest according to the applicable definition for forest carbon projects, and employ applicable and useful stratification criteria that allow making decisions about the treatments and interventions required for the conservation and improvement of dry forest ecosystems.

- The dominance of deciduous tree species in the tropical dry forest and marked difference between the wet and dry seasons, require a multi-temporal analysis of satellite images in order to conduct a proper analysis of historical land use change and deforestation.

- In dry forests, degradation may be more frequent than deforestation. It is important to consider farming practices, fuel wood consumption and selective logging evaluations to size the causes, quantify the impact and then design activities and implement measures to reduce degradation.

- Monitoring activities for emissions from deforestation made during the implementation phase of REDD+ in dry forests, should include tools to monitor livestock, fuel wood collection and selective logging in order to integrate the monitoring of these sources of degradation and keep a records of the emissions ascribable to forest degradation.

IX. Further actions

- Conduct studies for the definition and delimitation of degraded dry forests in order to focus the restoration and enrichment activities of this class as part of the REDD+ activities, as a response to the need to recover the ability of providing services and goods in these ecosystems. Thus generating more income generating carbon credits from activities that allow the increase of forest carbon stocks.

- It is recommended for the establishment of permanent plots to be considered for the evaluation and monitoring of the degradation process by measuring the carbon stocks and evaluating the natural regeneration occasionally.

- Assess the complementarity of the carbon sequestration ecosystem service with hydrological, landscape and biodiversity conservation services. Carbon may not generate a sufficient return for funding the conservation activities, reason why it is feasible and necessary to generate income for other ecosystem services that will allow achieving the financial sustainability of the project.

- Valuate the co-benefits of REDD+ in this ecosystem to prove they are greater than those that can be given in the Amazonia due to a higher population density and dependence on the forests.

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REDD+ Project “Reduction of deforestation and degradation in Tambopata National Reserve and Bahuaja Sonene National Park in the scope of Madre de Dios Region– Peru”

Carlos Sánchez Díaz – Collaboration: Paul Ramírez Nelson

SUMMARY

The present experience is part of the contract signed by AIDER and the Peruvian State to administrate Tambopata National Reserve (RNTAMB) and Bahuaja Sonene National Park (PNBS), both categorized as Natural Protected Areas (NPA) and located in Madre de Dios Region.

In this frame, it was developed a project to reduce the emissions of greenhouse gases (GHG) from deforestation and forest degradation (REDD) of both NPA forest with the objective of create a mechanism whci can contribute to the financial sustainability of the administratios conctract. From its formulation, the project "Reduction of deforestation and degradation in Tambopata National Reserve and Bahuaja- Sonene National Park in the scope of Madre de Dios Region– Peru" REDD+ project or Tambopata Bahuaja REDD+ project has born, as an AIDER´s institutional wager to condolidate the participate management proposal of NPA by SERNANP and put in value the ecosystemic services that are offer by SINANPE.

The project from the beginning was directed to the voluntary carbon market, reason why this project took into account the utilization of Climate, Community Biodiversity Standards (CCB) and Verified Carbon Standard (VCS) as a backup for potential buyers of carbon credits.

This process has allowed validating the potential of the project to reduce emissions in a volume of 3,982,427 tCO_2-e for the first 10 years, from which have been already verified reductions in net GHG emissions of 190,796.2 tCO_2-e. This has consolidated the first trading carbon credit operations in Peru for a volume of 103,735 tCO_2-e and commit to future transactions with a volume of 2,458,180 tCO_2-e. These achievements have allowed opening the voluntary carbon market in Peru, being Tambopata Bahuaja REDD + project one of the pioneers in this process.

Like any new experience, the project has not been free of challenges in technical, social and legal terms, which have been overcome with the effort of its technical and executive management team and the support of the Peruvian State through the Service of Natural Protected Areas (SERNANP). The challenges faced and overcome are now part of organizational learning and contribute to the development of REDD + mechanism in Peru.

I. Location and characteristics of the project

The project is located in Madre de Dios Region, which has an extension of 85,873.22 Km^2. Its geographical boundaries are with Regions of Cusco, Puno and Ucayali, as well as with Bolivia and Brazil. This Region is politically divided in three Provinces: Tahumanu, Manu and Tambopata, being the latter where the main city, Puerto Maldonado, is located. The figure 1 shows the location of the project.

Figure 1. Location map of the project

1.1 Biophysical characteristics

A) Climate

The climate corresponds to the subtropical moist forest with an annual mean temperature of 26°C, ranging between 10°C and 38°C. Maximum temperatures reach 38°C regularly presented in the months of September and October. Annual rainfall ranges from 1,600 to 2,400 mm, defining two stages given the frequency and amount of precipitation: dry season, between April and December, and a rainy season in the months of January to March, (Rasanen 1993, quoted by INRENA 2003b).

B) Hydrography

Tambopata National Reserve, Bahuaja Sonene National Park and their buffer zones include a part of the basins of Tambopata and Heath rivers. These, are conformed by streams of all sizes which facilitate the access to the vast majority of the area during the rainfall season.

C) Physiography and soils

The topography of Madre de Dios Region is characterized by two big biophysical units: Subandean strips from the eastern cordillera and the Madre de Dios river valley. The first is the largest and is located to the east of the Subandean cordillera, ranging from 176 to 500 meters above sea level. It is characterized by a slight and undulating topography, dominated by the alluvial plains and low hills.

In general terms, the soils of the region are poor in nutrients given the nature of the lithology, the constant chemical weathering (caused by high temperatures and humidity) and the nutrients leaching originated by the rainfall during almost all year long. (IIAP, 2011, quoted by INRENA, 2003b)

D) Ecology

According to the Ecologic Map of Peru (INRENA, 1994), the area of the project present the following life zones: i) Subtropical rainforest (bp-S), ii) Subtropical moist forest bh-S, iii) Subtropical wet forest (transition to bp-S) bmh-S/bp-S, iv) Subtropical wet forest bmh-S

According to the map of forest classification, prepared by INRENA for the implementation of the RNTAMB and PNBS Master Plans, in the area of the project is possible to find the following forest types: i) Alluvial flood forest, ii) Terrace forest, iii) Forest Hill and iv) Mountain forest.

E) Biological diversity

The area of the REDD+ project is a representative space of the biological diversity worldwide. This can be demonstrated through the fulfillment of the endpoints shown as follows in figure 2.

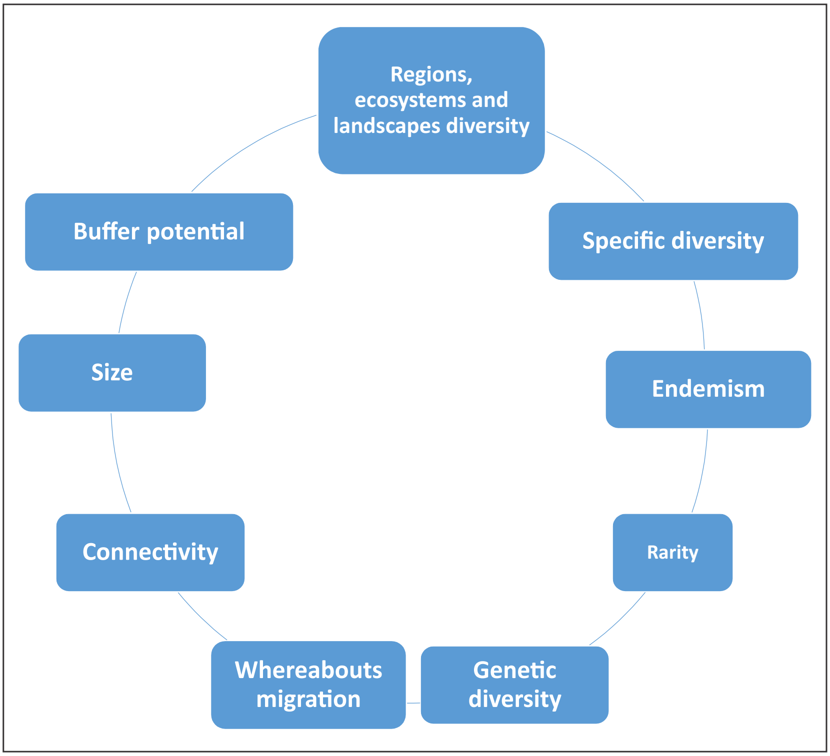


Figure 2. Endpoints of biological representativeness present in the area of the project

The area where the project will be conducted has representative ecosystems of the following biogeographic provinces: Subtropical Amazonia and Subtropical Yunga, having inside its boundaries the unique sample of Tropical moist Savanna in Peru (INRENA, 2003a). The area shows the following ecoregions: Moist Forest of Southwest Amazonia and Savannah of Beni (Dinerstein et al., quoted by Miranda and Beck, 2003)

Regarding to the species diversity, investigations conducted between 1970 y 1980 in the current area of RNTAMB showed a register of more than 570 bird species, and 1,200 species of butterflies, for example. It was found more than 150 tree species over an area of 0.01 Km^2, becoming one of the Plant diversity World

Center, identified by IUCN and WWF (INRENA 2003b). At present, the Reserve have registered 103 amphibian species, 632 of bird, 180 of fish, 169 of mammals and 103 of reptiles (INRENA, 2003b). Meanwhile, in the whole area of PNBS (including the near area of Puno) have been proved the high biological diversity: 74 registered species in 8 families of amphibian; 607 registered species in 60 families of birds; 171 registered species in 30 families of fish; 56 registered species in one family of reptile and 180 registered species in 30 families of fish. (INRENA, 2003a).

Figures 3 and 4 show the representativeness of the NPA considered in the project

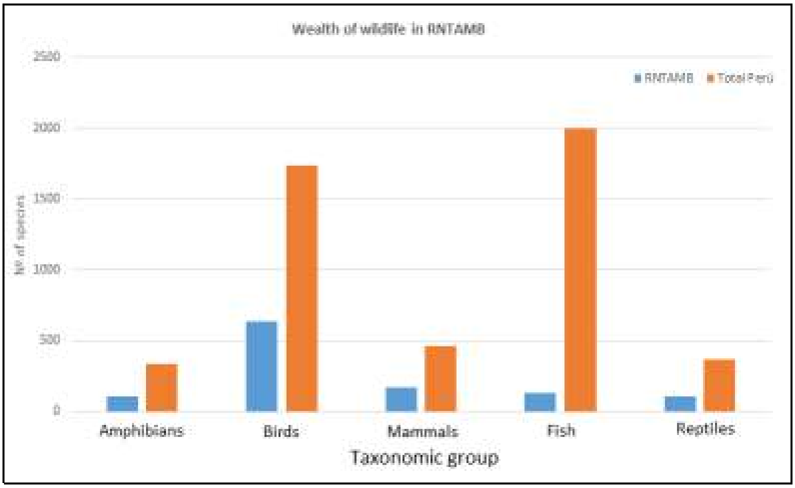


Figure 3. Wildlife richness in RNTAM (Prepared by INRENA, 2003a)

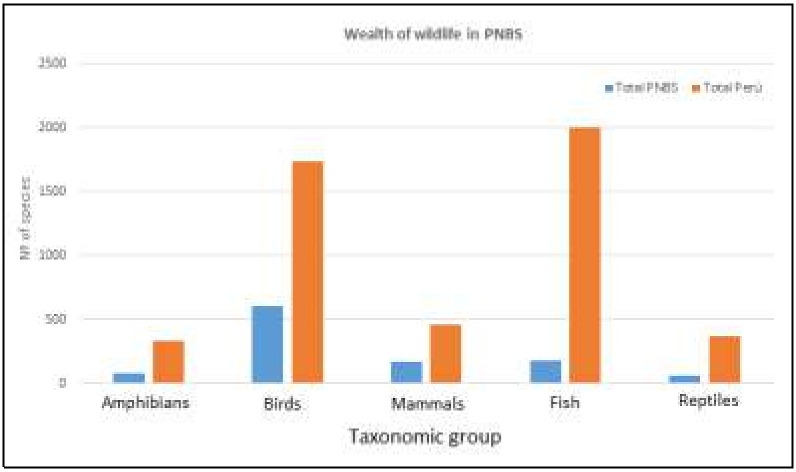


Figure 4. Wildlife richness in PNBS (Adapted from INRENA, 2003b)

The area of the project is internationally known for its richness of wildlife. En 1980, the preliminary inventory leading by Pearson through the area of (in that time named) Tambopata Reserved Zone (ZRT) reported for the surroundings of the confluence of Tambopata and La Torre rivers, 80 species of amphibian and reptiles, 533 bird species, 77 of mammals and significant quantities of invertebrate, highlighting Lepidoptera (112 species of diurnal butterflies) and Odonata (151 species) (INRENA 2003b). Later studies performed by the Rapid Assessment Program of International Conservation in RNTAMB (quoted by INRENA 2003b) and the inventories conducted in the surroundings of the touristic lodges (Explorer's Inn, Tambopata Research Center), confirm the importance of the area of the project in terms of species richness. (INRENA, 2003b)

In 2000, the Center of Data for Conservation (CDC-UNALM) and the World Wide Fund for Nature (WWF-OPP), collected and systematized the lists of species hitherto available to produce the database of biodiversity of PNBS and RNTAMB. From the analysis of the database managed by the head of the reserve, fish assessments (Chang, 1998, cited by INRENA 2003b) and based on the research made by Ascorra and Mitchell and by Doan and Arizabal (quoted by INRENA 2003b) there are 103 species of amphibians identified, as well as 632 species of birds, 169 species of mammals, 103 species of reptiles and 205 species of fish for RNTAMB (INRENA 2003b).

The project area provides healthy habitat and refuge for recovery of populations of large mammals (INRENA 2003b). Among these, it can be found species which, for decades, especially in the 1950s, were victims of intense hunting because of the high value of their fur, threatening them to almost extinction. Examples are the river otter (*Pteronura brasiliensis*), otorongo or jaguar (*Panthera onca*) and cats *Leopardus pardalis* and *Leopardus wiedii*. Although, at present, the hunting levels have decreased, the mentioned species are still under threat, mainly due to their habitat loss. It has also been found that large populations of species in many parts of the Amazon are already rare due to over-hunting, especially tapir and spider monkeys, but also jaguar, peccaries, medium and large monkeys and alligators (Walsh, quoted by INRENA 2003b). It has been registered the species for which there is little information about the status of their populations, such as forest dogs (*Atelocynus microtis* and *Speothus venaticus*) (INRENA 2003b).

The project area is characterized by continuously achieving new records of species. In 2002, International Conservation published reports of the biological assessments in the Pampas del Heath, performed in 1996 in three localities: Juliaca, Las Pampas (both evaluated for the second time) and Enahuipa of the Heath River area and also in the Quebrada Palma Real Grande, in which were obtained 19 new records of amphibians, 16 birds, 4 mammals and 25 reptiles (INRENA 2003a). In 2009 it was first recorded in Peru, the ibis (*Theristictus caudatus*) (Williams *et al.*, s.p.)

Ascorra and Mitchell investigations reported four new mammalian species for Peru. *Lutreolina crassicaudata*, *Eumops maurus*, *Holochilus* sp., y *Pseudoryzomys simplex* (a marsupial, a bat and two rodents, respectively), all of them located in the area of Heath River (INRENA 2003a).

1.2 Activities in the TAMBRN and BSNP

The main activities carried out within the project area are the following activities: i) collecting fruits of Brazilian nut ii) nature tourism, iii) research, iv) biological monitoring, and v) training.

A) Collection of Brazilian nut

The modality of the Brazilian nut exploitationin the TAMBNR is based on a contract signed between SERNANP and the contract holder.
So far, SERNANP have been awarded 98 contracts for use within the project area, of which 85 were approved in RNTAMB and 13 in PNBS.
The area under contracts for the exploitation of Brazilian nut is 70 901.8 ha and corresponds to the area classified as direct use within the RNTAMB and special use within the PNBS.

Garcia (2013) made an analysis of the ethnicity of the contract holders resulting that most of them are born in the Amazon[90], and lesser extent, recent migrants from high Andean areas settled in Madre de Dios about 15 years ago. Also, within RNTAMB and PNBS, indigenous inhabitants of the Native Communities Infierno, Sonene and Palma Real collect Brazilian nut. For communities of Sonene and Palma Real the Brazilian nut harvesting areas are located in the Sectors of Heath and Patuyacu, respectively. In the Infierno Community, the villagers of mixed race origin have concessions in the sector of the same name; while the indigenous population, in La Torre sector.

B) Nature Tourism

RNTAMB is considered as the leading destination for nature according to SINANPE and second in revenue returns after the historic sanctuary of Machu Picchu. This is because of the existence of major attractions like river and forest licks and, lakes, trails, rivers, charismatic species and high biodiversity (SERNANP, 2012a).

[90] Descendants of migrants who settled in Madre de Dios three or more generations ago.

Figure 5. Chuncho Lick– RN Tambopata/AIDER-Julio Magan

The most visited attractions from RNTAMB are grouped into sectors, within which were installed Control and surveillance Stations (CSS) useful to register, control and monitor the activity. The defined areas are: Sandoval Lake, Middle Tambopata with La Torre CSS and High Tambopata with Malinowski CSS. Then it will be detailed the hierarchy[91] according to the inventory of tourism resources of Peru prepared by the Ministry of Foreign Trade and Tourism (MINCETUR). Also are shown the results of the evaluation of tourist attractions of the Tourist Use Plan (PUT)[92] of RNTAMB according to the CSS. (SERNANP, 2012 a)

91 Setting a hierarchy is a comparative process, which allows establishing an order of importance of the tourist attractions (ranging from 4-1); Hierarchy 3 refers to "resources with exceptional features, able to motivate, by its own or together with other contiguous resources, present current or potential national or foreign visitors." Hierarchy 2 states: "Resources with some striking features able to interest visitors who had come to the area for other tourist motivations, or motivate local tourist flows."

92 The qualification of the tourist attraction from PUT indicates a ranking between 4 and 1; being 4 the best qualification. This value is the result of the assessment of the attractive based on their qualities considering two groups: a) intrinsic value of attractive b) the feasibility of putting sustainable tourism.

Table 1. Main tourist attractions within RNTAMB

<table>
<tr><th>Attraction</th><th>Hierarchy</th><th>PUT value</th><th>CSS</th></tr>
<tr><td>Colorado Lick</td><td>2</td><td>3.8</td><td rowspan="2">Malinowsky</td></tr>
<tr><td>Chuncho Lick</td><td>2</td><td>3.1</td></tr>
<tr><td>La Torre Lick</td><td></td><td>1.7</td><td rowspan="7">La Torre</td></tr>
<tr><td>Sachavayoc Lake</td><td>3</td><td>3.1</td></tr>
<tr><td>Condenado I Lake</td><td>2</td><td>1.8</td></tr>
<tr><td>Condenado II Lake</td><td>2</td><td>1.8</td></tr>
<tr><td>Cocochа Lake</td><td>-</td><td>3.4</td></tr>
<tr><td>La Torre Lake</td><td>-</td><td>2.0</td></tr>
<tr><td>Katicocha Lake</td><td>2</td><td>-</td></tr>
<tr><td>Sandoval Lake</td><td>3</td><td>3.3</td><td>Sandoval</td></tr>
</table>

Source: Diagnosis of Master Plan of TAMBNR 2011-2016 (SERNANP, 2012a)

At present, twelve companies guide with certain frequency tourist groups within RNTAMB, from which five of them have authorization as a touristic operator, one have a concession to provide tourist and recreational services and other one with authorization to provide tourist and recreational services in a private property. However, there are other free guides and small companies that have access to the Reserve.

C) Investigation

Since 2008, the management of the research component of RNATMB and PNBS is a responsibility of AIDER as part of the contract signed with the Peruvian State. Its strategic partners include the Catholic University of Peru (PUCP), Wildlife Conservation Society (WCS), Colorado University, Fauna Forever, Francfor zoological society, among others.

In both NPA, is carried out scientific research for several decades ago. Systematized information between the period 1999 and 2010 indicate that 137 permits were given to conduct research within the RNTAMB and PNBS.
Taking into account all the types of research conducted in these NPA, can be highlighted research projects known as “ANCHOR” given that these are been performed to major scales giving rise to other investigations. Among these projects we can mention the following:

- Project “Registration of volatile emissions”
- RAINFOR Project. The RAINFOR project is one of the strongest long-term projects in Tambopata and involves researchers from 12 different scientific institutions dedicated to investigate the response of Amazon forests to climate change.
- Project “Lobo de Río”. This project is conducted by Frankfurt Zoological Society and it has more than 15 years en Tambopata area.

- Project Guacamayo

As part of the efforts to promote the investigation within these two NPA, AIDER with PUCP, RAINFOR, United Kingdom's Natural Environment Research Council (NERC) and Scottish Alliance for Geoscience, Environment and Society (SAGES), built a tower[93] of 42 meters high and installed equipment to monitor methane, carbon dioxide emissions, moisture fluxes, wind speed and solar radiation levels within RNTAMB area. "This tower will allow studying how tropical forests are affected by the greenhouse gases emission, as well as how soils are affected and how energy is transformed"[94]

Figure 6. Tower for GHG monitoring

[93] The tower is the first of its kind in Latinamerica

[94] Interview with John Grace (Emeritus professor at the University of Edinburgh), in NEO, supplement of Technology Innovation PuntoEDU weekly. Year 3. No. 35. PUCP. 2011

D) Training

In 2012, the headquarters of RNTAMB and AIDER fitted out the facilities of the Malinowski ex research center located at the CSS of the same name, which became a training center for 35 people, where multiple courses and workshops are developed on issues of control and surveillance, biological monitoring, research and ecosystem services. Figure 7 shows the facilities of the Malinowski training center. Figure 8 shows participants at a workshop course in ecosystem services.

Figure 7. Malinowski control stand and training center

Figure 8. Participants of the workshop course about ecosystemic services

II. Problematic and objectives

2.1 Underlying causes

A) Economic causes

One of the main causes of the increasing deforestation in Madre de Dios is explained by the increase in the international price of gold since 2002, this has been a motivation for the growth of the activity based on extracting alluvial gold. Gold production in Madre de Dios has been increasing from 9,600 Kg in 1995 to 16,502 Kg in 2007. See Figure 9 and 10

The rising value of gold makes mining more profitable, allowing it to grow. Therefore a greater demand for labor is needed having an influence in the increasing of migration to Madre de Dios. There is a high correlation (R^2 = 0.9818) between the population and the value of gold (see Figure 11).

Also, an analysis was performed to determine the relationship between deforestation and gold's value (Figure 12), resulting a low correlation (R^2 = 0.6661) compared with the one found in the analysis of population and value of gold (figure 11). Based on these two results it was determined that the gold's value has a significant correlation with population growth and deforestation.

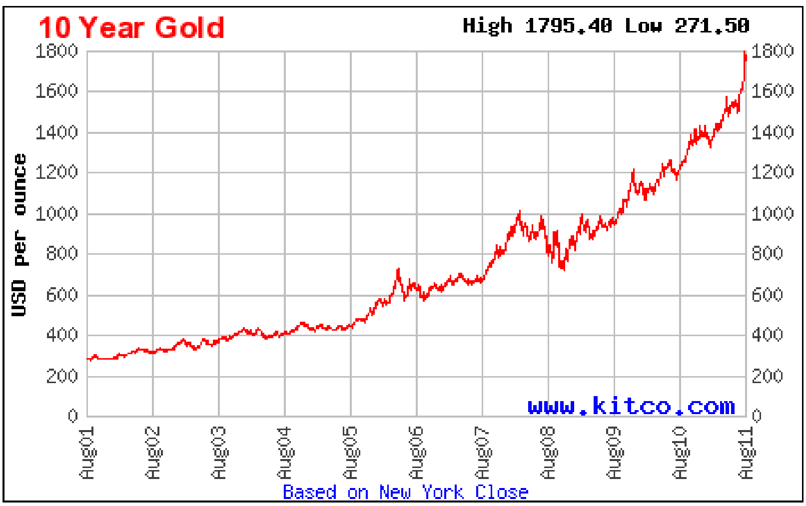
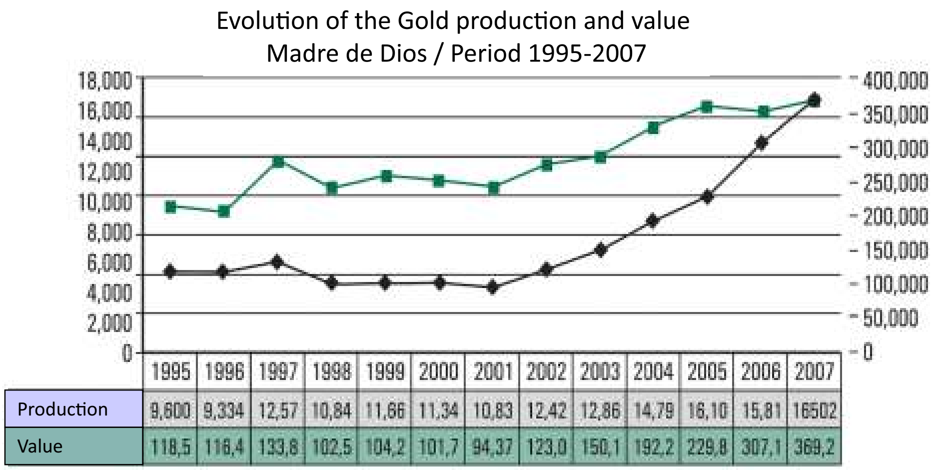


Figure 9. Quotation of an ounce of gold to 10 years in US $ (Source: Kitco metal inc. 2011, taken from Recavarren and Angulo 2012)



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Production	9,600	9,334	12,57	10,84	11,66	11,34	10,83	12,42	12,86	14,79	16,10	15,81	16502
Value	118,5	116,4	133,8	102,5	104,2	101,7	94,37	123,0	150,1	192,2	229,8	307,1	369,2

Figure 10. Evolution of gold production and its value in Madre de Dios (Source: Mosquera, C. *et al.*, 2009)

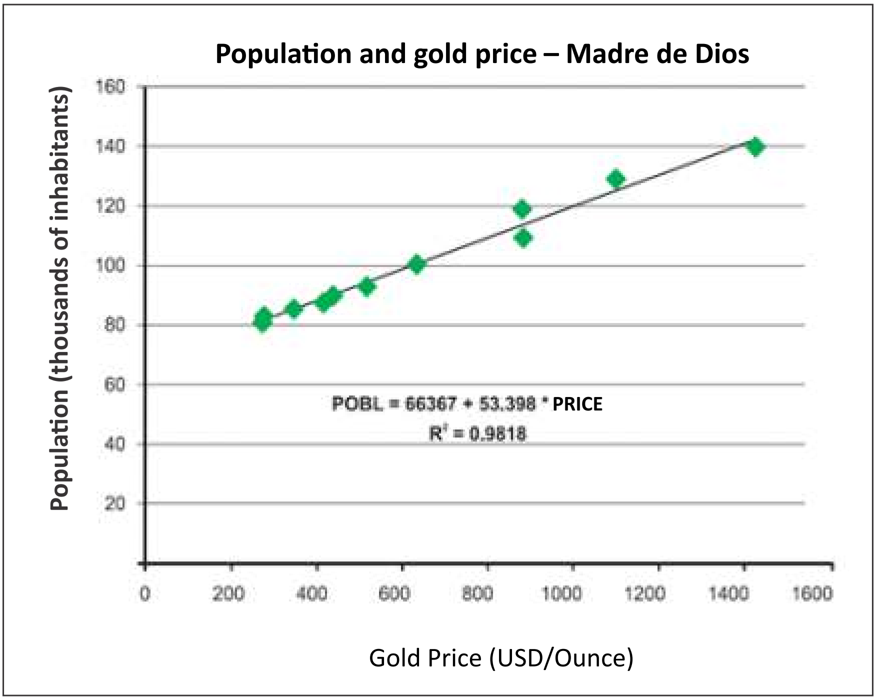


Figure 11. Linear regression of the population with gold's value (Source: Recavarren *et al.* 2011)

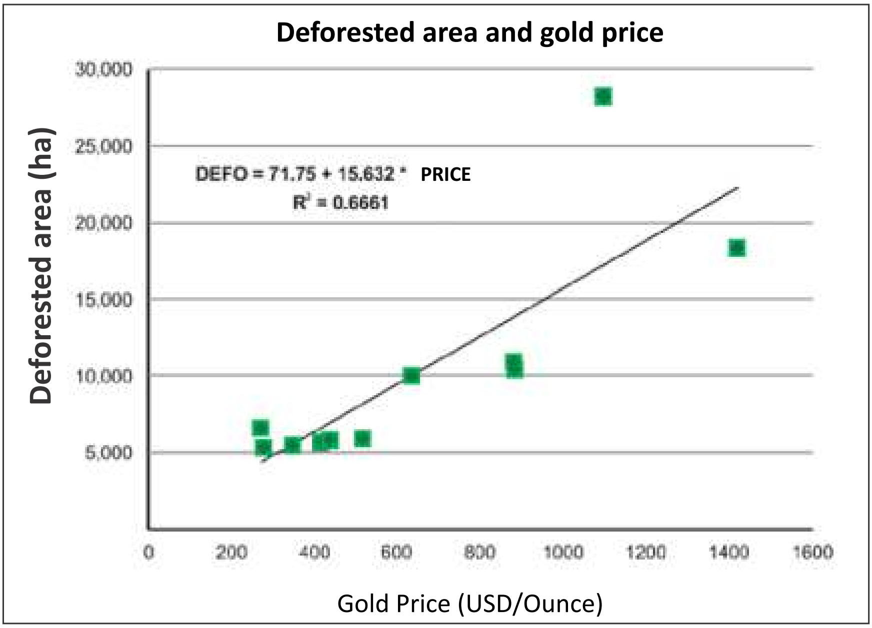


Figure 12. Linear regression of the deforested area with gold's value (Source: 2011 Recavarren *et al.)*

B) Population increase

In 1993, 45.1% of the population of Madre de Dios had foreign origin and in 2003, about 50% of the population was born in another region or abroad, highlighting that the majority of the local people were descendants of migrant families (INRENA 2003b). According to the Census of 2007, Madre de Dios have a population of 109,555 inhabitants (see Table 2), the least populated Region. The RNTAMB and PNBS are adjacent to the most populated areas of the region. Tambopata province accounts for 71.67% of the provincial population.

Observing the increment of the population per Region, showed in the census of 1993 and 2007, the highest increase is presented in Madre de Dios, with 63.5% more population than 14 years before, growing at an average annual rate of 3.5%, which equates to 3 039 people per year (see table 3). The proportion of men (54.3%) is the highest in the country, due to the situation of migrants and the most common jobs (INEI, 2008).

Table 2. Population in Madre de Dios, according to census since 1940 to 2007

Year	1940	1691	1972	1981	1993	2007
Population	4,950	14,890	21,304	33,007	67,008	109,555

Source: INEI, 2008

Table 3. Average annual growth rate of the population in Madre de Dios, censed since 1940 to 2007

Range (years)				
1940-1961	1961-1972	1972-1981	1981-1993	1993-2007
5.4	3.3	4.9	6.1	3.5

Source: INEI, 2008

The baseline scenario for the project consists mainly in change of use for shifting agriculture (mainly migratory), extensive grazing and illegal gold's exploitation. For the latter mentioned, it is necessary to continuously remove the forest cover, as well as soils

Also, there is pressure on forest resources (selective commercial timber extraction and primarily utilization of different non-wood forest products) and wildlife, causing forest degradation.

It's been found a correlation between forest cover relative to the population density (DEFO = 20,234 + 0.3014 * POPULATION) with R^2 = 0.7193; which means that 71.93% of the forest loss in Madre de Dios is explained by the population increase in the Region.

2.2 Drivers of Deforestation

Historically Madre de Dios has been one of the more intangible Amazonian regions. Given its geography and because it belongs to a different Amazon watershed this Region was a natural barrier to massive settlements, so the knowledge of the geography came with the first expeditions. The most known, the one conducted by Faustino Maldonado and Carlos Fermin Fitzcarrald. Later, Madre de Dios was inhabited from small-scale migrations.

One factor that has accelerated the process of migration to Madre de Dios was the construction of the South Interoceanic Highway (CVIS) which is part of the IIRSA (Initiative for the Integration of Regional Infrastructure in South America[95]). This

[95] The IIRSA was launched in 2000 by the governments of the 12 countries in the region with the support of the Inter-American Development Bank (IDB), the Andean Development Corporation (CAF) and the Financial Fund for the Development of the River Plate Basin (Fonplata). It includes promoting integration axes that bring together 335 projects worth 37.5 billion dollars. Dourojeani M. 2006.

corridor asphalted and improved 2 856 kilometers of road connecting Iñapari (Madre de Dios), the Brazilian border and the port of Ilo in southern Peru, reducing the costs of transport and mining supplies such as fuel, equipment, labor and others.

2.3 Deforestation agents

A) Miners

The main agent of deforestation is the mining activity, which was started and continued by small-scale miners, who operated in a few isolated areas using handmade techniques.

In 1970 the Government established an incentive to gold mining, encouraging migration to Madre de Dios; since 1980, internal migration increased throughout the country due to the economic crisis and political violence, which added to the rise in international gold value caused a mass migration of peasants from the south of the country, who settled on the banks of rivers and streams in search of gold. (INRENA, 2003b).

A large number of small miners, mostly illegal, keep operating with highly polluting handmade technology. The mercury used is wasted in Jayabe, Malinowski and Macaw rivers.

The vast majority of mining operations started its operations right after submit the permit application (mining request), assuming that it gives them the right to property and permission to start up, even when they know about the mining regulations and the related paperwork.

According to the diagnosis of alluvial gold mining in Madre de Dios, the critical areas in the surroundings of RNTAMB and PNBS (Diaz, 2010) are River Manuani Sector, High and middle Malinowski-AMATAF, Low Malinowsky Sector, Kotsimba Sector and Low Madre de Dios Sector

RNTAMB and PNBS, nevertheless the protective nature of their NPA classification, are not immune to these pressures increase.

The rising value of gold makes mining more profitable, allowing it to grow. Therefore a greater demand for labor is needed having an influence in the increasing of migration to Madre de Dios. It is therefore inferred that deforestation by mining in Madre de Dios, has a direct correlation with the price of gold. See figure 13.

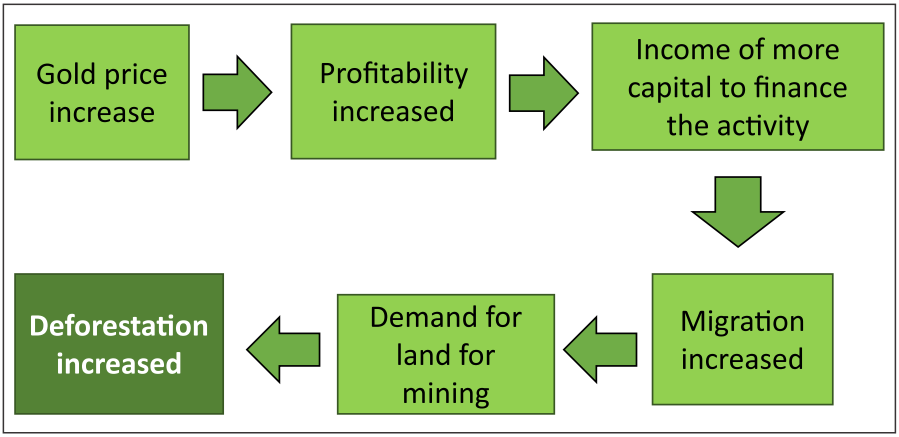


Figure 13. Scheme of deforestation by mining activity

B) Farmers

Farming in Madre de Dios is not the main cause in the process of occupation of lands, "This process is based on harvesting activities initially focused on rubber and brazilian nut (*Bertholletia excelsa*). The arrival of the road to Puerto Maldonado in the early sixties, allowed shifting cultivation and grazing activities to consolidate as the fronts of economic expansion."[96]

Agricultural activity is mainly for local consumption, low yields, related to cultural forms of production that is still based on traditional technology in land preparation. The latter consist in activities of slash and burn, using uncertified seeds, with little or no phytosanitary control. Harvest and post harvest is done manually and the storage techniques are not effective to ensure their preservation. Most agriculture is done for family subsistence, however, the surpluses can be sold in the local market, being rice, yellow corn, banana and yucca[97] the main products with extra production.

Between August and September of 2005 occurred many anthropogenic wildfires causing considerable damage, as also affected agricultural plots. The burning of fallow and agricultural waste is one of the main sources of wildfires and air pollution. As a result of the burning of fallow in 2005 there was a big cloud of smoke covering the provinces of Tambopata, Manu and Tahuamanu.[98]

[96] Glave and Pinedo, 1997

[97] Urban Developement Plan for Iñapari. Lima, june of 2008, Pg 35.

[98] Regional Committee for Civil-Defense MDD. Regional Plan for Disaster Prevention of MDD 2006-2011. Pg. 26

III. Tambopata – Bahuaja REDD+ project design

3.1 Assessment of the project feasibility

As first step deforestation since 2004 to 2008 (SERNANP, 2008), deforestation projected to 2050 (Soares, Filho et al, 2006) and biomass content (Saatchi *et al.*, 2007) was analysed.

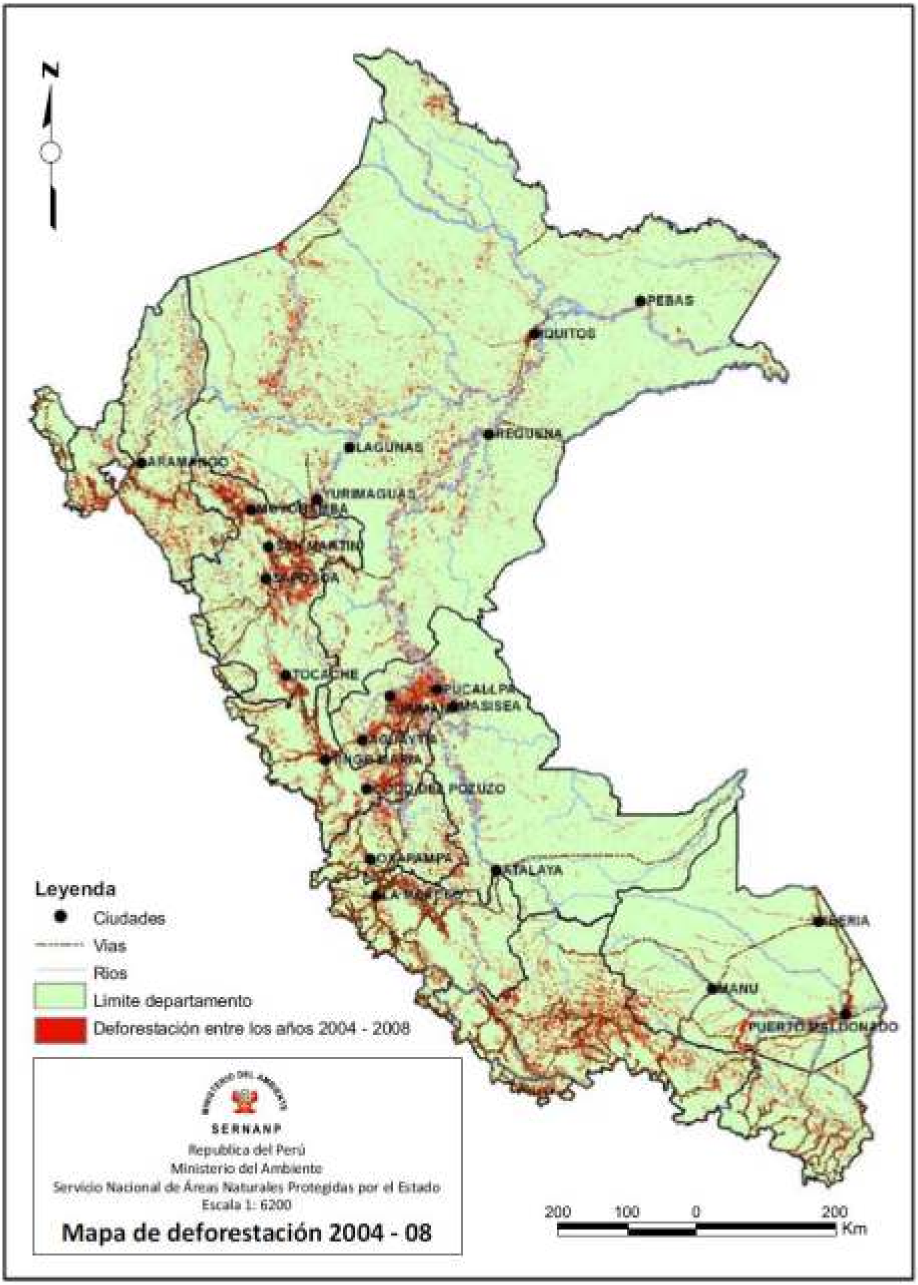


Figure 14. Map of deforestation 2004 to 2008

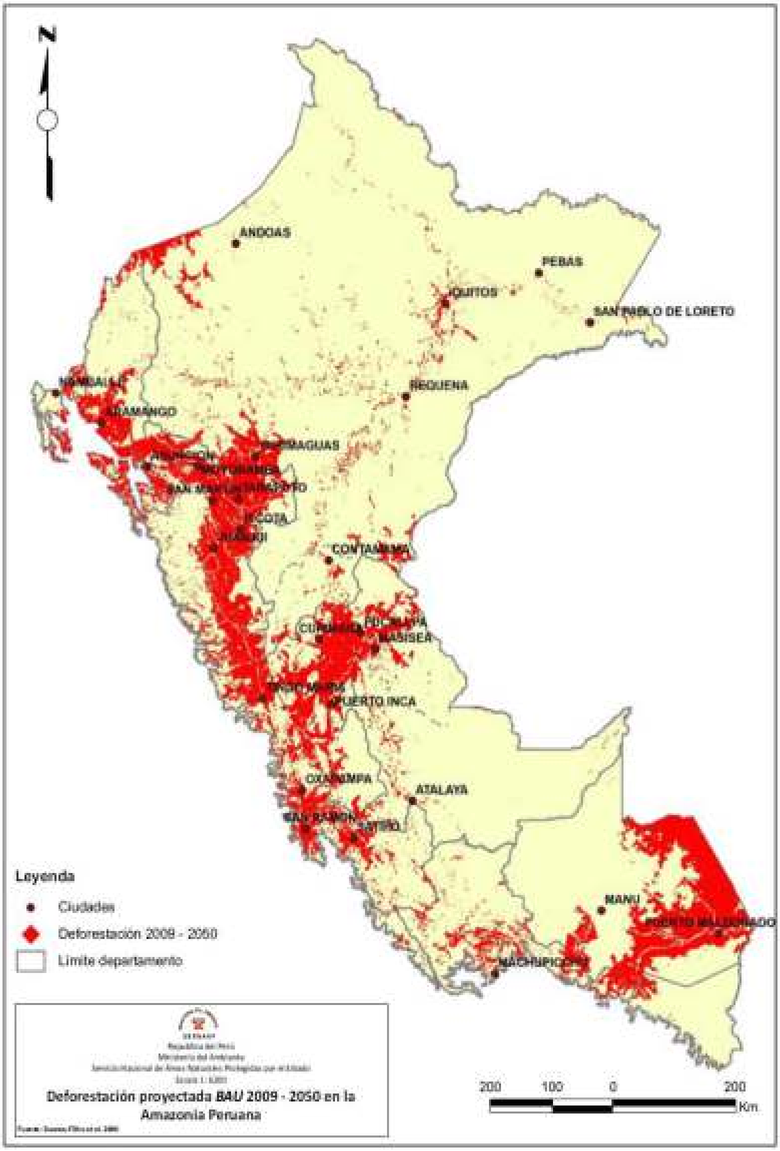


Figure 15. Map of deforestation projected to 2050

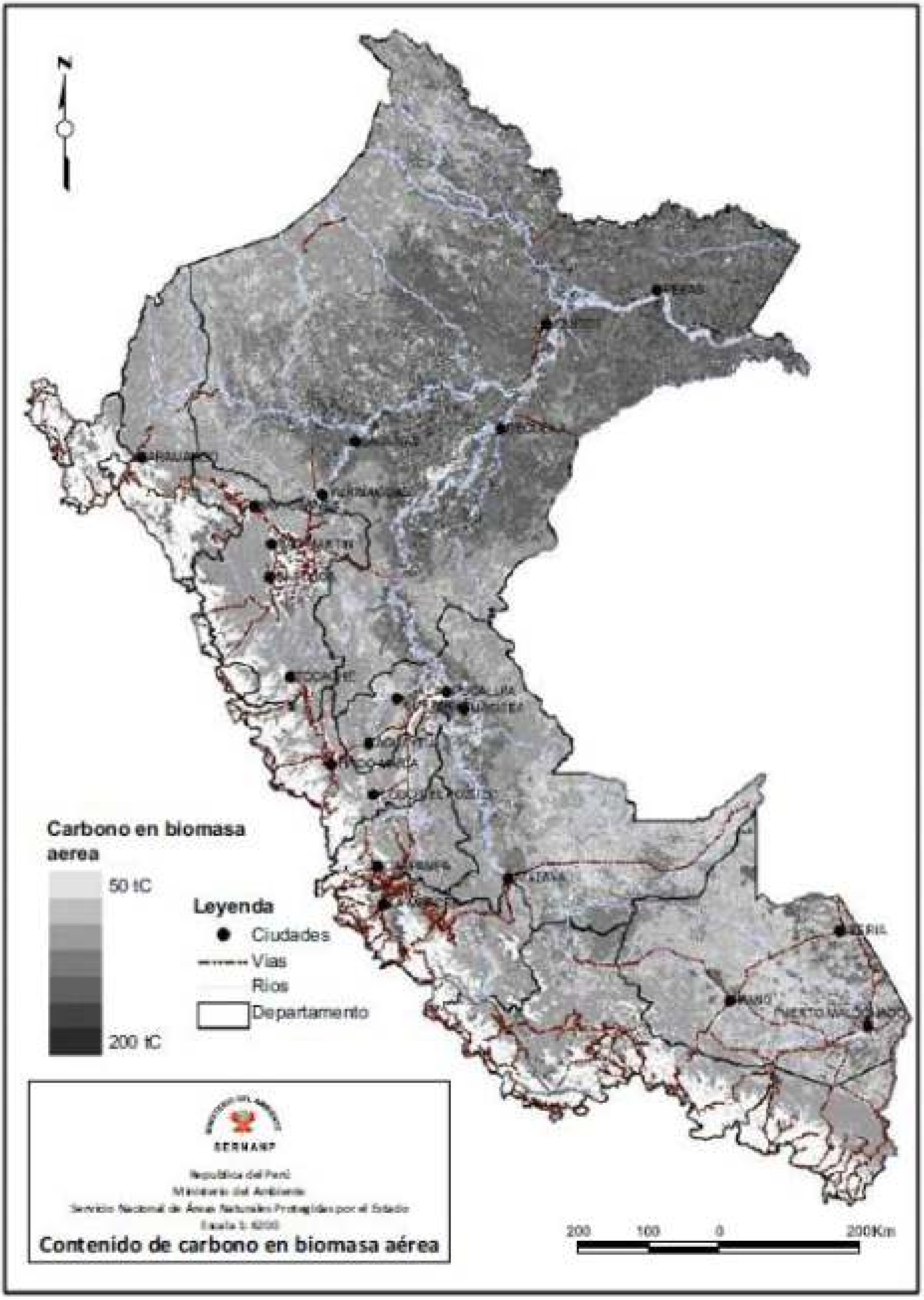


Figure 16. Map of biomass

Given the threats of present deforestation and the results of research detailed before, it can be said that the administration contract applies to REDD+ mechanism, being this the financial technical proposal of the contract. The objectives proposed and based on this mechanism are the following:

- **Climatic objective:** In the first crediting period of the project (10 years) has been estimated to reduce emissions of CO_2-e in 4 million tons, as a result of avoiding deforestation within the project area.

- **Community objective:** To keep and improve the welfare of the local people in the area of the project, who otherwise would be directly affected by the elimination of forest cover, biodiversity loss and contamination of hydrobiological resources, if the project is not carried out.

- **Biodiversity objective:** To keep safe the biodiversity in the area of the project, being this one of the most biologically diverse areas worldwide, will be avoided activities related to the forest fragmentation and habitat/ecosystems loss and ensuring the continuity of the Vilcabamba-Amboró Conservation Corridor.

- **Financial objective:** Contribute to the financial sustainability of Tambopata National Reserve and Bahuaja-Sonene National Park (Madre de Dios scope) according to their adequate management and the fulfillment of their initial creation objectives as NPA’s.

The REDD+ project would generate the required incomes to fulfill the demand of resources providing an adequate management to the mentioned NPA’s. The management basically consists in biological monitoring and investigation, as well as the strategy to reduce deforestation and forest degradation.

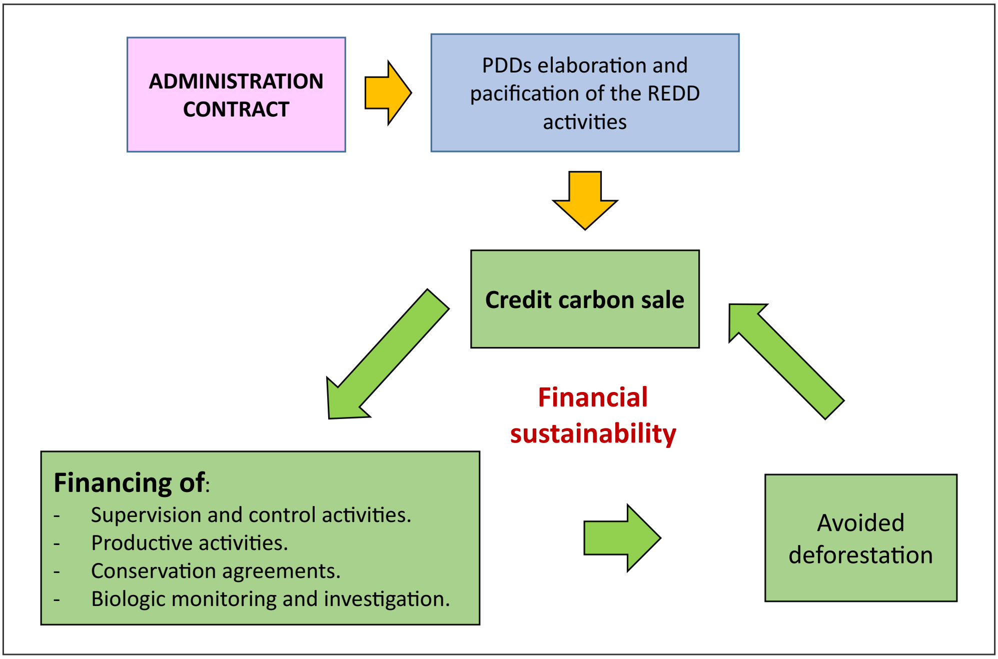


Figure 17. Financial sustainability scheme of the NPA's with REDD+ project

3.2. Design

The VCS standard was used because its methodological rigor in the process of estimating emission reductions, which offered a backup to trade carbon credits. The CCB standard was used in the project design in order to demonstrate the co-benefits for climate, community and biodiversity in an integrated and sustainable manner.

The project design had two general stages: i) quantification of the reductions and ii) design for the implementation.

Figure 4. Stages to design the project

Quantification of the reductions	- Limits - Cover changes - Deforestation processes - Projection of the future deforestation - Coefficients of variation for each stratum - Changes in the carbon existence for the baseline - Changes in the carbon existence with the project - Leaks - Net reductions
Design for the implementation	- Consultation and participatory planning - Deforestation / degradation processes - Formulation of alternative activities - Review of land tenure - Social baseline - Biodiversity baseline - Relations with authorities - Structure design for implementation - Budget and financial structure

Project boundaries

- **Spatial limits**

Region of reference: it was defined by the modular methodology VCS VMD0007, using the following endpoints: i) main agents of deforestation, ii) landscape factors, iii) transport and infrastructure facilities, iv) social factors, v) politics and reglamentations and vi) exclusion of planned deforestation. The defined region of reference has 5,638,200 ha, as it is shown in Figure 18.

Area of the project: it corresponds to the total extension quoted in the partial administration contract of RNTAMB y PNBS-Madre de Dios, upon which the proposer has legal control over the forest considered for the quantification of the avoided emissions from the project. This area covers 573,299 ha from which, until 2008, 541,620 ha correspond to definition of forest. The latter mentioned constitutes the area of REDD + project, as displayed in Figure 18.

Leakage belt: it is required given the identification of possible leaks caused by the displacement of the productive activities out of the project geographical boundaries. This leakage belt is within the buffer zone[99] of RNTAMB. To the

[99] Established by Article 3 of Supreme Decree No. 048-2000-AG, "Declare Tambopata National Reserve and extend the Bahuaja-Sonene National Park, located in the Regions of Madre de Dios and Puno" and whose boundaries were specified by Resolution Jefatural No. 298-2001-INRENA establishing the buffer zone of the Bahuaja-Sonene National Park and Tambopata National Reserve.

buffer zone, whose boundaries are mostly defined by the South Interoceanic Highway, and Tambopata River, was added a strip of approximately 2 km towards the north of the highway. This extension is based on the information of farmlands to 2008 (COFOPRI 2010), which was compiled and provided by the Head of the RNTAMB.

The information about farmlands shows that properties are placed in vast majority at both sides of the highway, where people carry out their economic activities in the first 500 m starting from its margin. The remaining 1,500 m are characterized by secondary and residual forest, as well as deforested areas. Given these population is relevant for the activities of the project, it was decided that the leakage belt would occupy the same 2 Km to the north.

- **Time limits**

  - Historical period: 2000 - 2010
  - Project start date: July 1st, 2010
  - Crediting period of the project: 20 years (July 1st, 2010 to June 30th, 2030)
  - First period for quantifying GHG emission reductions: 10 years (July 1st, 2010 – June 30th, 2030)

INRENA establishing the buffer zone of the Bahuaja-Sonene National Park and Tambopata National Reserve.

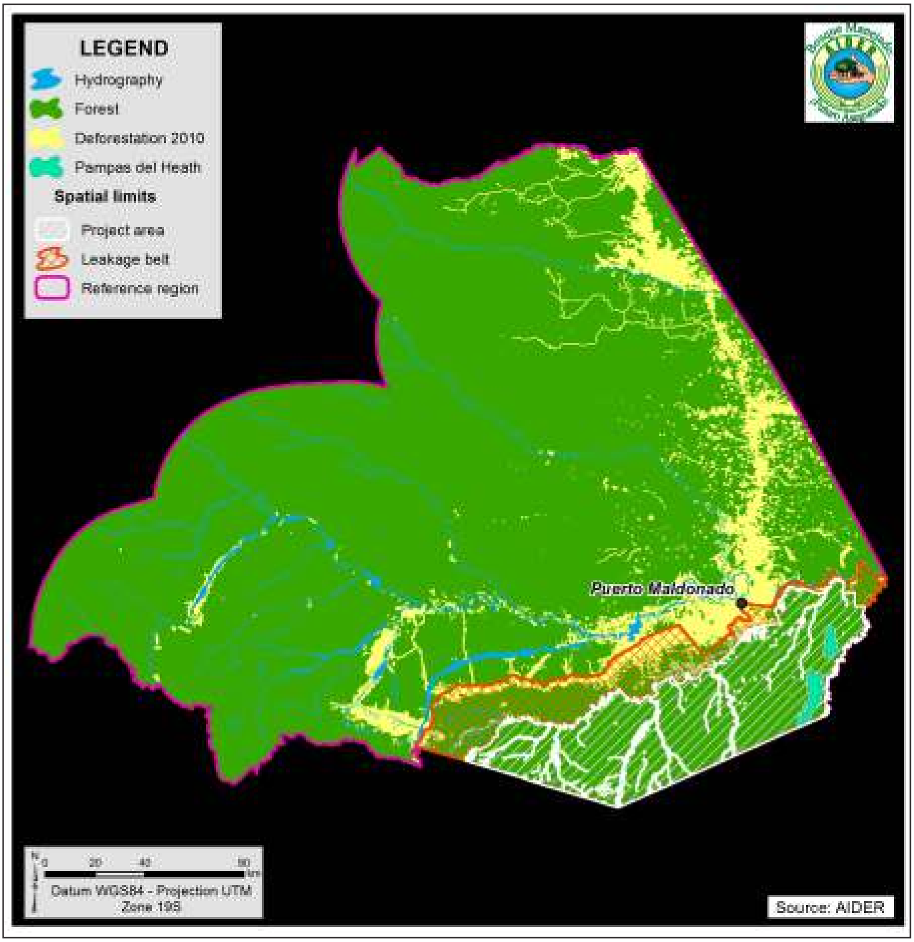


Figure 18. Spatial limits of the project

3.3. **Participants**

It was a key issue to start the project having clearly defined the roles and functions of each participant. Table 5 shows a detailed explanation for each one.

Table 5. Roles and functions of the participants

Institutions	Roles
Natural Protected Areas National Service (SERNANP)	Political support, monitoring ans supervision sof commitments for the REDD+ project implementation and the partial operational administration contract signed with AIDER.
Association for Research and Integral Development (AIDER)	Is the proponent of REDD + project, responsible for the design, implementation and monitoring of the project. Prepare technical and financial annual plans for the implementation of the project, which will be presented to SERNANP for their approval
Management Committee of RNTAMB and PNBS	Platforms through which the authorities of the population settled in the buffer zone are informed about the progress and achievements of the project.
Benefited population with the sustainable productive activities and conservation agreements	Native communities, populated centres, mining associations, nuts collectors and others located in the buffer zone of RNTMB and PNBS, whose participate of the economical activities promoted by REDD+ proyect, as conservation agreements, support for monitoring and surveillance and communication strategies

3.4. Preparation of the project design document

With the information developed in the above lines, it was prepared the project description document (PD) under the VCS standard version 3 and the requirements of the methodology VMD0007 VCS v1.1. The project design document was prepared based on CCB Standards, second edition.

Both documents were submitted to a systematic, independent and documented assessment of the project design according to each one of the endpoints proposed on both standards. The responsible of this assessment was a certification processes accredited organization. After this process, declarations of validation were issued (Figures 19 and 20).

In the case of validation with CCB, the project design reached the **gold level** for its contribution to adaptation to climate change and biodiversity benefits. This recognition allows recognizing the exceptional co-benefits of the project, beyond the profits of forest carbon.

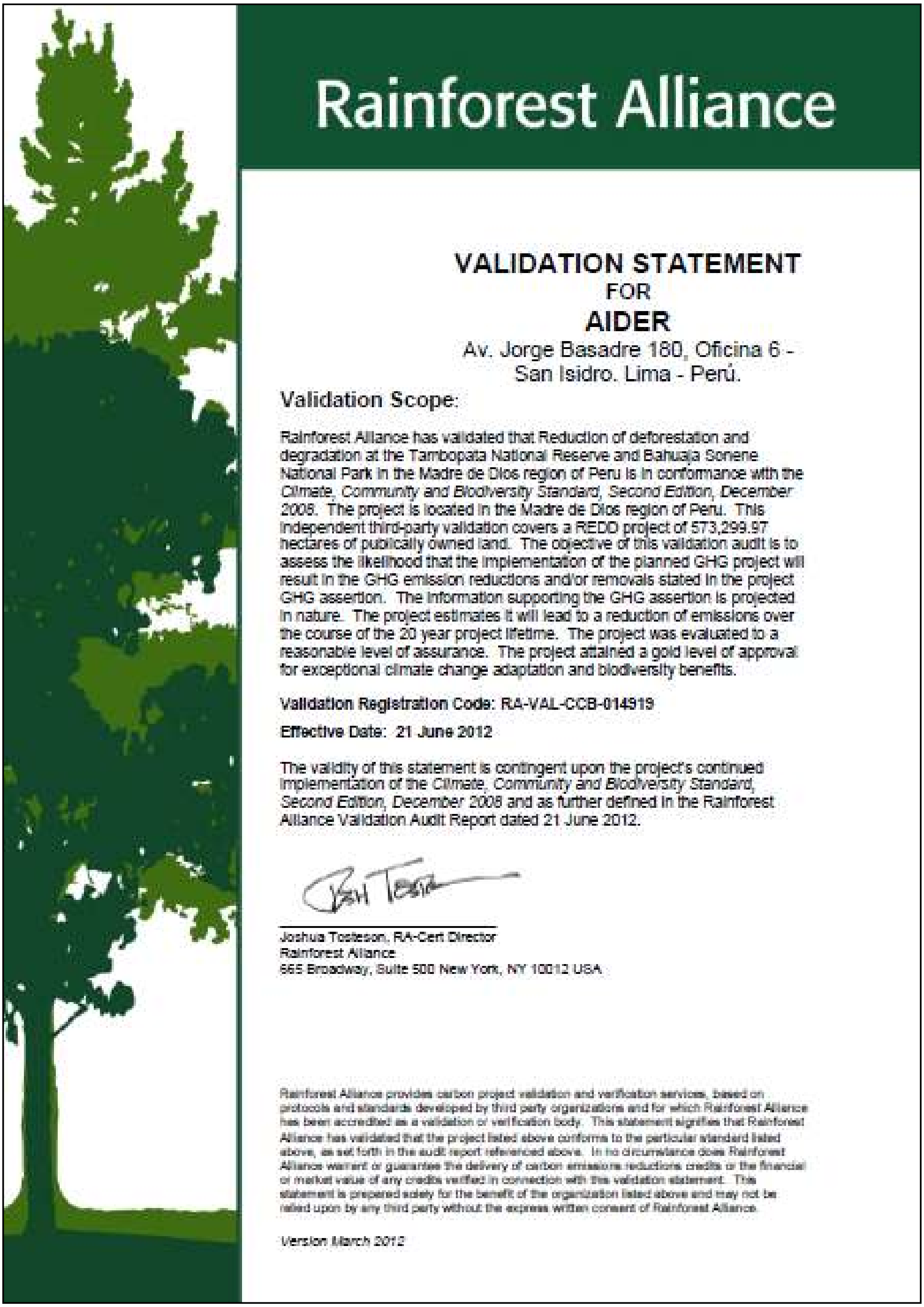
Registration codes and the effective dates are shown in Table 6.

Table 6. Validation data of the project

Standard	Validation code	Date	Estimated reductions for the first 10 years	Area of the project (ha)	Gold level
VCS	RA-VAL-VCS-015609[100]	June 21st, 2012	3,982,427 t CO_2 - e	573,300 ha	-
CCB	RA-VAL-CCB-014919[101]	June 21st, 2012	-	573 300 ha	Exceptional benefits in adaptation to climate change and biodiversity conservation

[100] https://vcsprojectdatabase2.apx.com/myModule/Interactive.asp?Tab=Projects&a=2&i=1067&lat=-13&lon=-69%2E5&bp=1

[101] http://www.climate-standards.org/2010/11/16/reduccion-de-la-deforestacion-y-degradacion-en-la-reserva-nacional-tambopata-y-en-el-parque-nacional-bahuaja-sonene-del-ambito-de-la-region-madre-de-dios-peru/



Rainforest Alliance

VALIDATION STATEMENT
FOR
AIDER
Av. Jorge Basadre 180, Oficina 6 -
San Isidro. Lima - Perú.

Validation Scope:

Rainforest Alliance has validated that Reduction of deforestation and degradation at the Tambopata National Reserve and Bahuaja Sonene National Park in the Madre de Dios region of Peru is in conformance with the *Climate, Community and Biodiversity Standard, Second Edition, December 2008*. The project is located in the Madre de Dios region of Peru. This independent third-party validation covers a REDD project of 573,299.97 hectares of publically owned land. The objective of this validation audit is to assess the likelihood that the implementation of the planned GHG project will result in the GHG emission reductions and/or removals stated in the project GHG assertion. The information supporting the GHG assertion is projected in nature. The project estimates it will lead to a reduction of emissions over the course of the 20 year project lifetime. The project was evaluated to a reasonable level of assurance. The project attained a gold level of approval for exceptional climate change adaptation and biodiversity benefits.

Validation Registration Code: RA-VAL-CCB-014919

Effective Date: 21 June 2012

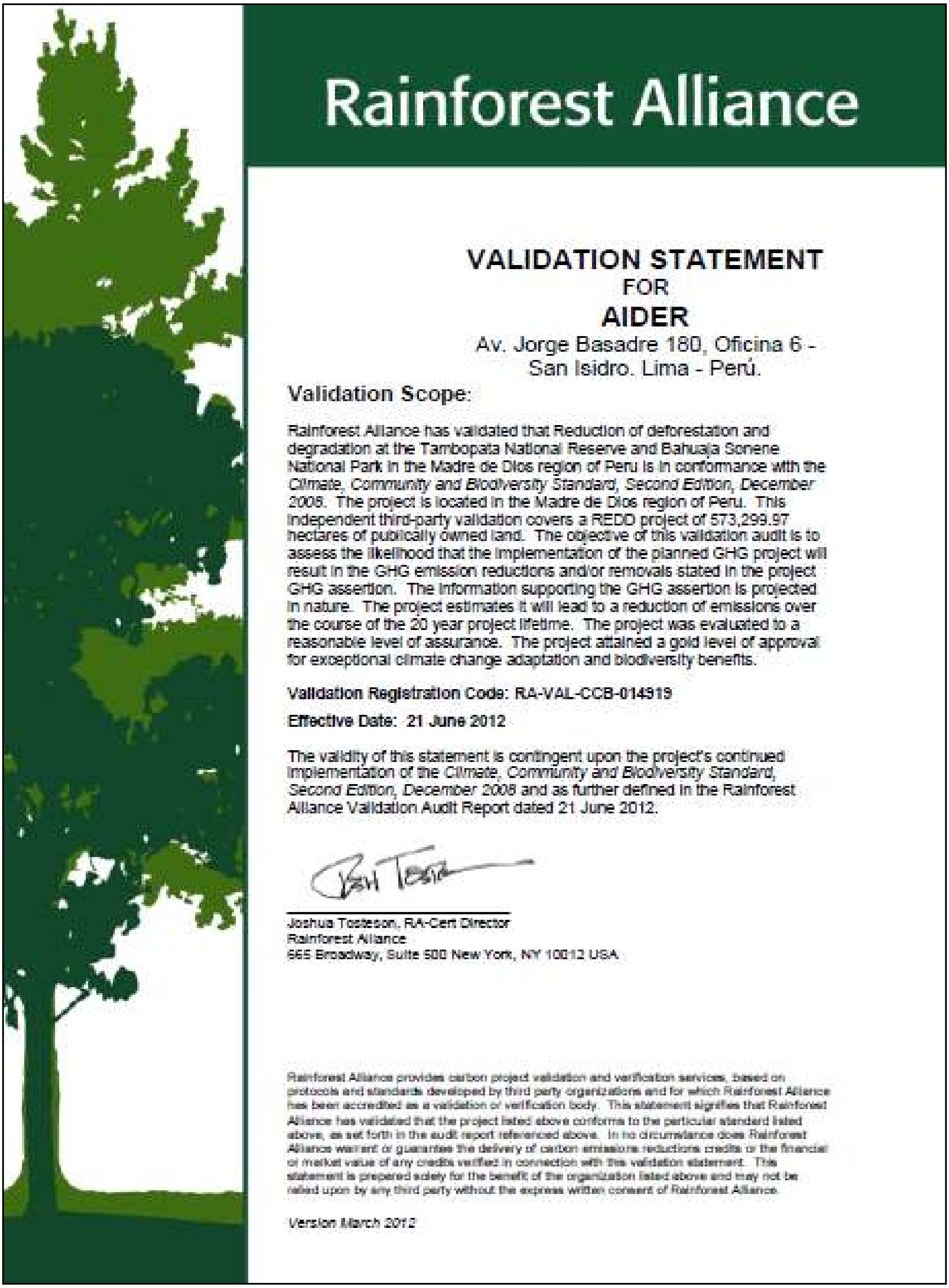
The validity of this statement is contingent upon the project's continued implementation of the *Climate, Community and Biodiversity Standard, Second Edition, December 2008* and as further defined in the Rainforest Alliance Validation Audit Report dated 21 June 2012.

Joshua Tosteson, RA-Cert Director
Rainforest Alliance
665 Broadway, Suite 500 New York, NY 10012 USA

Rainforest Alliance provides carbon project validation and verification services, based on protocols and standards developed by third party organizations and for which Rainforest Alliance has been accredited as a validation or verification body. This statement signifies that Rainforest Alliance has validated that the project listed above conforms to the particular standard listed above, as set forth in the audit report referenced above. In no circumstance does Rainforest Alliance warrant or guarantee the delivery of carbon emissions reductions credits or the financial or market value of any credits verified in connection with this validation statement. This statement is prepared solely for the benefit of the organization listed above and may not be relied upon by any third party without the express written consent of Rainforest Alliance.

Version March 2012

Figure 19. Validation statement under the VCS Standard



Rainforest Alliance

VALIDATION STATEMENT
FOR
AIDER
Av. Jorge Basadre 180, Oficina 6 -
San Isidro. Lima - Perú.

Validation Scope:

Rainforest Alliance has validated that Reduction of deforestation and degradation at the Tambopata National Reserve and Bahuaja Sonene National Park in the Madre de Dios region of Peru is in conformance with the *Climate, Community and Biodiversity Standard, Second Edition, December 2008*. The project is located in the Madre de Dios region of Peru. This independent third-party validation covers a REDD project of 573,299.97 hectares of publically owned land. The objective of this validation audit is to assess the likelihood that the implementation of the planned GHG project will result in the GHG emission reductions and/or removals stated in the project GHG assertion. The information supporting the GHG assertion is projected in nature. The project estimates it will lead to a reduction of emissions over the course of the 20 year project lifetime. The project was evaluated to a reasonable level of assurance. The project attained a gold level of approval for exceptional climate change adaptation and biodiversity benefits.

Validation Registration Code: RA-VAL-CCB-014919

Effective Date: 21 June 2012

The validity of this statement is contingent upon the project's continued implementation of the *Climate, Community and Biodiversity Standard, Second Edition, December 2008* and as further defined in the Rainforest Alliance Validation Audit Report dated 21 June 2012.

Joshua Tosteson, RA-Cert Director
Rainforest Alliance
665 Broadway, Suite 500 New York, NY 10012 USA

Rainforest Alliance provides carbon project validation and verification services, based on protocols and standards developed by third party organizations and for which Rainforest Alliance has been accredited as a validation or verification body. This statement signifies that Rainforest Alliance has validated that the project listed above conforms to the particular standard listed above, as set forth in the audit report referenced above. In no circumstance does Rainforest Alliance warrant or guarantee the delivery of carbon emissions reductions credits or the financial or market value of any credits verified in connection with this validation statement. This statement is prepared solely for the benefit of the organization listed above and may not be relied upon by any third party without the express written consent of Rainforest Alliance.

Version March 2012

Figure 20. Validation statement under the CCB Standard

IV. Estimation of avoided emissions by deforestation and degradation

4.1 Determination of the historical deforestation

The quantification and analysis of historical deforestation was made following the requirements of the REDD methodological module “Estimation of changes in carbon stocks and GHG emissions by unplanned deforestation in the baseline scenario” (BL-UP) Version 1.0

The technical characteristics of the analysis are:

- Software: ENVI 4.7.1 y Arc Gis 9.3.1 - Arc View
- Satellite: Landsat; sensor: 5TM y 7ETM
- “Path Rows”: 4/68, 3/68, 2/68, 4/69, 3/69, y 2/69
- Accounted years: 1990, 1995, 2000, 2005, 2008, 2009
- Methodology: Supervised classification
- Download sources: National Institute of Space Investigation – INPE (Brasil), Maryland University (USA) and USGS Glovis: The Gloval Visualization Viewer.
- Verification of the field map: applying the methodology proposed by Chuvieco (“008)
- Reliability of the map: To 2008 (92.73 %), 2009 (93.55%), 2010 (91.43%)

As a result of this analysis was determined that historical deforestation in Madre de Dios, since 1990 to 2010, is mainly located at both sides of the South Interoceanic Highway (CVIS), as shown in figure 22.

The quantitative results of historical accumulated deforestation for the worked years are shown in Table 7 and Figure 22. The data show that between 1990 and 2010 have been deforested a total of 190 689 ha, with an annual deforestation rate of 0.0515 equivalent to 9,534 ha/year.

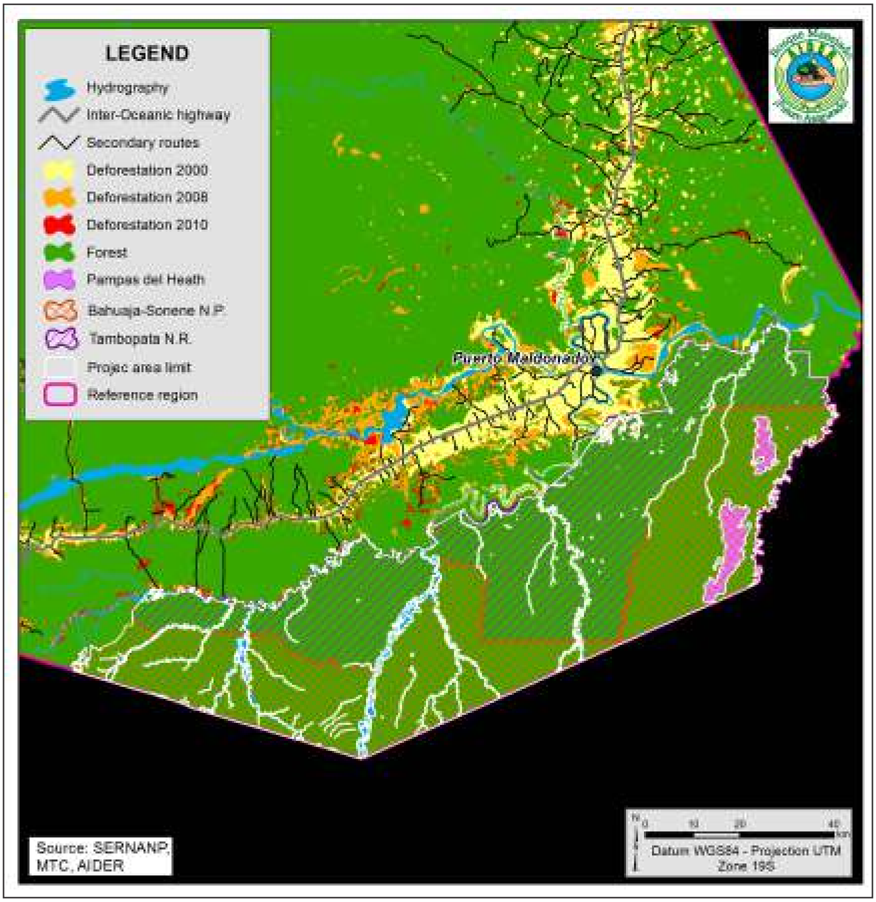


Figure 21. Historical deforestation in Madre de Dios since 2000 to 2010

Table 7. Historical accumulated deforestation in Madre de Dios

Year	Accumulated deforestation (ha)
1990	110,325
1995	164,454
2000	195,309
2005	223,591
2008	255,089
2009	283,380
2010	301,013

Source: AIDER, 2013c

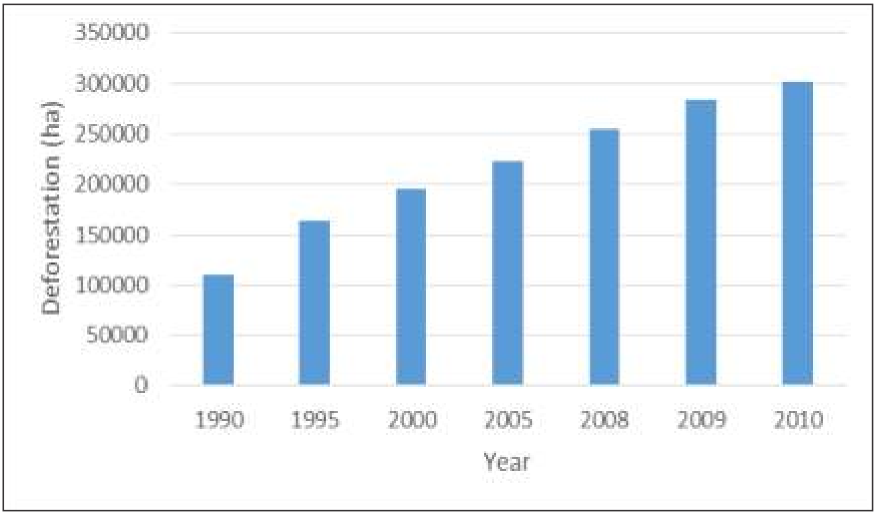


Figure 22. Accumulated deforestation in Madre de Dios to 2010

4.2 Carbon stock estimation

The carbon stock was determined through an inventory of carbon stored in the forest biomass in RNTAMB and PNBS and their respective buffer zones.

The carbon stocks are related to two variables: existent strata and carbon content per hectare per type of stratum.

A) Stratification

The stratification was conducted following the approved methodology VCS VM0007 Version 1.0, REDD Methodology Module, X-STR Module: VMD0016 Stratification methods for the area of the project. The technical characteristics of the process are detailed in table 8.

Table 8. Technical parameters for the stratification

Nº	ITEM	Description
1	Satellite images	Landsat 5TM y Landsat 7ETM
2	software	ENVI 4.7
3	Classification algorithm	The classification was conducted by the "Maximum Likelihood" algorithm; the post classification, applying Sieve Classes in order to solve the problem of isolated pixels.
4	Legend	5 categories. i) Forests, ii) Deforestation, iii) Rivers, iv) Lakes, v) Farming lands/ secondary forests
5	Sub strata	Inside forest, were set 12 strata (following physiographic and vegetation criteria) i)Mixed Aguajal, ii) Alluvial floodplain, iii) Strong high hills, iv) Slight high hills, v) Strong low hills, vi) Slight low hills, vii) Tropical savannah, ix) High terrace, x) Low terrace, xi)strongly dissected terrace, xii) slightly dissected terrace
6	Validation methodology map	Visual, in the area.
7	Map accuracy	95.24 %
8	Monitoring equipment	GPS
9	Definition of primary forest	Composed by terrace and hills tropical rainforest, according to the classification in the Forest Map of Peru prepared in 2000.
10	Definition of secondary forest	Those generated after being eliminated the main or upper strata of climax forest for agriculture, giving rise to the development of a new forest seedlings. They can be caused by anthropogenic activity or naturally originated by atmospheric phenomena, geology and wildlife, among others.

The area analyzed corresponds to Tambopata National Reserve, Bahuaja Sonene National Park (Madre de Dios) and their buffer zones. They present a total of 15 physiographic strata in an extension of 837,153 ha.

As a result of stratification was determined that forests have an extension of 753 977 ha which represents 90.06% of the area. The most frequent strata are alluvial floodplain forests (21.01%), Low terrace forests (22.80%) and slightly dissected terraces (18.16%). The area deforested represents 6.95% of the total area, mainly located in the leakage belt, the same as the agricultural area/secondary forest.

From 753,977 ha 541,620.1 ha exclusively correspond to TAMBNR and BSNP, being this the project area.

B) Carbon stocks

The carbon content was estimated through the field measurement in every one of each strata identified lines above. The sample consisted in 108 plots, which allowed having sample error of less than 10%.

The inventory was exploratory, consisting in a fusion of forest inventory methodologies developed by AIDER between 2000 and 2009 in Ucayali department using the Malleux Methodology (1982) and the the methodology established by Walker *et al.* (2007) for measuring terrestrial carbon. The result was the establishment of circular nested sample plots developed by Walker and the measurement methodology of woody plant species applied by AIDER in its forest inventories.

Estimating the carbon content was performed by applying the methodology requirements VMD0001 VCS. "Estimation of carbon stored in above and below ground biomass of trees reservoirs and non- living trees (CP-AB)." This is detailed in Table 9.

Knowing the extension of each stratum and their carbon stock, it was estimated that the area of the project storages more than 247 millions of tons of CO_2-e. The results are shown in Table 10 and Figure 23.

Table 9. Technical parameters to estimate carbon stocks

Nº	ITEM	Description
1	Sample design	Stratified sampling and randomly systematic distribution of vegetation types identified. Stratified sampling allows sample distribution in proportion to the size of the stratum.
2	Accuracy	The maximum sampling error for forested strata was 10%, related to the average total carbon stored per hectare.
3	Number of plots	For the calculation of sample plots, were established coefficients of variation (CV) of other research made in Madre de Dios. The following equation was used $$n = \frac{t^2 \left(\sum_1^M P_j S_j\right)^2}{E^2}$$ To ensure not to exceed the predetermined sampling error, 10% more plots were added.
4	Plot size	0.28 ha
5	Plot design	Circular nested plot of 5, 16 y 30 m of radius
6	Temporary or permanent	Temporary
7	Measured carbon reservoirs	Aboveground biomass (Trees over 5 cm DBH, palms and lianas)
8	Allometric equations	- Allometric equation to estimate aboveground biomass. - Source: Brown, 1997, quoted by Pearson et al, 2005. - Allometric equation to estimate aboveground biomass of the species cecropia (*Cecropia* sp.) Source: Pearson *et al.,* 2005 - Allometric equation to estimate the aboveground biomass of ungurahui palm (*Oenocarpus bataua*) Source: Pearson et al, 2005, quoted by Winrock, 2006. - Allometric equation to estimate aboveground biomass of wasaí palm (*Euterpe precatoria*) Source: Pearson et al, 2005, quoted by Winrock, 2006. - Allometric equation to estimate the aboveground biomass of palms. Source: Frangi and Luyo, 1995, quoted by Pasa, 2008. - Allometric equation to estimate aboveground biomass of lianas. Source: Putz, 1983, quoted by Pearson et al., 2005. - Allometric equation for calculating carbon stocks in aguaje. Source: Freitas et al., 2006.
9	Conversion from biomass to Carbon	0.5 IPCC, 2003
10	Extrapolation from sample unit to stratum scale	A form factor of the plot was used

Table 10. Carbon stocks in the area of the project

Strata	Extension (ha)	Aboveground biomass reservoir (tC/ha)	Belowground biomass reservoir (tC/ha)	Total biomass (t C/ha)	Stocked carbon (tCO_2 - e/ha)	Total carbon stock (tCO_2 –e)
Mixed Aguajal	29,405.1	56.7	16.3	73.0	267.6	7,868,567.9
Alluvial floodplain	150,428.2	85.5	24.0	109.5	401.4	60,376,716.9
Strong high hill	24,792.9	117.1	30.6	147.7	541.7	1,430,044.9
Slight high hill	17,146.4	102.4	27.1	129.5	474.6	8,138,271.5
Strong low hill	7,302.5	136.6	34.8	171.4	628.4	4,588,998.4
Slight low hill	6,707.0	176.3	42.9	219.5	803.6	5,389,771.0
High terrace	45,126.2	102.8	26.8	129.5	474.9	21,431,767.8
Low terrace	124,892.4	114.9	30.1	145.0	531.7	66,404,033.3
Strongly dissected terrace	24,123.7	114.7	30.5	145.1	532.2	12,838,560.0
Slightly dissected terrace	111,695.9	90.8	24.4	114.2	422.5	47,192,364.7
Total	**541,620.1**					**247,659,096.5**

Source: AIDER (2013c)

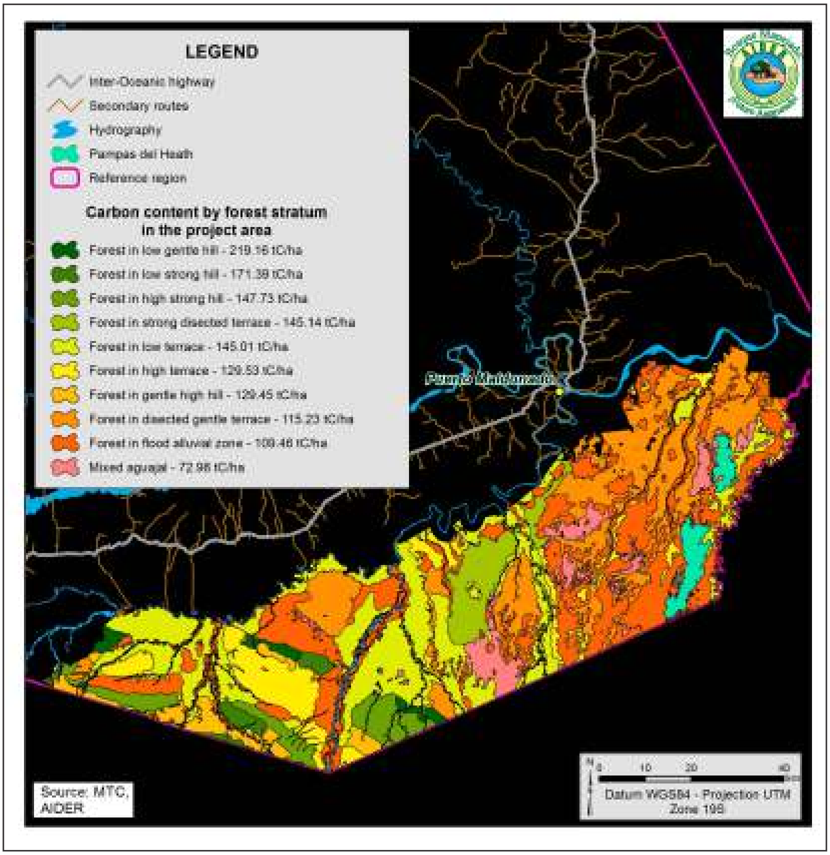


Figure 23. Carbon map in the area of the project

4.3 Projected unplanned deforestation

This projection was made to estimate the annual deforestation in the area of the project in a future scenario, determining which strata and how much of their extension would be affected, as well as their influence in terms of GHG emissions. The steps to achieve it were the following:

A) Scenario selection

Using the VCS VT0001- Tool for the demonstration and assessment of aditionality in VCS Agriculture, Forestry and Other Land Use (AFOLU) project activities, were identified, evaluated and determined the scenarios of land use for the project. From this analysis, were selected the most plausible land use, which is agriculture (mainly shifting cultivation), extensive grazing and the illegal extraction of gold.

B) Estimation of the annual areas of unplanned deforestation

The model of deforestation in Madre de Dios has been developed through an analysis of patterns of deforestation in the historical period taken as reference. Based on this analysis, it has been found a high correlation between increased population density and decreasing forest cover, which is explained in the following linear regression relating the both variables.

COV = 8,404,404 – 14,376,879 * population density

Where:

COV : Forest cover (ha)
Population density : inhabitants/ha

C) Location and quantification of the unplanned deforestation threat

The location of deforestation were modeled using Dinamica EGO software and pattern of historical deforestation occurred since 2000 to 2010. The modeling of deforestation was prepared in six steps:

(i) *Calibration*, reconstructing the transition from "Forest" to "Non-forest" for the period 2000 - 2008, depending on the connectors or existing deforestation drivers and their interaction with deforestation occurred;

(ii) *Simulation*, once developed the pattern of deforestation with calibration, were created simulated maps of deforestation to 2008;

(iii) *Validation*, consisted in comparing the map of the simulated deforestation with the real deforestation occurred, quantifying the overlap between both maps and determining the accuracy rate between the simulated and the real map;

(iv) *Test modeling of deforestation*, to observe and verify the behavior pattern of deforestation built;

(v) *Modeling validation test*, in order to know how successful is the deforestation model developed;

(vi) *Modeling*, with the pattern of deforestation constructed and validated, were modeled deforestation since 2010 to 2030 according to the projected annual rate. Projections of deforestation are shown in Figures 24 and 26.

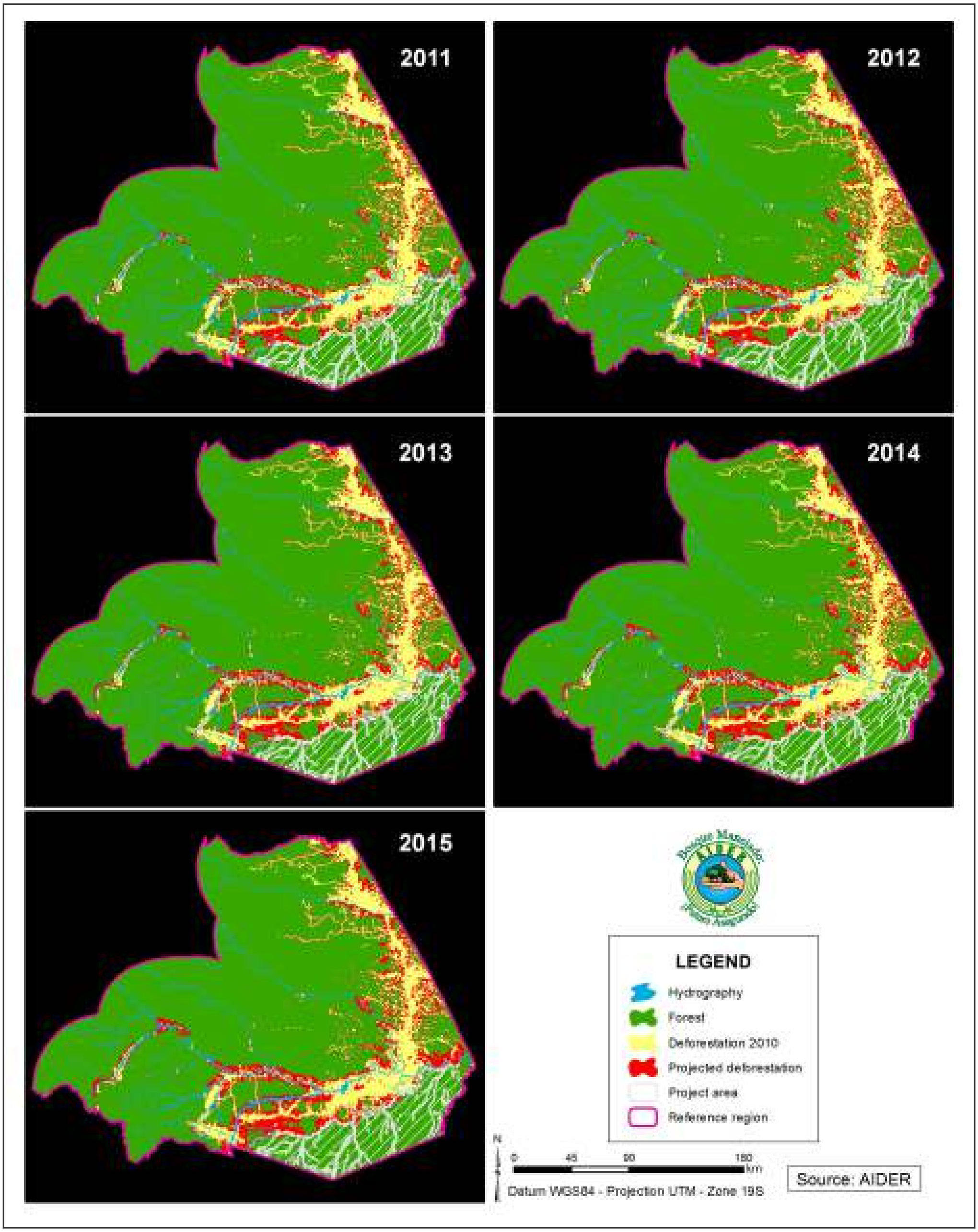


Figure 24. Projection of deforestation 2011-2015

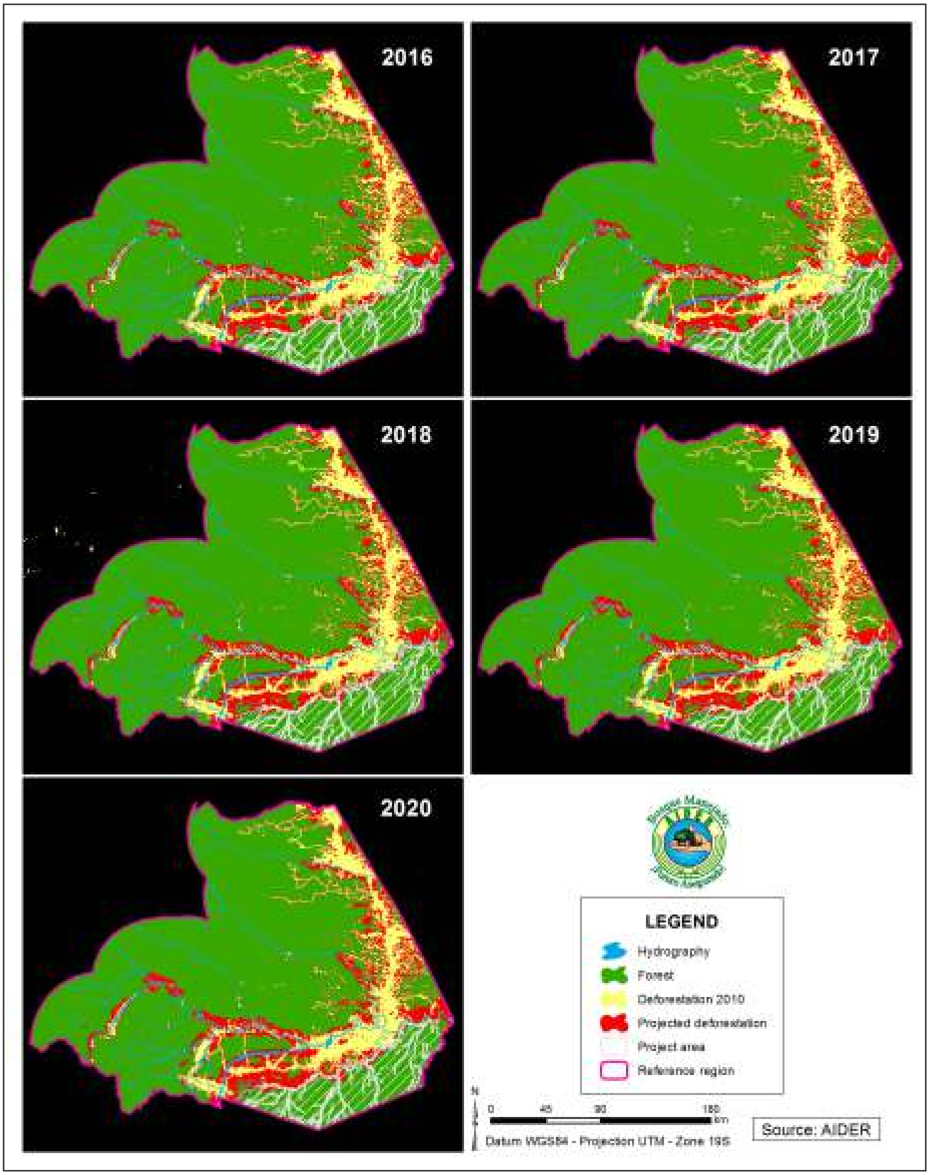


Figure 25. Projection of deforestation 2016-2020

D) Estimation of changes in carbon stocks and GHG emissions.

Estimations of the carbon stocks variation was conducted taking into account only the aboveground and belowground biomass reservoirs. The other reservoirs were considered no significant as a result of the T-SIG tool, “Tool to prove the significance of the GHG emissions in activities of the A/R CDM projects.” (Version 01)

4.4 Calculation of avoided emissions and Verified Carbon Units

The process followed for the calculation of avoided reductions and Verified Carbon Units (VCU) is illustrated in Figure 27. The total net GHG emission reductions from REDD + project are shown in Table 11.

A) Emissions from the reference scenario

The calculation of emissions from baseline was conducted in accordance with the VCS module "Estimation in carbon stocks and GHG emissions by unplanned deforestation in the baseline scenario" (BL-UP) Version 1.0

For quantification of emissions in the area of the project, have been only considered the emissions proceeded from the loss of above and belowground biomass caused by the removal of forest cover.

For the calculation of net emissions, were discounted the stored carbon in after-deforestation strata.

B) Project emissions

Emissions caused by the activities of the project have been considered insignificant.

C) Leaks for activities displacement

Quantification of the leaks of the REDD project was made using the VCS Module VMD0010 "Estimation of emissions from activity shifting for avoided unplanned deforestation" (LK-ASU).

D) Reduction of emissions

Reductions in GHG emissions were calculated by subtracting the leakage and project emissions to the net emissions of the baseline scenario, according to the following equation.

$$\boxed{\Delta REDD, t = C_{BSL} - C_P - C_{LK} \quad (1)}$$

Where:

$\Delta REDD,t$: Total net reductions of GHG emissions over time t, tCO2 –e
C_{BSL}: Net GHG emissions in the baseline scenario; t CO_2 –e
C_P: Net GHG emissions of the project; t CO_2 – e
C_{Lk}: Net GHG emissions due to leaks; t CO_2 –e

E) Verified Carbon Units (VCU)

The focus of the VCS standard related to the permanence of carbon credits from AFOLU projects is to reserve a percentage of credits (buffer) which is managed by VCS. The percentage is related to the risk level of the projects, which in the case of REDD + Project Tambopata-Bahuaja was estimated at 13% using the "AFOLU Non Permanence Risk Tool: VCS Version 3.1" tool

The calculation of the Verified Carbon Units (VCU) was made by subtracting the reserve of non-permanence risk credits (13%) of net GHG emission reductions.

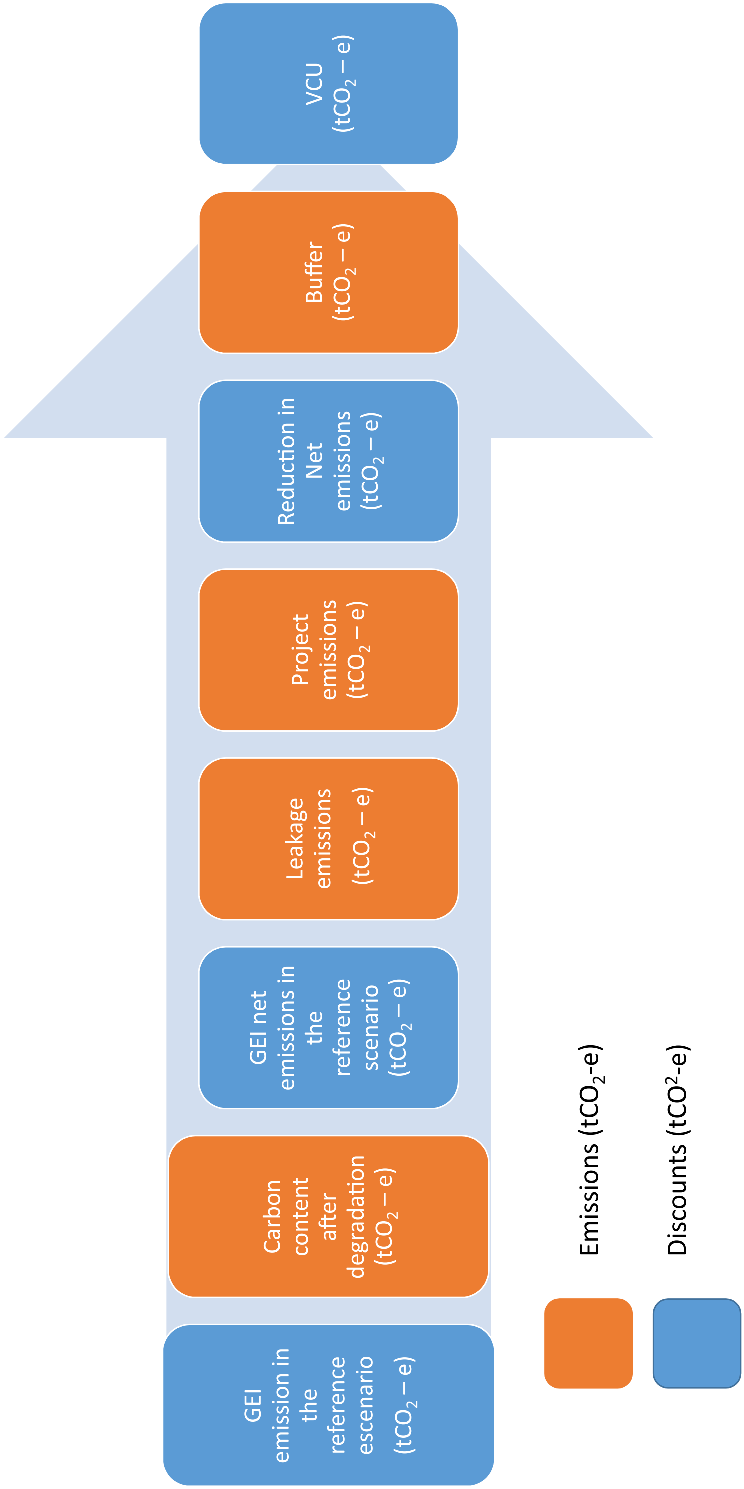


Figure 26. Process of the VCU calculation

Table 11. Estimations of reductions and VCU

year	GHG emissions in the baseline scenario ($tCO_2 - e$)	Carbon stocks after deforestation ($tCO_2 - e$)	GHG emissions in the baseline scenario ($tCO_2 - e$)	Leakage emissions ($tCO_2 - e$)	Estimation of project emissions ($tCO_2 - e$)	Reduction of net emissions ($tCO_2 - e$)	Buffer (depending on the risk) 13% ($tCO_2 - e$)	VCU ($tCO_2 - e$)
2010-2011	213,990	18,603.9	195,385.7	29,414.0	0	165,971.7	21,576.3	144,395.4
2011-2012	288,777	24,655.5	264,117.7	39,693.3	0	224,423.9	29,175.1	195,248.8
2012-2013	393,921	33,811.2	360,109.8	54,146.5	0	305,963.3	39,775.2	266,188.8
2013-2014	457,638	38,948.4	418,690.0	62,904.8	0	355,785.2	46,252.1	309,533.2
2014-2015	527,924	45,601.8	482,322.1	72,565.9	0	409,756.2	53,268.3	356,487.9
2015-2016	689,037	59,622.2	629,415.2	94,711.8	0	534,703.4	69,511.4	465,192.0
2016-2017	727,741	62,787.3	665,391.7	100,031.7	0	565,360.0	73,496.8	491,863.2
2017-2018	732,089	62,787.3	669,301.6	100,629.4	0	568,672.2	73,927.4	494,744.8
2018-2019	916,024	78,947.3	837,076.8	125,912.3	0	711,164.6	92,451.4	618,713.2
2019-2020	946,976	82,063.4	865,868.7	130,166.7	0	735,702.0	95,641.3	640,060.7

V. Project Management

5.1 Organization for the project management

TheTambopata Bahuaja REDD+ project proponent is AIDER, with the SERNANP support in the frame of the administration contract. AIDER is responsible for the design, implementation and monitoring of the project.

It has been established that AIDER will prepare technical and financial annual plans for the implementation of project, which will be presented to SERNANP for their approval.

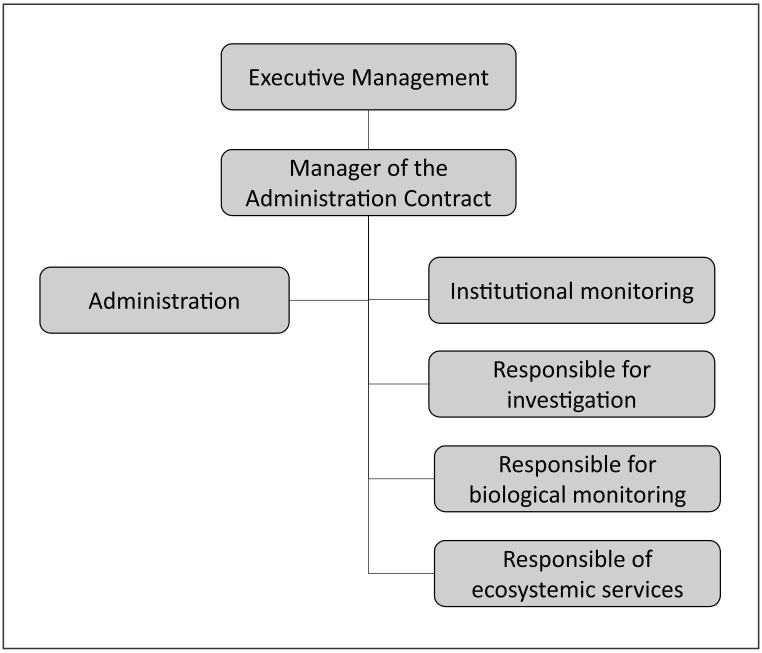


Figure 27. Organization chart for the REDD+ project development

5.2 Planning

REDD + is a mechanism of payment by results, where the monetary benefits depend on the efficiency and effectiveness of efforts to reduce deforestation. That is why it is necessary to implement well-designed strategies of low costs to ensure the profitability of the project.

In that sense, management documents to guide the actions to reduce deforestation and degradation were developed, as well as the achievement of the REDD+ co-benefits in terms of local population quality of life improvement and biodiversity conservation.

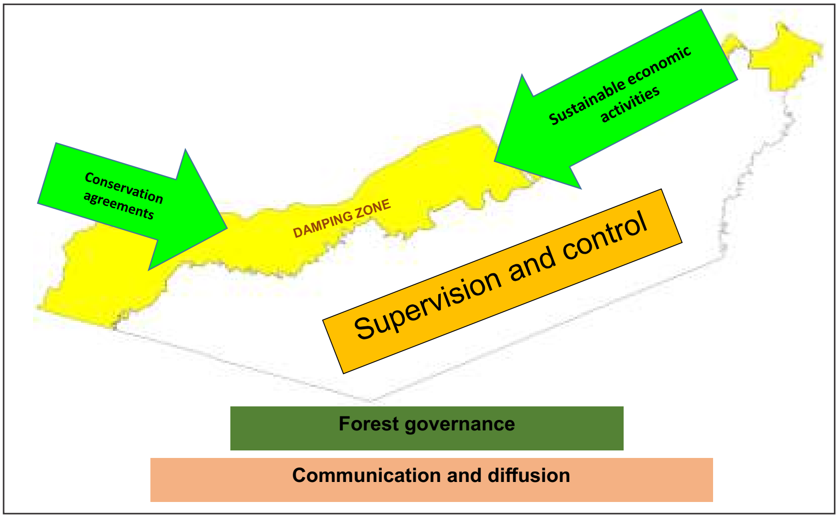


Figure 28. Intervention of the REDD strategy

A) REDD Strategy

The REDD strategy is a planning document for the management of the project, which establishes the activities and the involvement of actors, required in order to avoid deforestation and forest degradation.

The REDD strategy has: i) strategic objectives, ii) Limits of the intervention scope, iii) Implementing period, iv) political and economic context and v) Logic framework approach and vision of the program.

The steps to define the REDD strategy were:

- Participative determination of the REDD+ project objectives
- Determination of the causal model (tree of problems)
- Sectorization: for a better analysis of threats and potentials to be accounted as part of the strategy, the area of the project was sectored according to i) kind of actors, ii) kind of threats, iii) economic present activities, iv)population, v) most frequent socio-environmental infractions, vi) granted rights and vii) scope covered by the control and surveillance station.

For this analysis, the support information was the following: NPA zoning map, superposition of granted rights map and socio environmental infractions map of RNTAMB and PNBS. Working under this criteria, were identified 7 sectors (figure 29).

- Sector I: Mazuko-Kotzimba
- Sector II: Farfán, Azul, Yarinal A6
- Sector III: Malinowsky - La Torre
- Sector IV: Infierno
- Sector V: Loero, Jorge Chávez, Nueva América
- Sector VI: Sandoval - Huisene
- Sector VII: Sonene – San Antonio

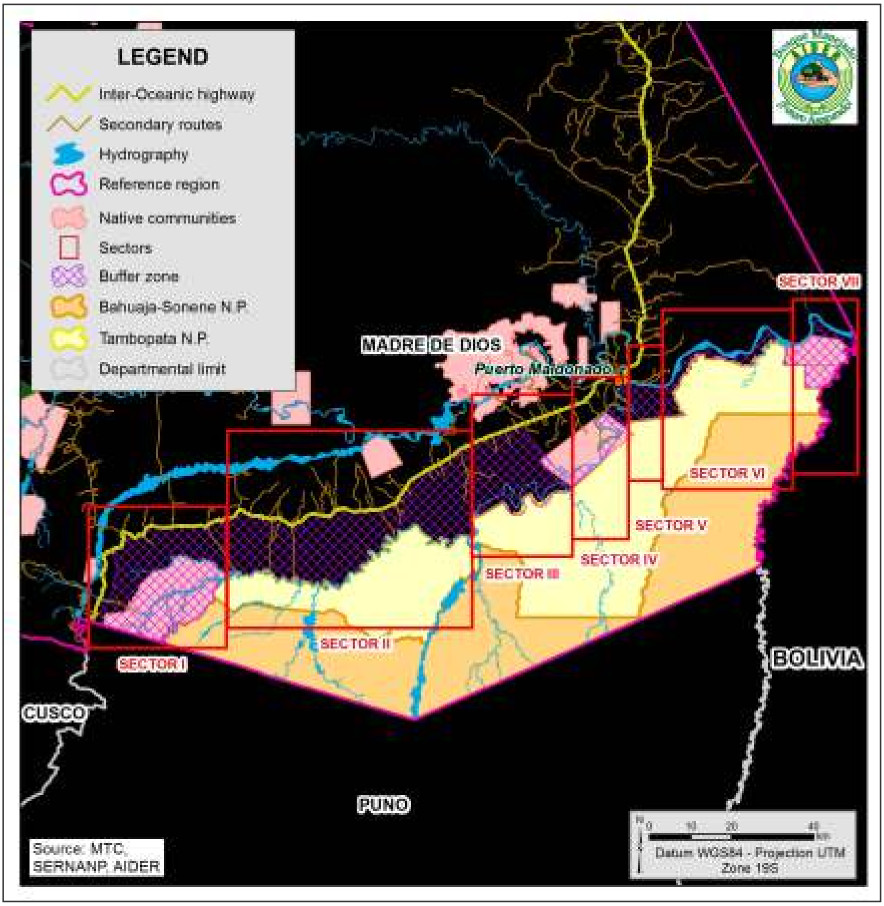


Figure 29. Identified sectors to REDD strategy

Table 12 shows the threats for each sector and the zoning made for both NPA's. This information was useful to prepare a matrix of deforestation threats and biodiversity loss per sector.

Table 12. Deforestation threats and biodiversity loss per sector

Sector	Mining	Farming	Logging	Poaching	Invasions	Overlapping areas	Burnings
SECTOR I. Mazuko, Kotzimba							
SECTOR II. Farfán, Malinowsky, A6							
SECTOR III. La Torre							
SECTOR IV. Infierno							
SECTOR V. Loero, Jorge Chávez, Nueva América							
SECTOR VI. Sandoval, Huisene							
SECTOR VII. Palma Real, San Antonio							

Source: AIDER, 2013a

The logical intervention to avoid deforestation and degradation was worked based on a logic approach, which allowed establishing indicators and goals. There were identifies 9 results as is showed in figure 30.

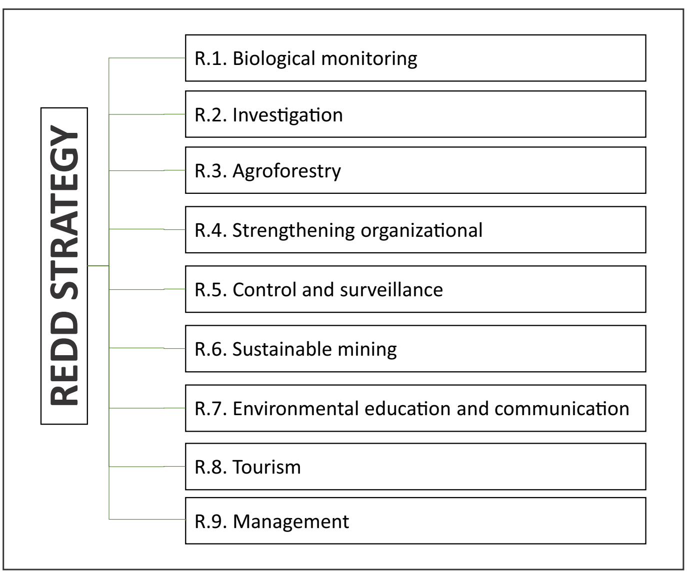


Figure 30. Constituents of REDD strategy

The budget of the REDD strategy amounts to **US$ 12,142,578.34** for the years 2014-2021. A summary by strategic result is presented in Table 13.

Table 13. Budget for REDD+ project

Component	Total (US$)
1. Biological monitoring	310,500.00
2. Investigation	207,700.00
3. Agroforestry	4,372,725.64
4. Organizational strengthening	973,397.49
5. Control and surveillance	237,000.00
6. Sustainable mining	160,000.00
7. Environmental education and communication	46,500.00
8. Tourism	80,000.00
9. Management	5,754,755.21
Total	**12,142,578.34**

B) Other management documents

In order the REDD+ project to generate additional benefits to carbon credits, it was used CCB Standard. Table 14 shows the mentioned documents, the purpose and the criteria of the CCB standard they apply.

Table 14. Complementary documentation to design the REDD+ project

Management documents	Objectives
Participatory Rapid Diagnosis (DRP) in the buffer area	The diagnoses were identified by initial conditions in the project area. Were determined ethnic composition, organization, main economic activities, income, basic services, internal and external conflicts, etc.
Social baseline	Project Impacts: are needed indicators to describe how socioeconomic conditions could change in the future due to REDD + project
Communication Plan	The communication plan identified channels, messages and communication strategies of the project so the REDD + project information flow at all levels (committees, general population).
Training Plan	This training plan seeks to strengthen capacities of local professionals as well as local people, so that gradually they assume roles in key positions of REDD + project.
Mechanisms and procedures for conflict resolution	This guide has allowed us to include in the project design, a process to listen, respond and resolve complaints from the community and others in relation to REDD + project.

VI. Project Monitoring

The monitoring of the REDD+ Project Tamboata-Bahuaja includes socioeconomic monitoring, biodiversity monitoring, GHG emissions monitoring, activities implementation monitoring. Figure 31 shows the level of responsibilities to these.

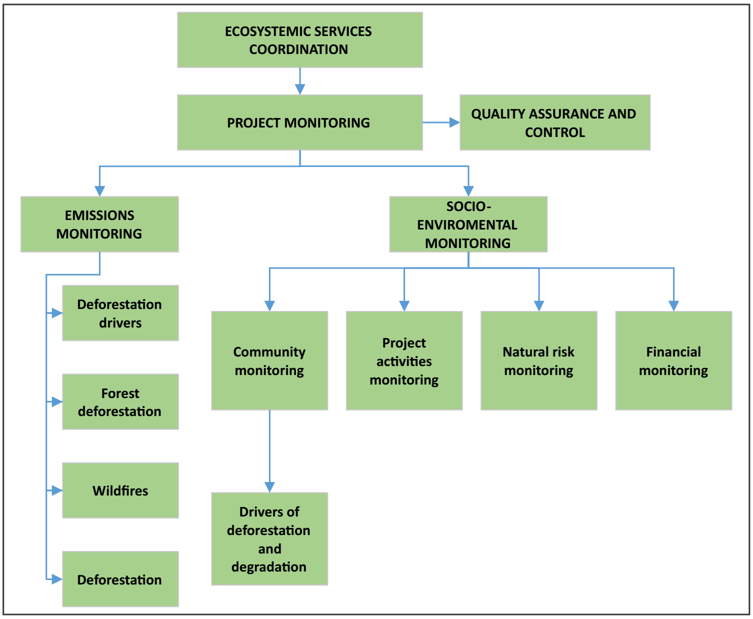


Figure 31. Organization chart for responsibilities to monitoring the REDD+ Project

Figure 32. AIDER Technical Team, responsible for the management and monitoring of the REDD+ Project

6.1. Socioeconomic monitoring

The REDD+ project looks for generate positive impacts on the population located in the area of the project.

Taking as reference the socio economic conditions encountered at the start of the project in 2010, will be conducted periodic monitoring of the activities of the project.

The socioeconomic monitored endpoints are:

- Type of production, productivity, income levels, profitability of economic activities.
- Legal certainty of the property
- Family mobility and demographic pressure
- Familiar or local leadership
- Skills and knowledge about forest management
- Familiar perception of the forest
- Participation and commitment of the local social organizations.

The positive net impacts of the project will be verified through the CCB Standard.

6.2. Biodiversity monitoring

The REDD+ project Tambopata Bahuaja got the CCB GOLD award due to the exceptional benefits to biodiversity. In other words, it has been recognized that the area of the project is a global significant zone for the biodiversity conservation, given its condition of vulnerability and irreplaceable character.

The monitoring of biodiversity is based on the eight conservation targets identified for Tambopata National Reserve and Bahuaja Sonene National Park.

1. Type of forest
2. Brazilian nut tree stands
3. Pampas of Heath
4. Wetlands, rivers, lakes, aguajales
5. Licks
6. Jaguar (*Panthera onca*)
7. Big Mammals threated: monkey (*Ateles chamek*), otter (*Pteronura brasiliensis*)
8. Endangered Birds: Harpy Eagle (*Harpia harpya*), blue-headed macaw (*Promolius couloni*)

The methodology used for the registration of species includes: transects, camera traps, trap prints, river censuses, and occasional observations.

Positive net and exceptional impacts of the project will be verified through CCB Standard.

Figure 33. Monitoring Pampas de Heath using camera traps

6.3. Carbon Monitoring

The purpose of the carbon monitoring is to obtain the necessary information to estimate the amount of GHG emissions avoided during the crediting period, evaluate the effectiveness of project activities and gather all the information needed to ensure the achievement of the objectives of reducing project emission.

Figure 34. Monitoring of the forest degradation transects

According to the reference scenario for the period 2010 – 2011, the projected deforestation in the area of the project is 436.1 hectares. By monitoring for that period was determined that 427 hectares had been preserved, having only 11.7 hectares deforested, which meant an efficiency of 97% (see Figure 35).

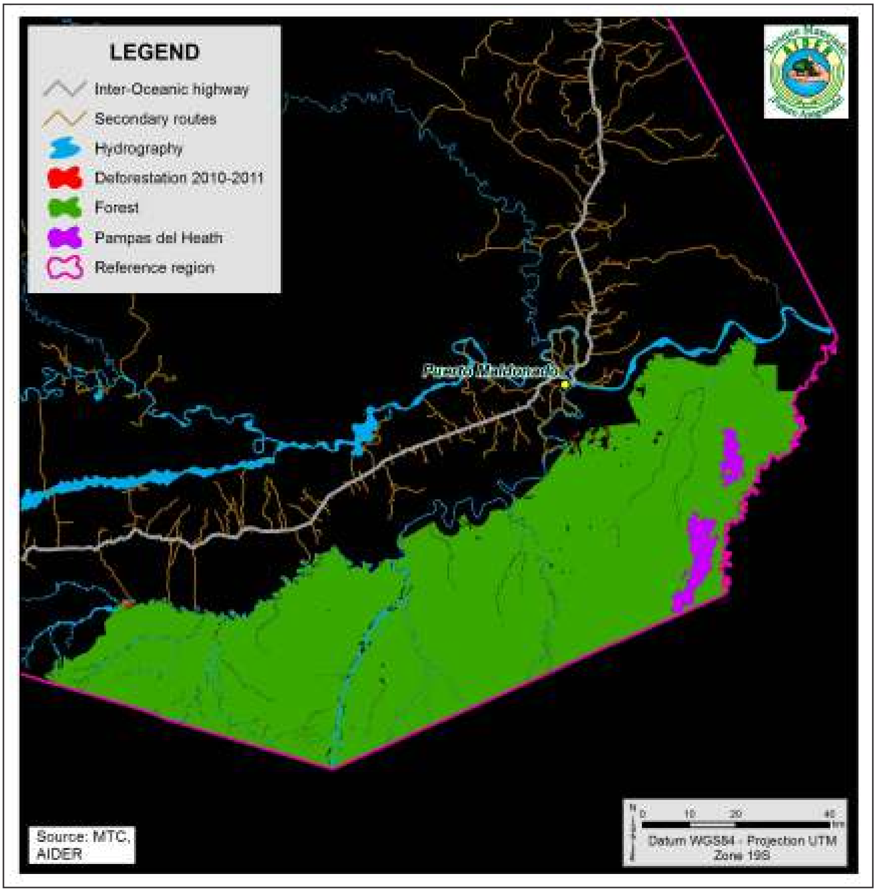


Figure 35. Deforestation monitoring 2010-2011

From data of avoided deforestation, were determined the associated emissions, using the VCS module VMD0015 "Methods for monitoring of greenhouse gas emissions and removals" (M-MON). Also, the calculation of activity-shifting leakage was performed according to Module VCS VMD0010 "Estimation of emissions from activity shifting for avoided unplanned deforestation" (LK-ASU). As for the estimation of GHG emissions different from CO_2 produced by burning biomass, was used the Module VCS VMD0013 "Estimation of greenhouse gas emissions from biomass burning" (E-BB).

Made the calculation, was determined for the period 2010 -2011 that the REDD+ project successfully reduced emissions in 190,796.2 tCO_2-e compared to baseline. These calculations were verified under the VCS standards, so in April 2013 was obtained the verification statement (see Figure 36), then registering the carbon credits in the MARKIT account[102]

[102] (https://products.markit.com/br-reg/public/project.jsp?project_id=103000000003877)

Rainforest Alliance

VERIFICATION STATEMENT
FOR
AIDER
Av. Jorge Basadre 180, San Isidro. Lima, Perú

Verification Scope:

Rainforest Alliance has verified that Reduction of deforestation and degradation in Tambopata National Reserve and Bahuaja-Sonene National Park within the area of Madre de Dios region - Perú Project is in conformance with the *the Verified Carbon Standard Version 3*. The project is located in Madre de Dios, Perú. This independent third-party verification covers a REDD project of 573,299.97 hactares of publically owned land. The objective of this verification audit is to verify the implementation of the validated GHG project. The information supporting the GHG assertion is historic in nature. The verification assessment covered the monitoring period from July 1, 2010 to June 30, 2011, and verified the following calculated emission reductions and/or removals were achieved during the monitoring period with a reasonable level of assurance.

Total number of verified emission reductions and/or removals: 190,796.2 tCO_2e
Total number of credits to be deposited in the buffer account: 24,804 tCO_2e

Verification Registration Code: RA-VER-VCS-017401

Effective Date: 09 April 2013

The validity of this statement is contingent upon the project's continued implementation of the *the Verified Carbon Standard Version 3* and as further defined in the Rainforest Alliance Verification Audit Report dated 09 April 2013.

Joshua Tosteson, RA-Cert Director
Rainforest Alliance
665 Broadway, Suite 500 New York, NY 10012 USA

Rainforest Alliance provides carbon project validation and verification services, based on protocols and standards developed by third party organizations and for which Rainforest Alliance has been accredited as a validation or verification body. This statement signifies that Rainforest Alliance has verified that the project listed above complies with the particular standard listed above, as set forth in the audit report referenced above. In no circumstance does Rainforest Alliance warrant or guarantee the delivery of carbon emissions reductions credits or the financial or market value of any credits verified in connection with this verification statement. This statement is prepared solely for the benefit of the organization listed above and may not be relied upon by any third party without the express written consent of Rainforest Alliance.

Version March 2012

Figure 36. Verification Statement

6.4. Monitoring of the project implementation

The monitoring of the project will be conducted based on the Monitoring Plan consisting in i) indicator, ii) method of data collection, iii) data collection tools, iv) Frequency of data collection, v) Information sources.

VII. Project results

7.1 Social

Since 2010, the REDD + project of Tambopata National Reserve and Bahuaja Sonene-MDD National Park has developed activities that have had a positive impact on the livelihoods of men and women settled in these NPA and their buffer zones.

- Promote agroforestry systems in the buffer zones for the increasing of agricultural production and to reduce the pressure to primary forest, with the consequent increase of the economical incomes to the farmers.
- In the native communities of Palma Real, Sonene, Infierno and Tres Islas the environmental governance has been strengthened by solving boundary disputes and rectifying the area of their territories. Once cleaned up the territories, their zoning was performed, which has identified important areas to develop sustainable activities such as ecotourism, which is also an option to authorities Palma Real Community.
- Training workshops have been developed to leaders and young people from communities (men and women) on issues related to REDD+, leadership, duties and rights, climate change, file management, waste management and processing of organic fertilizer; allowing to recognize the importance of taking responsibility to contribute to the development of their communities, promoting the horizontal treatment, multiculturalism, democracy, among others. As a result, at present, the new board is composed of young people interested in making positive changes in their community.
- In the native community Infierno it has been promoted the recovery of their traditions and their Ese'eja language, so two members of the community have been designated as teachers for their expertise in that language, and now they are responsible for teaching language and some customs to elementary students.
- The project contributes to food security in Sonene and Palma Real communities by building reservoirs for Brazilian nut and installing and implementing agroforestry plots and fish farms.
- The project has favored social welfare in Palma Real, by building a small dam, which allows water to reach the community , now indigenous women don't have to walk 2 Km with their buckets or wash their clothes inside the forest, running many dangers.

7.2 Climate

The results regarding to climate are given by the reduction of emissions for deforestation in RNTAMB and PNBS.

The first verification period for emission reduction was from July 1st, 2010 to June 30th, 2011, through which the net reduction was about 190,796 tCO_2-e considered as total net GHG verified emissions. The quantity of carbon credits to be deposited in buffer account was 24,804 tCO_2-e, therefore, the difference become VCU, and this is 165,992.3 tCO_2-e that can be sale.

The second verification period was from July 1st, 2011 to June 30th, 2013, through which the total net reduction of GHG emissions were 620,782.86 tCO_2-e. The total available VCU to be commercialized will be 540,159.39 tCO_2-e. Table 15 shows the estimated VCU and the verified VCU.

Table 15. Ex ante and tradable VCUs

Period	Estimated VCUs tCO_2-e	Verified VCUs tCO_2-e	Registered VCUs in MARKIT
2010-2011	144,395.4	165,992.2	YES
2011-2012	195,248.8	540,159.4[103]	YES
2012-2013	266,188.8		YES
2013-2014	301,355.5	370,907.7-	Pending
2014-2015	347,054.3	-	Pending
2015-2016	542,879.4	-	Pending
2016-2017	478,859.0	-	Pending
2017-2018	481,663.0	-	Pending
2018-2019	602,344.6	-	Pending
2019-2020	623,139.0	-	Pending

7.3 Biodiversity

The biodiversity monitoring of the project is based on the system prepared by AIDER as a result of the biological monitoring of the partial administration contact for both NPA's.

This system pretends to be realistic and useful, in order to conduct the management interventions in the NPA's. It is designedby simple and low cost indicators, requiring few equipment and a low economic investment to be implemented. It also incorporates other institutions to generate information and fulfill the objectives.

Ensuring other institutions involvement and ths system ownership from all the users, will be contributing to the sustainability of monitoring (Danielsen et al, 2000) and consequently to improve the development of the mentioned NPA's.

As part of the implementation of the biological monitoring, in the period 2010 – 2011, were plotted 23.9 km of linear transects to monitor wildlife in CSS. In the CSS Sandoval were traced 6.0 Km; in CSS San Antonio, 4.0 Km; in CSS Huisene, 4 Km; in CSS Jorge

[103] Two years verification

Chavez, 4.0 Km and in CSS Malinowski, 5.9 Km. These make a total of 11 transects in 5 CSS within RNTAMB. Moreover, traps camera were placed. (See figure 37)

Also, official and volunteers forest warders were trained in monitoring and assessing wildlife, as well as in the filling the formats to implement the Monitoring Integrated System.

Figure 37. Location of the transects in CSS Malinowsky – RNTAMB

Figure 38. Photo taken by a trap camera located in RNTAMB, Malinowksy sector

7.3. Economic

In Peru, the carbon market has been developing and is still growing. However, daily, more institutions join this market as part of their environmental responsibility. Tambopata Bahuaja REDD+ projct in one of the first experiences of sale of carbon credits in Peru.

In December 2011, the insurance company Pacífico acquired VCU from the Tambopata Bahuaja REDD+ project, branding a point in environmental projects private investment. From this other institutions and organizations started to buy VCU from the project, can be mentioned Condor Travel, South Pole Carbon and Toyota of Peru.

Figure 39. Carbon credits sale contract signing with Pacífico insurance company

The Tambopata REDD+ project has sold 103,735 carbon credits, revenues are used to finance the contract administration activities and to implement REDD strategy.

Currently, the project has cancelled carbon credits, in negociation and in future sale contracts. (See figure 41)

Figure 40. Signing of the contract of Carbon credits sale contract signing with Cóndor Travel company

Figure 41. Trade of carbon credits from REDD+ project

The main trade agreement for carbon credits generated by the project was realized with the climate fund Althelia which bought 2,448,180 future VCU's until 2019. This agreement will achieve the following:

- Will have 4000 ha of land with agricultural use in the buffer zone, under agroforestry production, with native cocoa as main crops, it gives high profitability to the production system, having assured market as part of the REDD+ project itself. All the cocoa valor chain is been funded by the project.
- 1,144 families in the buffer zone will improve incomes participatin of the agroforestry bussines, through forming cooperatives.
- Will be avoided deforestation of 11,983 ha of forest and the disruption of 100,000 ha of forest, preserving the biodiversity and assuring the benefits of other important ecosistemic services.
- 3,558,298 VCU to give self-financing was generated

VIII. Challenges and lessons learned

Some sectors see in REDD a threat to forests. Bad experiences in specific cases of implementation of REDD + projects, generated a stream of opinion against REDD, for which our project was affected due to its negative perception.

To reverse this situation, the views and concerns of the population were attended, all related to a negative perception of REDD. The progresses of the project were reported, using the platform led by RNTAMB Management Committee as a representative space of the population of the buffer zone. The use of socio-environmental standards as CCB has enabled us to design a project with the objective to minimize the risks and maximize the benefits.

Develop a methodology for calculating degradation. While REDD + has the mission to reduce emissions from forest degradation, methodologically there is still an empty space. AIDER team has proposed a methodology constituted by key informants, historical monitoring and fieldwork with which we could calculate reductions of emission by degradation.

Develop a methodology for projecting future deforestation. This has been a constant process of trial and error test, regards to the use of the most appropriate software and models which explain the future deforestation. This was achieved through teamwork, constant training and the use of institutional Know How.

On legal terms, one of the challenges was related to the ownership of carbon credits. At the beginning of the administration contract period (2008), the legislation was an uncertainty referred to ecosystem services and their ownership, presenting a loophole. On January 30th, 2014 SERNANP endorsed the presidential resolution 26-2014-SERNANP which regulates the trade of ecosystem services within NPAs. This meant an important precedent for the future trade of carbon credits.

IX. Next steps

- Carbon credits verification for the period 2011 – 2013.
- Implementation of 4000 ha under agroforestry systems, inside the buffer zone of Tambopata National Reserve, in the frame of the alliance with Althelia Climatic Fund.

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Feasibility assessment of forest carbon projects in "Pomac Forest Historical Sancturay" – PFHS

Cesar Samaniego Minaya – Collaboration: Percy Recavarren Estares

SUMMARY

Pomac Forest Historical Sancturay, due to its high diversity value and for being under a high degree of threat, has a high conservation priority (CDC-UNALM, 1992). The algarrobal or savanna type formation in the PFHS is unique in the National System of Protected Natural Areas. The PFHS protected area is located in the Lambayeque region and consists of 5,887 hectares. It is one of the four areas classified as Historical Sanctuary in Peru, preserving one of the most representative tropical dry forest areas of the ecoregion.

The protected area is still subject to a strong pressure over the occupation of its territory, which causes the loss and degradation of the tropical dry forest ecosystem that is representative of the area. One of the main threats to the PFHS is given by the systematic entrance of people to cut down trees, which unlike the collection of dry wood for the consumption of the local population, it is destined towards the illegal commercialization of firewood, algarrobo charcoal, sapote wood for crafts and faique wood for boats. Moreover, 50% of families in the buffer area maintain herds of goats and sheep grazing extensively in the forests of the protected area, posing a constant threat in some areas due to overgrazing.

As a conservation and restoration alternative from the PFHS, a project strategy was designed for this area on 2012, which consists in the development of activities for the reduction of emissions due to deforestation and forest degradation, increase in carbon content and reforestation. With these actions, the existing forests would be preserved and the deforested areas within the protected area would be restored, which would generate 402,383.29 tCO2-e one year after the project is implemented.

I. Location and characteristics of the communities

The Pomac Forest Historical Sanctuary (PFHS) protected area is located in the lower basin of La Leche river, Lambayeque region (Pitipo district, Ferreñafe province)[104], consisting of an area of 5,887 hectares. It is one of the four Historical Sanctuaries in Peru, and preserves one of the most representative tropical dry forest areas of the ecoregion. The typical vegetation formation is the algarroba", it counts with a varied fauna and an important monumental archaeological heritage, represented by numerous monumental remains of the Cholope, Moche and Sican culture.

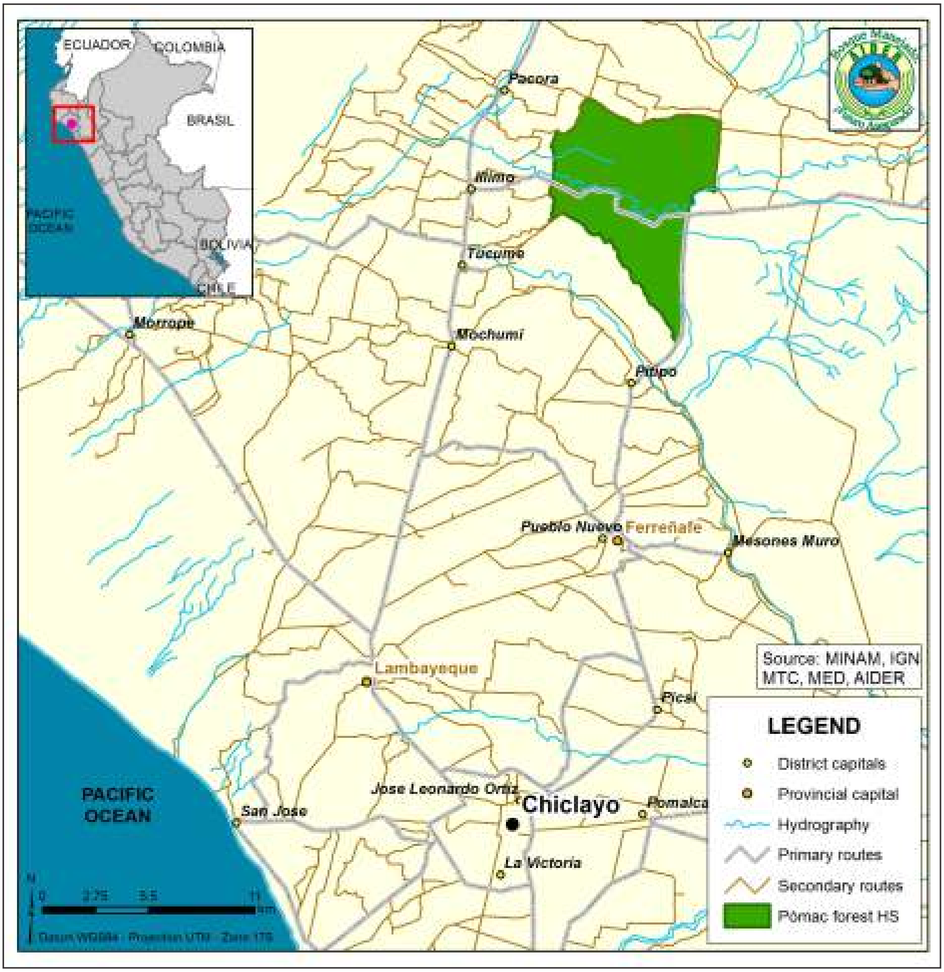

Figure 1. Map showing the location of the study area

[104] 90% of the PFHS Surface is located in the ditrict of Pitipo (Ferreñafe province) and 10% is distributed between Tucume, Pacora and Jayanca districts (Lambayeque province)

1.1. Biophysical characteristics

In the dry Pomac tropical forest, annual rainfall reaches 107.8 mm. The scarce rainfall is concentrated between March and April, being sporadic most of the time and only abundant during the El Niño phenomenon. Maximum temperatures have been registered in the months of February and March with 33.1ºC on average, reaching 34.4ºC as maximum; while minimum temperatures have been recorded in the months of July and August with 11.5ºC on average.

The physiography of the protected area is undulating flat mainly, with an average slope of approximately 8%. Soils are deep, with a medium to heavy texture, silty-loam and sandy-loam with calcium or gypsum materials belonging to xerosols or yermosols.

Hydrography is determined by the surface runoff of the La Leche river watercourse, which has an irregular flow that carries water from November to April and is dry the rest of the year. Also, the Taymi River is an artificial pre-Hispanic channel located in the buffer zone. Groundwater is an important hydro biological resource, found between 18 and 20 meters of depth, which provides water supply for family consumption and irrigation.

According to the ecological map of Peru (1976), due to land use capacity, there are some protection areas in the sanctuary that cannot withstand economic activities, not even extensive grazing or grazing in low quality agro ecological lands. In the protected area the limiting factor is water, as the land use capacity is only the natural aptitude of the land and it can change when humans alter its conditions with irrigation.

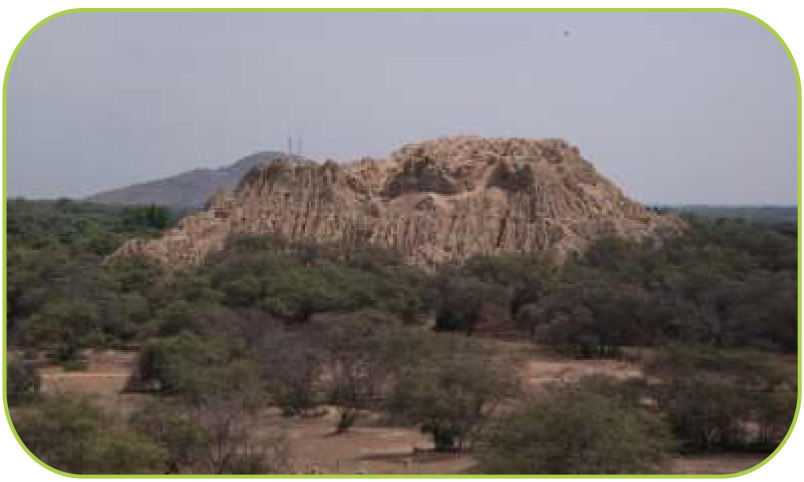

Figure 2. PFHS landscape photograph

1.2. Ecology and biological diversity

The PFHS is a priority area for conservation due to its high diversity value and for being under a high degree of threat (CDC-UNALM, 1992). The algarrobal or savanna type formation in the PFHS is unique in the National System of Protected Natural Areas - SINANPE (PM-PFHS, 2011). The ecosystems present in the PFHS are classified into different systems or classification levels, standing out the predominance of the tropical dry forest of super arid moisture content, with algarrobal formations and groups of riparian forests.

Figure 3. Algarrobo photography

The PFHS protects 5 endemic flora species of the tropical dry forest, 3 cacti and 1 herbaceous specie endemic to Peru. Endangered nationwide wild flora species, categorized according to DS-043-2006-AG, are: zapote (*Capparis scabrida*) critically endangered, algarrobo (*Prosopis pallida*) vulnerable and faique (*Acacia macracantha*) near threatened. Moreover, 16 species of endemic birds to the Tumbes region and 5 endemic species for Peru have been identified, two of which are only protected in the sanctuary: cortarrama peruana (*Phytotoma raimondii*) critically endangered and golondrina de tumbes (*Tachycineta stolzmanni*) near threatened (PM-PFHS, 2011).

Ecologically, the PFHS contributes to the connectivity between populations and ensures the continuity of ecological processes that take place in the La Leche river basin biological corridor, as well as the Lambayeque biological corridor, formed by the dry forest throughout the region.

1.3. Socioeconomic characteristics

The influence area of the buffer area has 14 populated areas with a total population of 11,198 inhabitants. Most inhabitants have a direct access to the forest, developing activities that allow the generation of household income. The homes in the area are made with poor materials, mostly “adobe” and “quincha”, and tin roofs. The populated areas lack basic water and sewage services, being groundwater their main source of drinking water.

Pitipo district, in which mostly of the sanctuary surface is located, is one of the mos excluded in Peru. In this district, food insecurity is high (0.5003), poverty (48.2%) oppress distrital population and extreme poverty (7.2%) (MIDIS, 2014)[105]y[106].71.2% of Pitipo population life in the rural zone (INEI, 2014)[107]. According to PNUD (2013[108]), distrital human development index (HDI) is 0.3501 (against 0.4617 in Lambayeque region and 0.5058 in Peru). Born life expentancy in 67 years, less than national average (74 years), population percentage with complete secondary education in only 54$ (67.9% at national level), the population with 25 years to more is only 6.34 years of education (national rate is 9%) and, monthly per capita familiar income is S/. 398 (against S/.697 al national level and 527 at departmental level).

The productive activities are related to livestock and farming, being manual labor in farms or private lands the main occupation, from where main income is earned. Beekeeping is an activity that takes place within the protected area, it is implemented by some families who have developed beekeeping production techniques. Ecotourism activities in the protected area have a great potential; to the date there is an organization of local guides and marketers of ropical dry forest products that lend their services to the Pomac Forest Historical Sanctuary. Tourist flow to the PFHS has been increasing regarding ecotourism and bird watching. Statistics of the Master Plan indicate that a large percentage of bird watching companies worldwide considered PFHS as a destination for endemic bird watching in the tropical dry forest.

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105 In fuction of economical incomes to cover the basic basket of consumption (poverty) and the food basic basket (extreme poverty). MIDIS (2014), with information of INEI (2010) “Poverty evolution in Peru 2009: departmental, provincian and distrital scale)

106 Level poverty in Lambayeque department in 24.7% and national poverty level is 23.0%. Extreme poverty in Lambayeque is 1.9% and extreme poverty is 4.7%

107 INEI (2014), with National Cense data 2007

108 PNUD (2013) Human Development Report in Peru

Figure 4. Map showing the areas of influence and populated areas in PFHS

II. **Background and Problematic**

The PFHS has presented the conditions for the development of various cultures in the tropical dry forest ecosystem; with the occupation of ancestral populations in different periods of history through an adaptive and sustainable use of the tropical dry forest resources. Some cultures that occupied the PFHS and that stand out for making a good use of its resources are: Chólope, Moche and Sicán. The latter stood out for the construction of pyramids that are currently part of the archaeological attractions of the sanctuary. Later, in the colonial and republican times, the PFHS was occupied and divided into plots constituted into paddocks dedicated to livestock and was recognized as the "estancia Sicán", later named “Batán grande estate”, known for its fine forests for grazing cattle and goats. In 1969, with the “reforma agraria”, the large farms present in the area came to form agricultural production cooperatives, integrated by the farm workers.

In 2001, after the consolidation and zoning process of the area, the PFHS was created over an area of 5,887.38 hectares containing biological and archeological wealth, excluding agricultural areas that no longer had any relation with the creation purposes of the protected area. However, since the decade of 1970s until 2001, there were a sequence of invasions that on 2004 were stopped by the agencies responsible for the administration and management of the protected area in coordination with the regional and local authorities. In 2009, after a trial, an area invaded area of 1706 hectares returned to the PFHS, after eliminating the illegal occupation of the area. However, the PFHS still faces a strong pressure over the occupation of its territory, which causes the loss and degradation of the tropical dry forest ecosystem that is representative of the area.

The problems regarding the conservation of the PFHS depend on a number of factors and chain of events, which are called the “causal model of deforestation” by the project. Their identification and analysis is very important to be able to design and implement the appropriate strategies for stopping the deforestation and forest degradation with sustainable productive alternatives for the population. Thus, an analysis of the chain of events leading to deforestation and forest degradation in the protected area is to be made. The identification of the deforestation agents presented below was conducted through a "Training workshop on REDD+ projects, identification of deforestation agents and drivers and economic activities in the “Pomac Forest Historical Sanctuary”, made in 2012 with the head staff of the PFHS people who know about the reality of the protected areas.

A) Illegal loggers of species like algarrobo, zapote and faique

One of the main threats to the PFHS is given by the systematic entrance of people to cut down trees, which unlike the collection of dry wood for the consumption of the local population, it is destined towards the illegal commercialization of firewood, algarrobo charcoal, sapote wood for crafts and faique wood for boats. Thus, a selective logging of trees with special characteristics is done according to their purpose, resulting in the loss of biodiversity and ecosystem degradation. Moreover, logging is opening roads for the carrying wagons and mules into the PFHS, which fragments the ecosystem. Illegal logging has also been observed, which takes place for land use change into agriculture and infrastructure as a result of the invasions.

The main driver of deforestation in the PFHS is the lack of employment opportunities for the residents of the buffer area. Lack of employment increases every year when agricultural activities come to an end and also during times of drought, which makes productive activities be reduced and thus the pressure on forests increase (PM-PFHS, 2011).

B) Livestock

The Master Plan for the PFHS for the 2011-2016 period, states that 50% of the families in the buffer area maintain a herd of goats, sheep and cattle grazing extensively in the forests of the protected area, posing a constant threat in some areas due to overgrazing. Their presence on the forests is affecting the natural regeneration, as they feed on the natural forest regeneration and cause the debarking of young trees. This impact is increased by the prolonged periods of drought in which there is a shortage of fodder. Livestock is characterized by being extensive and disordered, which is why it has a low yield; in addition, it is done without applying suitable management techniques, thus disturbing the peace of the wildlife habitat, one of the objectives of the sanctuary.

C) Invaders

It is a practice with a history in the PFHS that has been causing serious damage to the ecology and to the archaeological heritage, as well as strong social conflicts between the state and invader populations. It consists in the appropriation of lands that "are not occupied" generating an infrastructure sprawl promoted by external agents, which has been a constant threat in La Leche river basin. The mafias who run this practice rely on all kinds of influences to invade properties and through long trials seek to profit for several years. This produces changes in land use, high biodiversity loss and destruction of archaeological heritage.

Furthermore, agricultural activities that cause deforestation in areas with water availability for expanding the agricultural barrier are also considered, as well as the occurrence of fires caused by man during activities such as illegal charcoal making, beekeepers burning during the harvest of honey and misuse of fire by visitors. It is also important to mention that after the El Niño phenomenon, the risk of fire increases significantly. Fires generate drastic loss of biodiversity and ecosystem services, generally being reported in areas of 0.5 to 2 hectares.

III. Project design

3.1. Conceptualization and pre-feasibility assessment of the project

The initial step in the conceptualization of the feasibility assessment of forest carbon projects in the PFHS was a quick diagnosis of the ecological, socio-economic and legal characteristics that enable the development of such projects. In the ecological aspect, the stratification of the vegetation cover and the land use classes present in the PFHS were analyzed in order to identify areas of dense dry forest, sparse dry forest with restoration potential and degraded areas or bare soil areas with reforestation potential.

The socio-economic analysis contemplated the area’s background analysis and the identification of the key stakeholders and project participants, as well as the people potentially affected by the implementation of the forest carbon projects. This allowed the definition of the target group with which the project design would be developed in a participatory way. Similarly, an analysis of the legal and regulatory conditions was conducted. It would enable the implementation of forest carbon projects as a tool for the assessment of the forest ecosystem services and serve as a financial mechanism to achieve the sustainable management of the biodiversity present in the area.

Once the stakeholders and potential activities for the implementation of a comprehensive forest carbon project were defined, the next step was the Project Idea Note (PIN) development that enables a concise description of the project and a review of the basic assumptions. For this, the project included an analysis based on a conservative rate of deforestation calculated with secondary sources and growth rates from experiences in tropical dry forests in Piura, which were used to estimate the potential emissions reduction from preventing unplanned deforestation and to evaluate the potential for increasing carbon stocks through forest restoration and carbon sequestration through reforestation, respectively.

The development of the PIN allowed a preliminary assessment of the applicability of a forest carbon project at an ecological, socio-economic and technical level. However, the aim of this project is to generate specific technical information that would allow a more precise quantification of the emissions reduction and removal through forestry activities in order to analyze the financial viability if these activities were implemented in the PFHS.

The overall objective is to evaluate the technical and financial feasibility of a comprehensive forest carbon project implementation in the PFHS. The implementation of this project seeks to contribute with climate change mitigation and generate social and biodiversity benefits as outlined below.

- **Climate Objective:** Contribute to climate change mitigation by reducing emissions of greenhouse gases (GHG) caused by deforestation and forest degradation, as well as capturing GHG emissions by increasing forest carbon stocks in sparse forests and carbon sequestration through reforestation.
- **Community Objective: C**ontribute to the welfare of communities and local people involved in the project through the implementation of sustainable productive activities and by improving their environment and conditions of forest goods and services on which they depend.
- **Biodiversity Objective:** Contribute to the conservation of the priority conservation targets of the PFHS characterized by a high rate of endemism.

3.2. Design

The analysis of the ecological, socio-economic and legal characteristics of the PFHS allowed to conclude that the project area is characterized by dense and sparse dry forests, which are threatened by deforestation and forest degradation by local populations; degraded areas with scarce woody vegetation with restoration and/or reforestation potential; and surrounding low-income populations with a high degree of dependence on forest products. The surrounding populations carry out productive activities, most of them unsustainable, of low yield, and without application of appropriate techniques. It also has significant endemic biodiversity that has been generating tourism activities in the protected area with a great potential for expansion.

The mentioned conditions, considering the scale of the project, allowed to determine the design and financial evaluation of a comprehensive forest carbon project that includes the reduction and removal of GHGs due to the protection of forests, restoration of sparse forests and reforestation of degraded and bare areas, integrating productive activities and strengthening the biodiversity monitoring activities contemplated in the Master Plan of the PFHS.

3.3. Participants

The design of the project includes the participation of: the head of the PFHS represented by SERNANP, local and regional authorities, populations in the influence area of the protected area and the Association for Research and Integrated Development (AIDER).

SERNANP is responsible for the administration of the protected area, relies on management tools such as the Master Plan and Annual Operating Plans, and assumes the role of managing the distribution of the benefits generated by the ecosystem services in the area action such as carbon sequestration. Local and regional authorities participate effectively in the management of the sanctuary through the Management Committee and take advantage of spaces such as participatory budgeting, development plans and public investment projects to consider the PFHS a priority.
The inhabitants in the area of influence participate in productive activities, conservation, and reforestation, and support Monitoring, Reporting and Verification tasks of the project. AIDER is responsible for the technical design, implementation and monitoring of the forest carbon project, as well as the management of the climate benefits. It also facilitates the valuation and commercialization process of the carbon credits in the market through transactions and fund researching, using as a financial instrument the valuation of carbon sequestration as an ecosystem service.

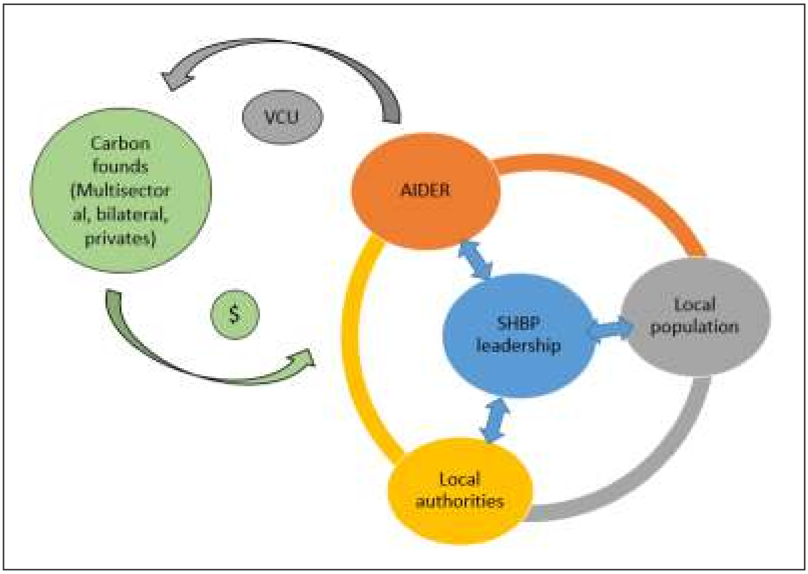

Figure 5. Participants of the project

Figure 6.Participatory project design development

3.4. Project Design Document elaboration

The Project Design Document (PDD) is the key source of information and analysis that summarizes the project's characteristics, quantifies carbon benefits and defines the monitoring plan, providing the basis for the validation and independent verification of the project and its emissions reduction.

Based on the project's characteristics, the scale of the projected carbon benefits, location and applicability with the available methodologies for forest carbon projects, the Verified Carbon Standard (VCS) was proposed. VCS is aimed at the voluntary carbon market, has an international acceptance and recognition, and is the preferred carbon quantification standard by the buyers in the market, capturing most of the forest carbon transactions.

The evaluation of the approved VCS methodologies and its applicability criteria to the project conditions allow to choose this standard due to its rigorous application of criteria in the quantification of emissions reduction, which allow the VCS project to apply to other standards and carbon funds for exceeding the criteria and the requirements set.

Spatial limits of the project

The area of REDD+ project comes to be the Pomac Forest Historical Sanctuary with an area of 5,187.4 hectares, corresponding to dense and sparse dry forest strata, and recovery areas, excluding the elevated areas.

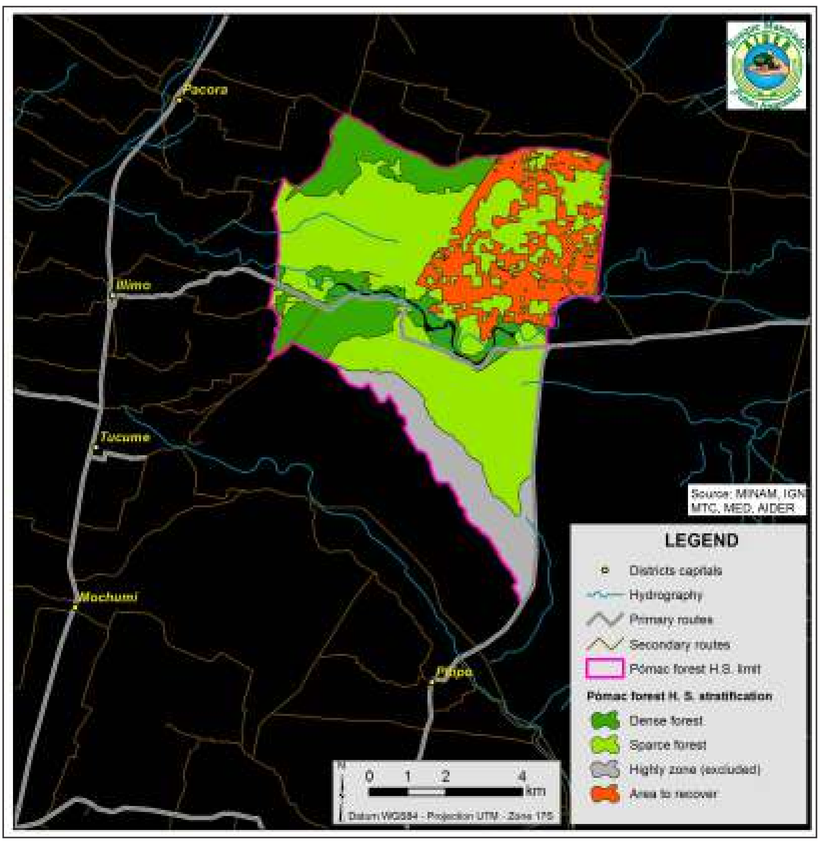

Figure 7. Map of the Project area

IV. Forest carbon evaluation and estimate

The main objectives in this phase were: a) the characterization of the project base line based on historical deforestation and forest degradation analysis, historical patterns of land use change in the area, b) carbon content estimate, and projected increase in carbon stocks and preliminary estimate of carbon benefits. This evaluation was conservative, considering that the results will be applied in a financial profitability analysis of the project.

4.1. Area, stratification of the forest (types of forest) and stored carbon

The study area and the types of forests were established as follows:

A) PFHS study area stratification

- **Satellite image selection.** The layer with the boundaries of the PFHS was selected, then Geo Eye satellite images, downloaded via the Internet with QUAMTUN GIS open layers complement, were super imposed. The most recent year without cloud coverage was selected.

- **Satellite image processing.** For the processing of the satellite images obtained, Quantum GIS 18.0, and ArcGIS 9.3.1 softwares were used. The methodological sequence begins with the satellite images from the QUANTUM GIS open layers complement, which go through the process of location in the appropriate projection, resulting in a high spatial resolution online mosaic of images.

Once imported, the images are classified visually in vector format on a scale of 1:10,000 for editing the categorized areas. At this stage, it is necessary to separate the initial classification in independent vector files; then, the errors that may have happened in the Quantum GIS are corrected and finally it is merged into a single database. This allowed establishing the stratification of the study area as shown in Table 1.

Table 1. Study area stratification

Strata	Surface (ha)
Recovery area	961.2
Dense forest	1,121.2
Sparse forest	3,105.0
Elevated area	664.9

B) Estimate of carbon stored in the PFHS

Prior to the carbon inventory, a bibliographic search on research related to the topic was performed, resulting in a vacuum of information for the study area. This meant that the starting point would be studies performed elsewhere that present similar ecosystems to the ones of the area; obtaining as results studies conducted in the Piura region through the "Reforestation and Carbon Sequestration in the dry forests of Ignacio Tavara Peasant Community " project.

This information was a precedent for the development and design of the forest carbon inventory in the study area, which was exploratory with an optimum stratified sampling design and a random systematic distribution of plots, the ones that were located in the vegetation strata identified in the study area. The sample consisted of a network of points that were equally distributed (400 x 400 m) throughout the study area. A number of points that corresponded to the evaluation plots were selected at random for the sparse and dense dry forest strata. 23 plots distributed proportionally in each stratum of forest were evaluated, as is shown in table 2.

Table 2. Number of evaluated carbon plots

Strata	Surface (ha)	Plots
Sparse forest	3,105.0	19
Dense forest	1,121.2	4
Total	**4,226.2**	**23**

The evaluation plot consisted of temporary circular nested plots of 10, 20 and 30 meters of radius. In each plot, the measurements of all types of woody vegetation were taken, contemplating the following variables:

- **Living biomass of small plants,** in the plot of 10 m radius, a destructive sampling comprised by all woody vegetation ≤ 3 cm DBH[109] and/or ≤ 40 cm crown diameter was performed.

- **Living biomass of shrubs,** in the plot of 20 m radius, a sampling of woody plants without prevalent trunk and > 40 cm crown diameter was performed. In this case the measurement of total height (m) was also registered.

- **Living biomass of trees,** in the plot of 30 m a sampling of algarrobo, sapote, faique and other tree species, with > 3 cm DBH was performed. In this case, plants with more than 3 axes that altogether have a DBG > 3 cm, are considered. In this case the measurement of total height (m) was also registered.

For estimating the biomass, the direct method was used, which is established on chapter 4 on supplementary methods and good practice guidance from the Kyoto

[109] Diameter at breast heigh (1.3m)

Protocol[110]. For this purpose, a series of allometric equations from studies performed in places with similar characteristics to the ones of the study area were identified.

The allometric equations to estimate the aerial biomass of tree species can be seen in table 3.

Table 3. Allometric equations used for woody species

Specie	Equation	Source
Zapote (*Capparis scabrida)*	Biomass (kg)=10^(−0 535+ɑɛɱ10ɑɐ)	Martínez *et al*. (1992)
Algarrobo (*Prosopis pallida*)	ɤɹ ɾɫ ɑBA=18,552+0,052ݣɓ ɐɠ²ɗ	Llanos, M. (2010)

Where:

BA : Aerial biomass (kg)
DBH : Diameter at breast height (cm)
H : Total height (m)

The underground biomass for tree and shrub species was calculated with default factors (root stem factor "R"), established by the IPCC[111] for tree species (R = 0.27) and shrubs (R = 0.40) of the tropical rainforest. The biomass/carbon ratio applied was of 0.5[112].

Also, by not having information to quantify carbon stored in the tropical dry forest shrubs and by noticing an abundance of shrub species like vinchayo, cuncuno and Canutillo in the project area, a study was conducted to generate a specific allometric equation for the species.

[110] IPCC (2003)
[111] IPCC (2006)
[112] IPCC (2003)

Determination of an allometric equation for tropical dry forest ecosystem shrubs

This study aimed to determine an allometric equation by destructive sampling methodology for the most abundant shrub species in the study area, such as the vinchayo, cuncuno and canutillo.

i. <u>**Characterization of the species being studied**</u>

- **Vinchayo** (*Capparis ovalifolia)* Capparaceae family

  Shrub characteristic of the north coast; it can grow up to 3 meters high, has a grayish bark and orange flowers, its fruit is fleshy and serves as fodder, the stem is used for firewood and the leaves for baths against rash.

Figure 8. Vinchayo (*Capparis ovalifolia)*

- **Cuncuno, Perlillo,Tetilla** (*Vallesia glabra)* Apocynaceae family

  Has medicinal use, it is an acute toxicity insecticide, also used in moisture conservation, as fodder, to improve soil fertility and as biodiversity habitat. Associated with the presence of birds, hummingbirds and insects.

Figure 9. Cuncuno (*Vallesia glabra)*

- **Canutillo, Palo negro** (*Grabowskia boerhaaviaefolia)* Solanaceae family

  Has medicinal use, used in moisture conservation, as fodder, to improve soil fertility, as biodiversity habitat, in the production of honey and as a container of dunes. Associated with: bees, birds and flies.

Figure 10. Canutillo (*Grabowskia boerhaaviaefolia*)

ii. Method

In order to determine the carbon allometric equation for the shrubs vinchayo, cuncuno and canutillo in the PFHS, destructive sampling was conducted, which is detailed below:

A field assessment was made to determine the minimum and maximum existing crown diameter range in the study area, and stratification by average crown diameter range was developed. Then, 30 individuals distributed among the 3 species were selected according to the average crown diameter ranges of the shrubs, according to following table:

Table 4. Number of shrubs to sample according to crown diameter range

Average Crown diameter (m)	Vinchayo	Cuncuno	Canutillo
0.4 - 1	1	1	-
1 - 2	2	2	1
2 - 3	3	2	1
3 - 4	3	1	1
4 - 5	3	1	1
5 - 6	3	1	-
6 - 7	2	-	-
+7	1	-	-
Total sample	**18**	**8**	**4**

- For each of the shrubs, total height (Ht), crown diameter (CD) and diameter at root-collar (DRC) were measured; in each case, the largest and smallest diameter was measured (both measurements perpendicular to each other).

- Also, the bottom part of the shrubs was cleaned and a plastic was placed in order not to mix biomass to be cut from the shrubs with any other that might be on the soil.

- After the shrub is cut at ground level; in the case of vinchayo leave twigs up to 1 cm in diameter were taken as sample leaves, considering branches all of those larger than 1 cm in diameter; in the case of "cuncuno" and "Canutillo" leave twigs up to 0.5 cm in diameter were taken as sample leaves, considering branches all of those larger than 0.5 cm in diameter. Both samples (leaves and branches) were weighed and recorded.

Table 5. Consideration on leaf and branch classification according to their diameter

Shrubs	Considered leaves up to branch diameter (cm)
Vinchayo (*Capparis ovalifolia)*	1.0
Cuncuno (*Vallesia glabra)*	0.5
Canutillo (*Grabowskia boerhaaviaefolia*)	0.5

- From each of the registered samples, a representative subsample was taken. Each individual subsample was weighed and registered, and contained a representative distribution of branches and leaves. The subsample for leaves had an average weight of 0.5 kg and 1.0 kg branches.

- Each subsample was coded and conditioned to remove its moisture and prevent it from rotting in the respective bags until they were taken to the lab and dried in an oven at 80°C until constant dry weight.

Figure 11. Weighing of shrub biomass

iii. <u>**Results**</u>

From the obtained data, carbon content estimate for each of the 30 samples was obtained; these results were analyzed by creating a trend line and coefficient of determination with exponential, linear and potential regressions, as shown in Table 6.

Table 6. Coefficient of determination results for the applied trend lines

Trend line	R^2 coefficient of determination		
	Diameter at the neck of the plant	Crown diameter	Plant height
Exponential regression	0.6	0.8	0.8
Linear regression	0.4	0.5	0.5
Potential regression	0.9	0.9	0.8

iv. Conclusions

From the results shown in Table 6, it could be observed that the trend line where potential regression is applied with variable crown diameter presents the best fit, with a coefficient of determination of 0.934, the same that is shown in figure 12.

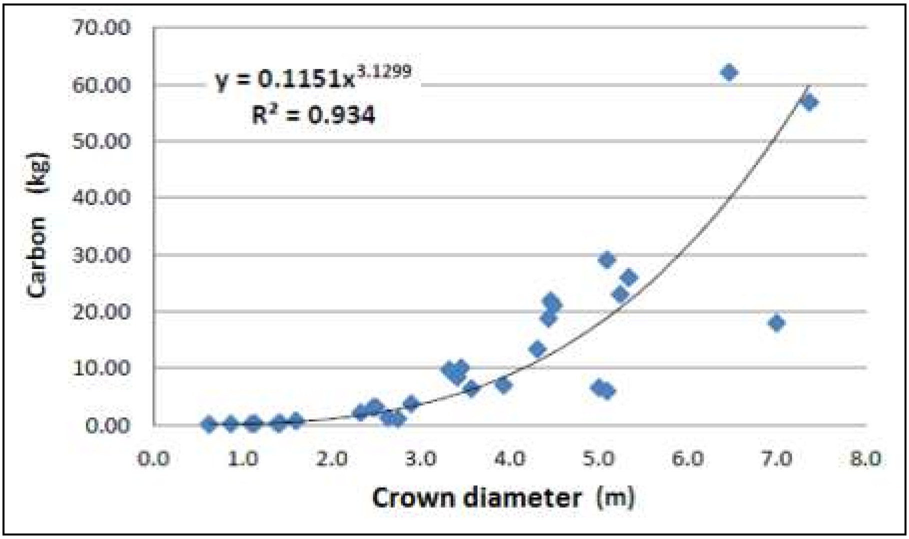

Figure 12. Trend line of potential regression applied with variable crown diameter for estimating forest carbon for dry forest shrubs in the PFHS

$$CA = 0.1151\ X^{3.1299}$$

Where:

CA : Carbon content of the shrub (kg)
X : Average diameter of the shrub (m)

- **Estimation of the forest carbon stock**

With the results from the forest carbon inventory, carbon content for each stratum according to the established reservoirs was estimated. In Table 7, carbon content per stratum was determined in relation to each reservoir.

Table 7. Carbon stored in aerial and underground reservoirs for evaluated forest types

Forest type	Aerial reservoir (tCO_2-e/ha)	Underground reservoir (tCO_2-e/ha)	Reservoir total (tCO_2-e/ha)
Sparse forest	38.8	11.3	50.1
Dense forest	197.9	54.8	252.7

For this study, only carbon stored in aerial and underground biomass of trees and shrubs for each stratum was considered. Other reservoirs were excluded for being considered optional under the VCS methodologies and estimating that their content does not exceed 5% of the total carbon stock in the dry forest ecosystem, as pointed out by the tool for analyzing the significance of GHG emissions in activities from afforestation/reforestation (A/R) CDM projects Version 01[113].

As a result of the inventory, carbon content and CO2-e stored in the PFHS forest could be determined.

Table 8. Stored carbon equivalent for each forest type found in PFHS

Forest type	Carbon stored (tCO_2-e/ha)	Surface (ha)	Carbon stock (tCO_2-e)
Sparse forest	50.1	3105.0	155,603.8
Dense forest	252.7	1121.2	283,348.5
Total		**4226.2**	**438,952.3**

- **Estimate of carbon stored after deforestation**

For the post deforestation estimation, the strata considered were agricultural activities, urban areas and roads. Information from secondary sources was used in this case, as the area does not have this type of study.

[113] Tool for testing significance of GHG emissions in A/R CDM project activities (Version 01).

Table 9. Stored carbon equivalent after deforestation for each forest type

Forest type	Aerial reservoir $CAB\text{-}tree,i$ (tCO_2-e/ha)	Underground reservoir $CBB\text{-}tree,i$ (tCO_2-e/ha)	Reservoir total (tCO_2-e/ha)
Livestock and faming	8.4	5.9	14.3
Urban areas	0	0	0
Roads	0	0	0

4.2. Avoided emissions for deforestation in dry and sparse forest.

The estimate of the avoided emissions was based on the 4226.2 hectares corresponding to the sparse and dense dry forest strata present in the PFHS; a conservative deforestation rate of 2.5% was used, calculated with unofficial secondary sources, in order to project the deforestation for a 10 year period base line. This value is conservative because for Peru the deforestation rate used is of 0.136[114].

The avoided deforestation estimate provides a constant annual loss of 106 hectares of forest in the PFHS, corresponding to 78 hectares of sparse dry forest and 28 hectares of dense dry forest. For the post-deforestation strata present, 23.2% corresponds to agricultural activity, while the remaining post-deforestation strata have a carbon content of cero (urban areas, roads, bare soil). Also, a 2% deforestation leak was considered for shifting of activities outside the project area. The reduction of emissions for avoided deforestation in the PFHS can be seen in table 10.

[114] Sabogal, A. 2011

Table 10. Avoided emissions due to avoided deforestation in the study area

Projected years	Avoided deforestation (tCO_2-e)	Post-deforestation scenario (tCO_2-e)	2% Leaks (tCO_2-e)	Avoided deforestation with leaks (2%) (tCO_2-e)
2013	10,974	351	219	10,403.8
2014	21,948	351	439	21,158.2
2015	32,921	351	658	31,912.5
2016	43,895	351	878	42,666.9
2017	54,869	351	1,097	53,421.3
2018	65,843	351	1,317	64,175.6
2019	76,817	351	1,536	74,929.9
2020	87,791	351	1,756	85,684.3
2021	98,764	351	1,975	96,438.7
2022	109,738	351	2,195	107,193.0

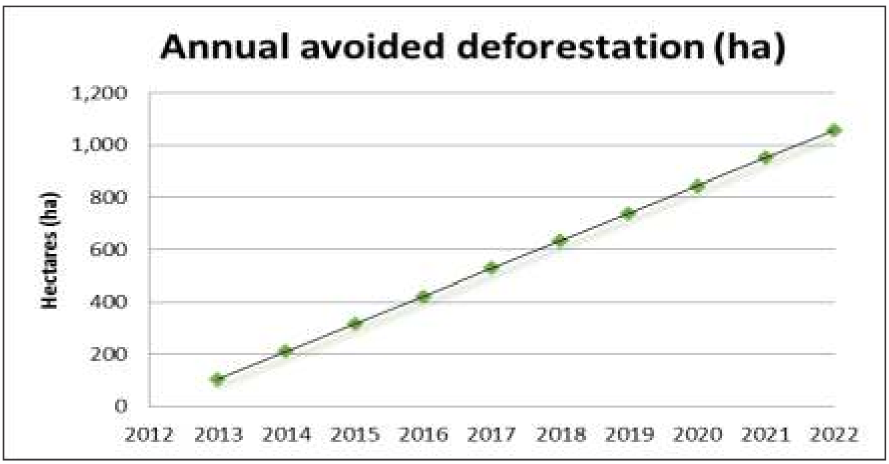

Figure 13. Avoided deforestation projection (2013-2022)

4.3. Carbon content increment in the sparse type of forest

Carbon content increment estimate was made for the sparse dry forest stratum of 3,105 hectares. For this, it was assumed that the sparse dry forest could increase its carbon content to one similar to the dense dry forest (that would mean an increase from 50.11 to 252.72 tCO_2-e/ha), this means a total increase of 202.61 tCO_2-e/ha during the first 10 years for the sparse dry forest stratum. The calculations can be seen in table 11.

For the increase, a growth simulation was applied using the DBH and height variable for the first 10 years, experience taken from a dry forest in the department of Piura[115]; the

[115] Llanos, M. 2010

DBH and height growth equations were constructed for the algarrobo, being the allometric growth equations detailed on the lines below and visible figures 14 and 15.

- DBH growth: allometric equation to estimate DBH growth for the algarrobo

$$DAP = 4.056*T^{0.732}$$

Where:

DAP : Diameter at breast height (cm).
T : Age (years)

Being R^2=0.97

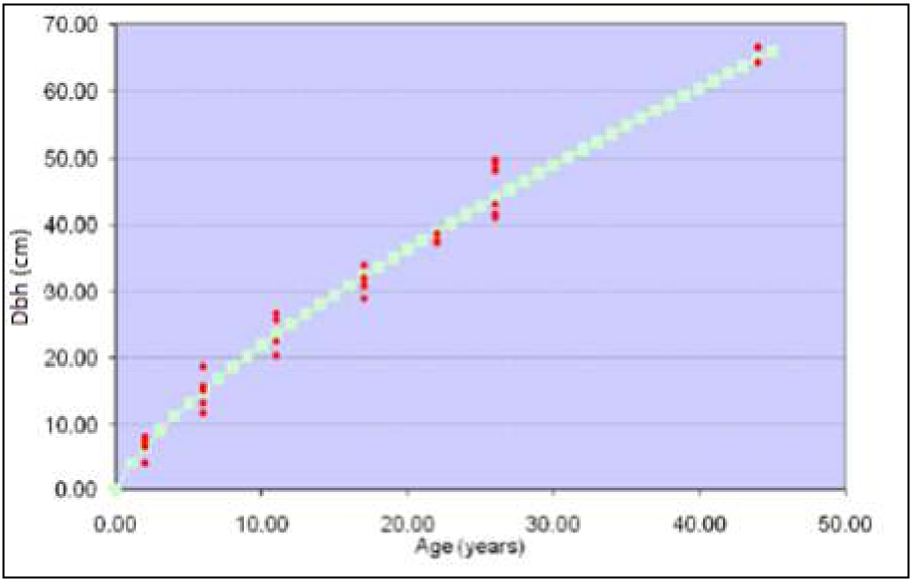

Figure 14. Graph showing a DBH growth model for algarrobo

- Height growth: allometric equation to estimate height growth for the algarrobo

$$H=21.08*(1-e^{(-0,0175*T)})^{0.493}$$

Where:

H : Total height (m)
T : Age (years)

Being R^2 = 0,86

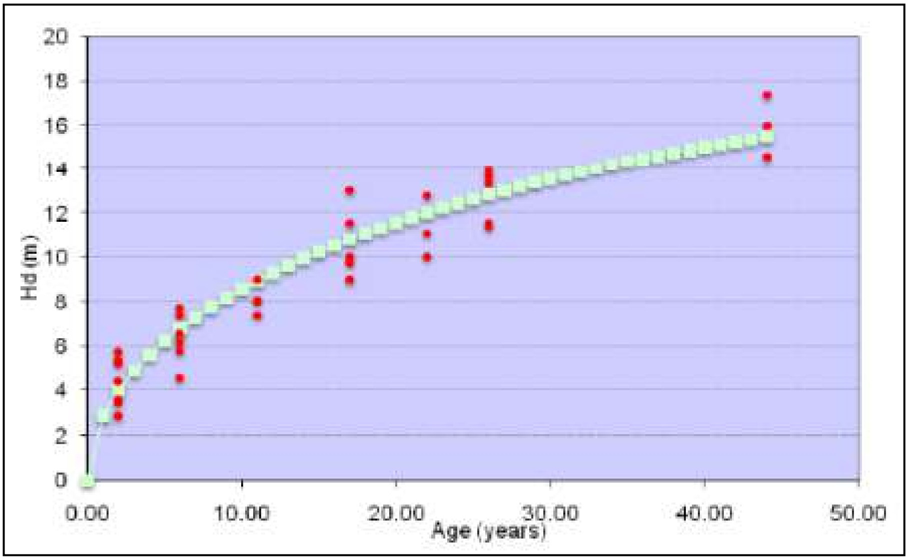

Figure 15. Graph showing a height growth model for algarrobo

Table 11. Carbon content increase on the sparse dry forest for the first 10 years

Projected years	Carbon increment (ha/year)	Annual increments (tCO_2-e)
2013	4.8	14,774.1
2014	4.9	15,167.0
2015	5.3	16,599.8
2016	6.4	20,025.9
2017	8.8	27,261.1
2018	12.5	38,716.8
2019	18.2	56,643.5
2020	27.2	84,309.2
2021	39.0	121,173.7
2022	55.1	171,160.8

4.4. Recovery of areas without a forest cover

The PFHS has a stratus denominated recovery area, which covers 961.1 hectares. For this study, a simulation was made to recover 500 hectares by planting algarrobo (*Prosopis pallida*); the generated data can be seen in figures 10 and 11. With these, a carrying capacity per hectare was calculated, according to carbon content stored in the dense dry forest. It was estimated that on the tenth year 252.7 tCO_2-e/ha would be obtained, having to install 495 trees/ha. Table 12 shows the increasing carbon for the reforested area for years 1 to 10.

Table 12. Carbon content increase on the reforested area for the first 10 years

Projected years	Reforestation in 500 hectares (tCO_2-e)
2013	10,705.9
2014	10,990.6
2015	12,028.9
2016	14,511.6
2017	19,754.4
2018	28,055.7
2019	41,045.9
2020	61,093.6
2021	87,807.0
2022	124,029.5

4.5. Net emission reductions and removals of GHG per year

From tables 10, 11 and 12, the sum of the avoided emissions from deforestation, increased carbon content and carbon sequestration by reforestation was made, which is shown in table 13. The sum represents the accumulated emissions reduction and net removals estimate for a period of 10 years.

Table 13. Net accumulated emission reductions and removals of GHG

Projected years	Net accumulated emission reductions and removals (tCO_2-e)	Increase of carbon (tCO_2-e/ha/year)
2013	35,883.9	21.4
2014	47,315.8	22.0
2015	60,541.3	24.1
2016	77,204.4	29.0
2017	100,436.8	39.5
2018	130,948.1	56.1
2019	172,619.4	82.1
2020	231,087.1	122.2
2021	305,419.4	175.6
2022	402,383.3	248.1

V. Financial viability

Based on the description of the project's activities and the projected carbon benefits of the project design, the elements required for budgeting and for making the financial projections are available. This considers the costs of designing, implementing, monitoring and verification of the project in the short and medium term. The financial viability is the result where all the data generated and processed will be translated into the profitability of the project and its feasibility from an environmental, economic and social point of view.

5.1. Income due to carbon credits

Using the data generated in Chapter 4 (forest carbon project benefits), the emissions due to avoided deforestation, increase in carbon content and carbon sequestration through reforestation, were quantified; with which the related income from the sale of the generated credits was quantified at a price of \$8 and \$9 for avoided emissions and carbon sequestration, respectively. These calculations are shown in Table 14.

5.2. Income due to beekeeping activity

In the case of beekeeping, which is integrated as an economic activity of the strategy to reduce emissions, the carrying capacity estimate for one hectare is equal to a hive. Under that scenario, in the "Training Workshop on REDD+ projects, identification of deforestation agents and connectors, and economic activities in Pomac Forest Historical Sanctuary", it was determined that beekeeping is an economic activity that depends on the forest and its conservation. Moreover, one of the outcomes of the workshop was that in the PFHS there are 930 beehives, the same that may be increased in up to 2000 additional beehives around the PFHS. Starting from these data, table 15 was constructed.

5.3. Cash flow of the project

In the cash flow, the potential income and costs involved in the forest carbon project is detailed for the PFHS. The income to be gained is due to avoided emissions for avoided deforestation, increase in carbon content and carbon sequestration by reforestation. The cash flow is considering all operating costs and management of the project. Table 16 shows the above information.

Table 14. Income from carbon credits for the first 10 years

Projected periods	Avoided emissions and capture in tCO_2-e credits			VERs y CERs sale income		
	Net credits for avoided deforestation	Net credits for carbon increment in sparse dry forest	Net credits for reforestation in 500 hectares	Net income for avoided deforestation ($)	Net income for carbon increment in sparse dry forest ($)	Net income for reforestation in 500 hectares ($)
2013-2014	10,403.8	392.8	284.7	83,230.7	3,142.8	2,562.1
2014-2015	10,754.4	1,432.8	1,038.3	86,034.8	11,462.7	9,344.6
2015-2016	10,754.4	3,426.1	2,482.7	86,034.8	27,409.1	22,344.4
2016-2017	10,754.4	7,235.1	5,242.8	86,034.8	57,880.9	47,185.5
2017-2018	10,754.4	11,455.7	8,301.3	86,034.8	91,645.8	74,711.2
2018-2019	10,754.4	17,926.6	12,990.3	86,034.8	143,413.1	116,912.9
2019-2020	10,754.4	27,665.7	20,047.6	86,034.8	221,325.7	180,428.6
2020-2021	10,754.4	36,864.5	26,713.4	86,034.8	294,916.2	240,420.8
2021-2022	10,754.4	49,987.1	36,222.5	86,034.8	399,896.5	326,002.6
2022-2023	10,754.4	55,161.7	43,084.1	86,034.8	441,293.2	387,756.5

Table 15. Beekeeping activity cash flow (US$) for a 10 year period

Details	Year										
	0	1	2	3	4	5	6	7	8	9	10
Costs	220,593	76,800	80,652	87,689	110,356	87,689	80,652	117,393	193,985	87,689	110,356
Income		177,778	177,778	177,778	177,778	177,778	177,778	177,778	177,778	177,778	177,778
Net income	-220,593	100,978	97,126	90,089	67,422	90,089	97,126	60,385	-16,207	90,089	67,422

Table 16. Cash flow for the project over a 10 year period

DETAILS	Year										
	0	1	2	3	4	5	6	7	8	9	10
INCOME (US$)		**266,713**	**284 620**	**313 566**	**368 879**	**430 170**	**524 139**	**665 567**	**799 150**	**989 712**	**1 092 862**
Avoided deforestation net income		83 231	86 035	86 035	86 035	86 035	86 035	86 035	86 035	86 035	86 035
Carbon increase in sparse dry forest income		3 143	11 463	27 409	57 881	91 646	143 413	221 326	294 916	399 896	441 293
Reforestation income in 500 hectares		2 562	9 345	22 344	47 186	74 711	116 913	180 429	240 421	326 003	387 757
Other forest products (Beekeeping)		177 778	177 778	177 778	177 778	177 778	177 778	177 778	177 778	177 778	177 778
TOTAL COSTS US$)	**335 593**	**627 050**	**690 102**	**391 249**	**338 916**	**241 249**	**234 212**	**270 953**	**347 545**	**241 249**	**263, 9**
Study costs, validation and verification	**115 000**	**-**	**-**	**12 000**	**12 000**	**12 000**	**12 000**	**12 000**	**12 000**	**12 000**	**12 000**
PDD elaboration	90 000										
Validation	25 000										
Verification				12 000	12 000	12 000	12 000	12 000	12 000	12 000	12 000
REDD strategy costs	**220 593**	**588 050**	**651 102**	**340 249**	**287 916**	**190 249**	**183 212**	**219 953**	**296 545**	**190 249**	**212 916**
- Beekeeping	220 593	76 800	80 652	87 689	110 356	87 689	80 652	117 393	193 985	87 689	110 356
- Control and surveillance		52 000	52 000	52 000	52 000	52 000	52 000	52 000	52 000	52 000	52 000
- Plantation and forest management		225 000	300 000	150 000	75 000						
- Enrichment and forest management		155 250	155 250								
- Economic activities		41 000	32 800	26 240	26 240	26 240	26 240	26 240	26 240	26 240	26 240
- Forest government		38 000	30 400	24 320	24 320	24 320	24 320	24 320	24 320	24 320	24 320
Negotiation costs											
Carbon monitoring and REDD strategies		**15 000**	**15 000**	**15 000**	**15 000**	**15 000**	**15 000**	**15 000**	**15 000**	**15 000**	**15 000**
Administration costs		**24 000**	**24 000**	**24 000**	**24 000**	**24 000**	**24 000**	**24 000**	**24 000**	**24 000**	**24 000**
Cash flow	**335 593**	**360 337**	**405 482**	**77 683**	**29 964**	**188 921**	**289 927**	**394 614**	**451 604**	**748 463**	**828 947**

VI. Expected results

From the processed and analyzed data, it can be concluded that the REDD+ project in the PFHS generates environmental, economic and social benefits:

a) Climate results

In a 10-year horizon, a loss of 1,056.5 hectares of forest as a result of deforestation would be avoided, hence avoiding emissions of 109,738.30 tCO_2-e; as an effect of enriching the sparse dry forest, the constitution of 3 105.0 hectares would be improved, increased its carbon storage from 155,603.8 to 326,764.6 tCO_2-e; on the other hand, 500 hectares of forest would be restored, storing 124,029.5 tCO_2-e. Added to this, the forest area of the PFHS would increase from 4,226.2 (dense and sparse forest) to 4,726.2 ha (dense forest, sparse and reforestation), which would have a positive impact on the biodiversity of the PFHS, both wildlife and vegetation, and would be a way to preserve all archaeological remains that exist in the area.

b) Socioeconomic results

Economically, with the REDD+ project contribution in the PFHS, an auto-financing for the restoration and conservation of the PFHS would be generated, this is reflected with the financial indicators calculated, as shown in table 17. There is an NPV of US $211,307.63 with an IRR of 14%, although this is not very attractive as a purely financial investment, seen from an environmental and conservation point of view, it has a great funding potential.

Table 17. Financial and economic indicators

Discount rate	11%
Net Present Value - NPV	US$ 211,307.6
Internal Rate of Return - IRR	14%
Discount incomes	US$ 2,918,205.8
Discount expenses	US$ 2,706,898.1
Benefit/Cost	US$ 1.1

From the social point of view, the proposed REDD+ project would achieve a positive impact to the surrounding populated areas due to the economic activities generated, such as: beekeeping, manual labor for the upkeep and management of the forest, reforestation and forest enrichment.

C) Environmental and conservation results

- A conservation and restoration mechanism was found for the PFHS by integrating activities to avoid deforestation and forest degradation, generating an increase in carbon content in disturbed forests and promoting reforestation in deforested areas, given that the objective of the protected area is to protect and restore the biodiversity of the area.

- In the dry tropical forest, non-timber products such as beekeeping and ecosystem services should be given a special value.

VII. Further actions

- Develop a marketing strategy for this proposal so that institutions committed with conservation, desertification and drought control, bet on this proposal and decide to finance its implementation.

- Develop a project for starting with the first activities of this project, seeking funding in international cooperation.

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Contributions of experiences to forest management and projects to climate change mitigation

Contributions of experiences to forest management and projects to climate change mitigation

Percy Recavarren Estares

In the present publication ¨Forest carbon projects in Peru, AIDER explains its experiences in forest management projects worked as an alternative to mitigate climate change and increase the economic benefits of the forest activity, through the activities in the afforestation and reforestation line, as well as forest manage and protection. In addition, with the developed activities and is still working, has contributed with: generation of forest information by the performed studies; mitigate climate change reducing deforestation and degradation emissions; biodiversity conservation by the protection of area with a high conservative value and the forest management with three native amazon groups. This contributions has been grouped according the Peruvian natural regions (coast, highlands and rainforest)

I. Allometric equations for forest species growth

1.1. Highlands

A) Eucalyptus (*Eucalyptus globulus*)

- Height growth: Allometric equation for height growth for eucalyptus

$$H = 31{,}15 * (1 - \exp(-0{,}125 * T))^{1{,}825}$$

Where:

H: total height

T. Age (years)

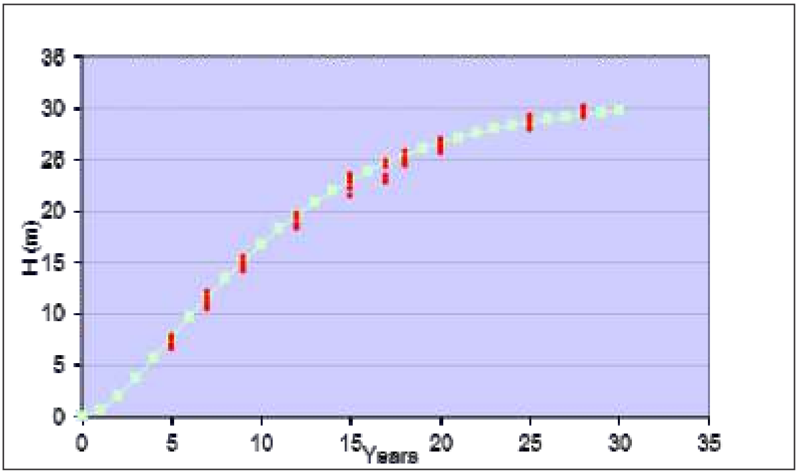

Figure 1. Graphic of the height growth model for eucalyptus

- Diameter growth: Allometric equation of DBH growth for eucalyptus.

$$DBH = 2,005 * T^{0.875}$$

Where:

DBH: Diameter at breast height (cm)
T: Age (years)

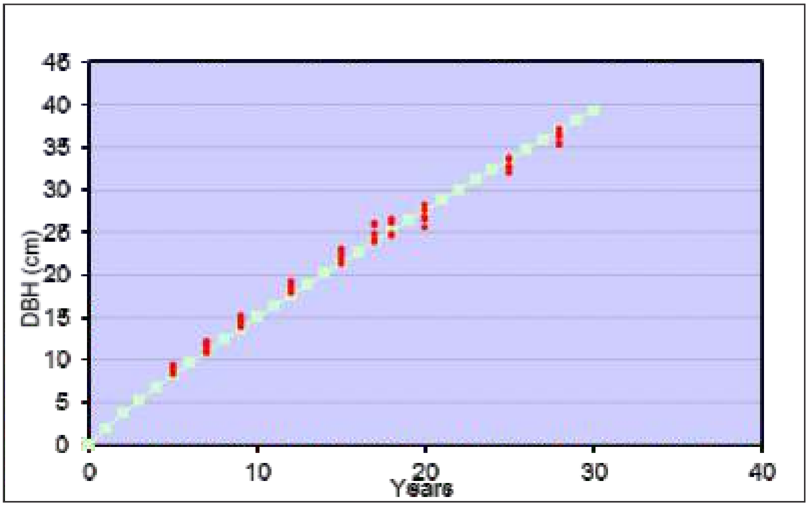

Figure 2. Graphic of the DBH growth model for eucalyptus

B) Pine (*Pinus radiata*)

- Height growth: Allometric equation for height growth for pine.

$$H = 23,52 * (1 - \exp(-0,099 * T))^{1,415}$$

Where:

H: total height
T. Age (years)

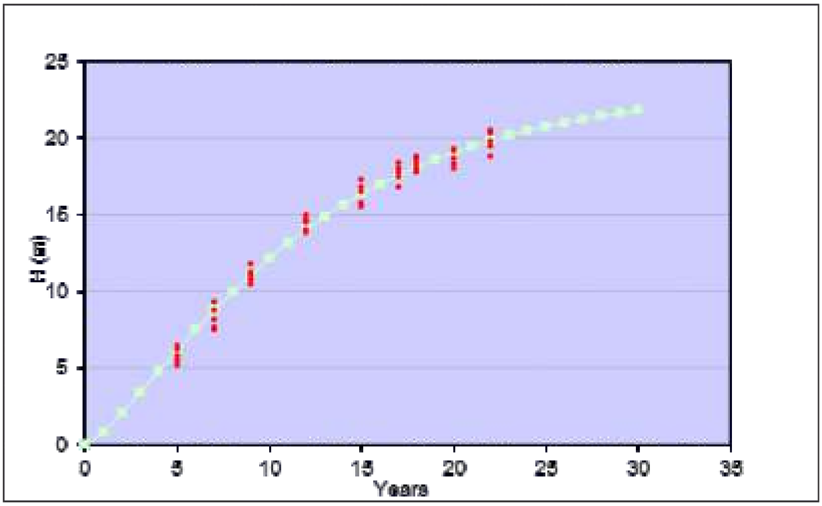

Figure 3. Graphic of the height growth model for pine

- Diameter growth: Allometric equation of DBH growth for pine

$$DBH = 1,515 * T^{0.965}$$

Where:

DBH: Diameter at breast height (cm)

T: Age (years)

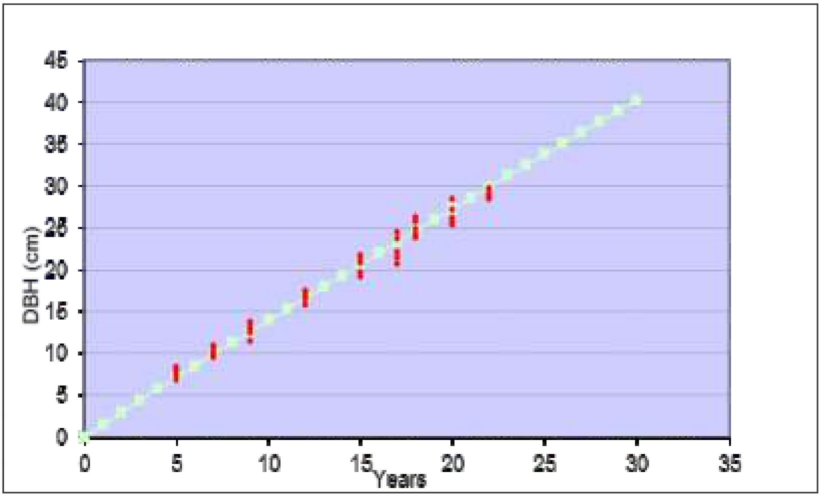

Figure 4. Graphic of the DBH growth model for pine

C) Queuña (*Polylepis* sp.)

- Height growth: Allometric equation for height growth for queuña.

$$H = 7 * (1 - \exp(-0,095 * T))^{1.2}$$

Where:

H: total height
T. Age (years)

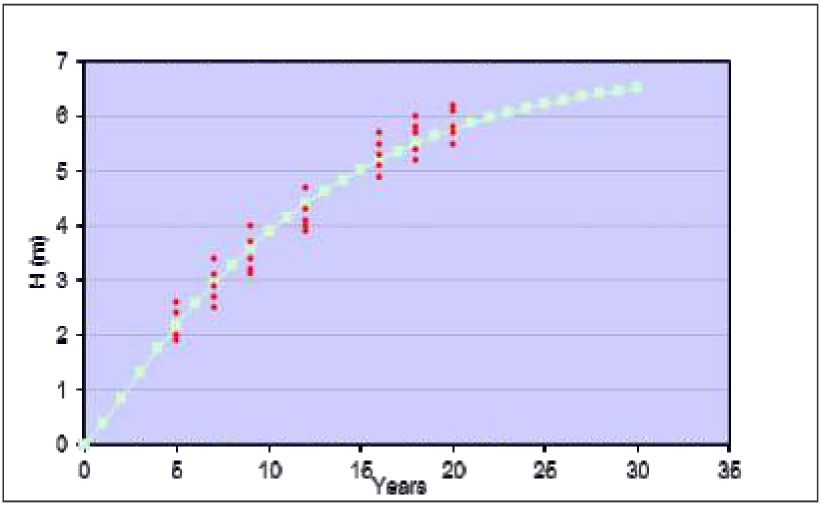

Figure 5. Graphic of the height growth model for queuña

- Diameter growth: Allometric equation of DBH growth for queuña.

$$DBH = 1,734 * T^{0,712}$$

Where:

DBH: Diameter at breast height (cm)
T: Age (years)

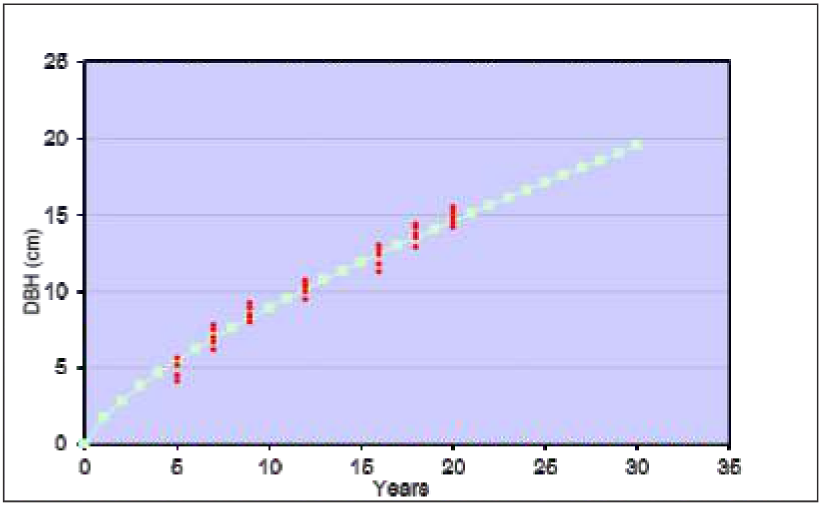

Figure 6. Graphic of the DBH growth model for queuña

1.2. Coast

A) Algarrobo (*Prosopis pallida*)

- Diameter growth: Allometric equation of BDH growth for algarrobo.

$$\textbf{DBH} = 4{,}056 * T^{0.732}$$

Where:

DBH: Diameter at breast height (cm)
T: Age (years)

Having an R^2 =0.97

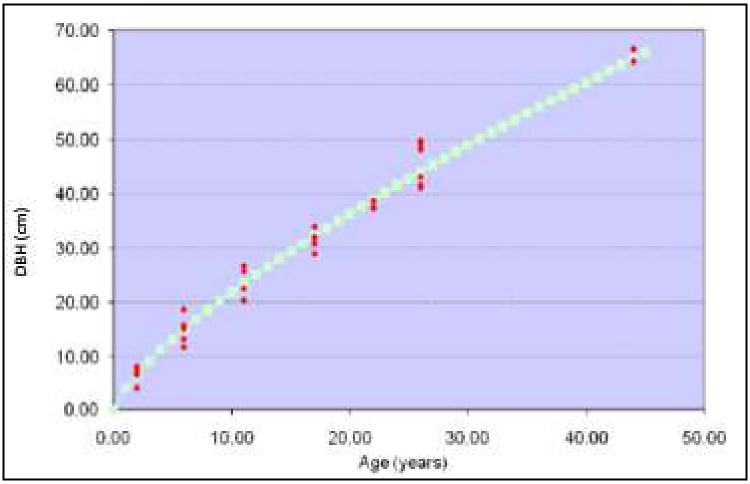

Figure 7. Graphic of the DBH growth model for algarrobo

- Height growth: Allometric height growth for algarrobo

$$H=21.08*(1-e^{(-0.0175*T)})^{0.493}$$

Where:

H: Total height (m)
Y: Age (years)

With an $R^2=0.86$

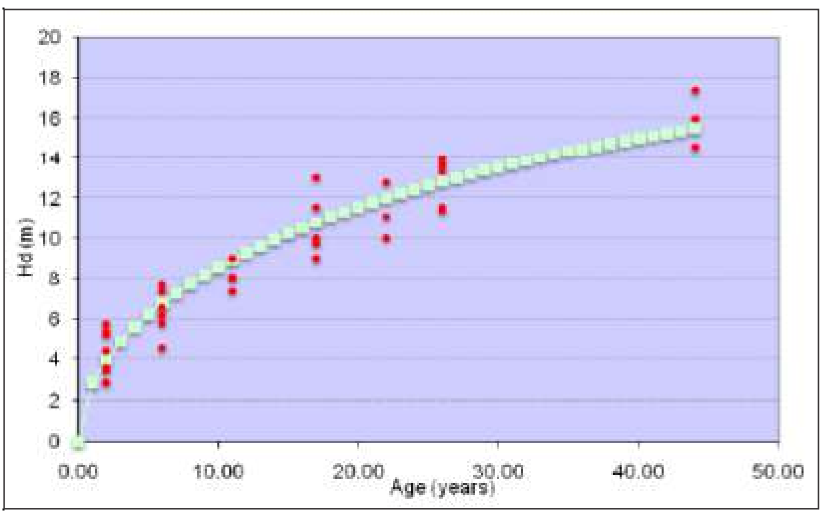

Figure 8. Graphic of the height growth for algarrobo

B) Zapote (*Capparis scabrida*)

- Diameter growth: Allometric equation for DBH growth for zapote

$$\mathbf{DBH = 1{,}146 * T^{0.692}}$$

Where:

DBH: Diameter at breast height (cm)
T: Age (years)

Which R^2 =0.95

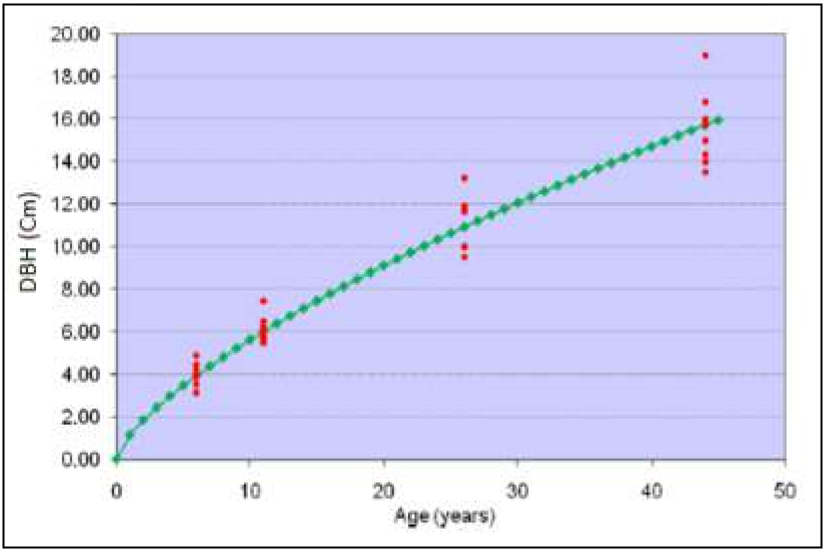

Figure 9. Graphic of the DBH growth of zapote

- Height growth: allometric equation of the height growth for zapote

$$\mathbf{H = 16.08 * (1 - e^{-0.0015 * T})^{0.418}}$$

Where:

H: Total height (m)
T: Age (years)

Which R^2 =0.88

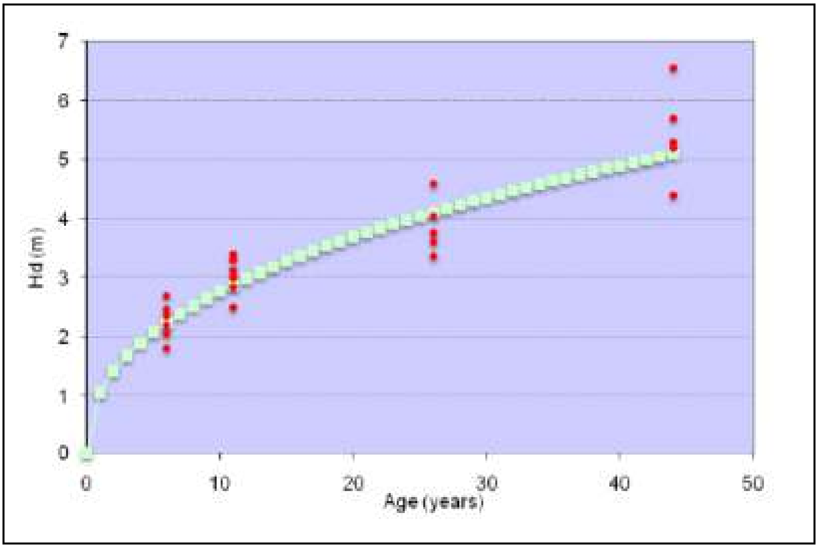

Figure 10. Graphic of the height growth for zapote

II. Allometric equations for carbon estimating

A) Forest

- Allometric equation to estimate carbon in paca (*Guadua* sp.), which is a kind of bamboo and belong to the Poaceae family.

y=7.2581x-7.0782

Where:

Y is the steam and leaf biomass (kg)
X is the diameter at the collar height (cm)

Which $R^2 = 0.90$

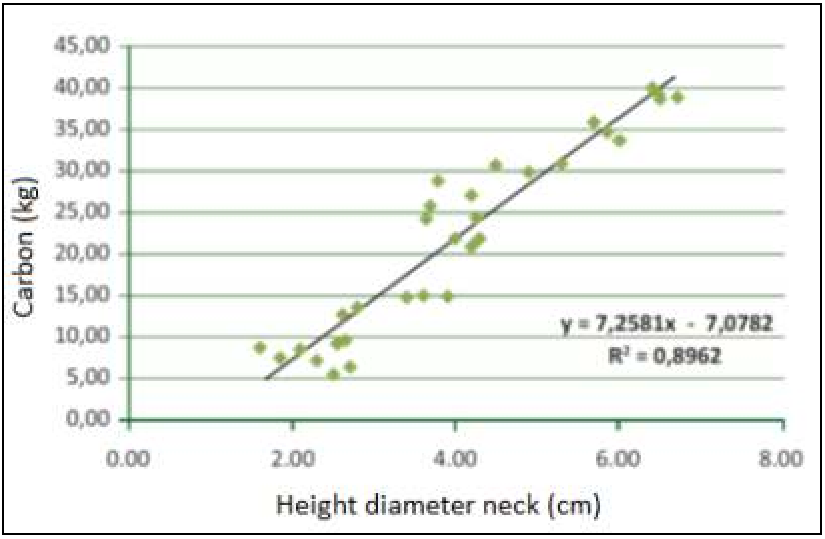

Figure 11. Graphic of the allometric equation to estimate carbon in paca

B) Coast

- Allometric equation to estimate carbon in shrubs of vinchayo (*Capparis ovalifolia*), cuncuno (*Vallesia glabra*) and canutillo (*Grabowskia boerhaaviefolia*).

$$CA = 0{,}1151\,X^{3{,}1259}$$

Where:

CA: Shrub carbon content (kg)
X: Shrub average diameter

Which $R^2 = 0.93$

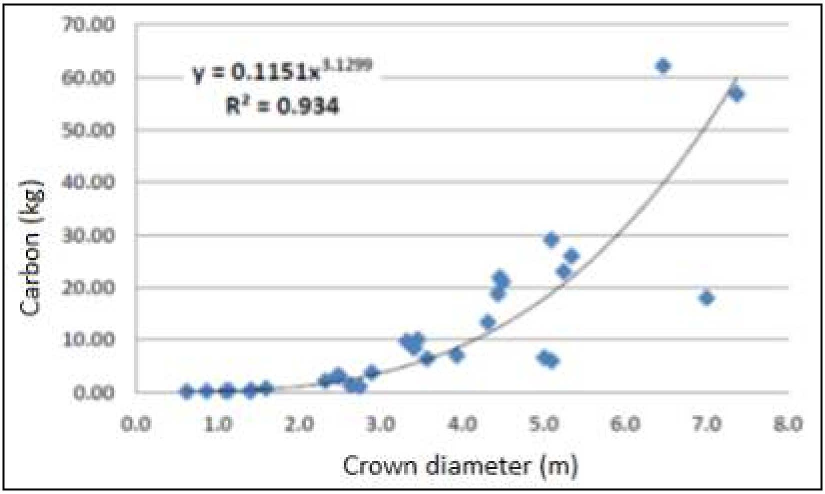

Figure 12. Trend line of the potential regression for the crown diameter variable for carbon estimation in dry forest shrubs in the SHBP

- Allometric equation to estimate carbon in faique (*Acacia huarango*)

$$Y=0.126X^{2.679}$$

Where:

Y: Total carbon (kg)
X: Crown average diameter 8m)

Which R^2=0.909

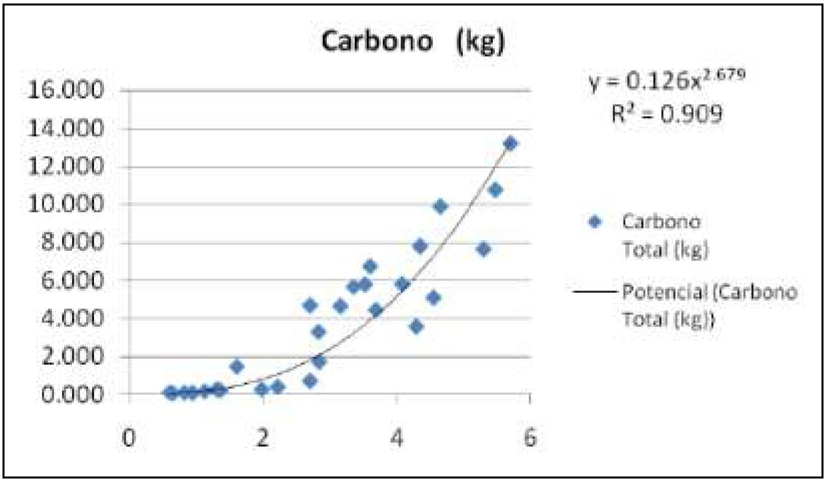

Figure 13. Graphic of the allometric equation to estimate carbon in faique

- Allometric equation to estimate carbon in overo (Cordia lutea)

$$Y=0.092X^{2.912}$$

Where:

Y: Total carbon (kg)
X: Crown average diameter (cm)

Which $R^2 = 0.927$

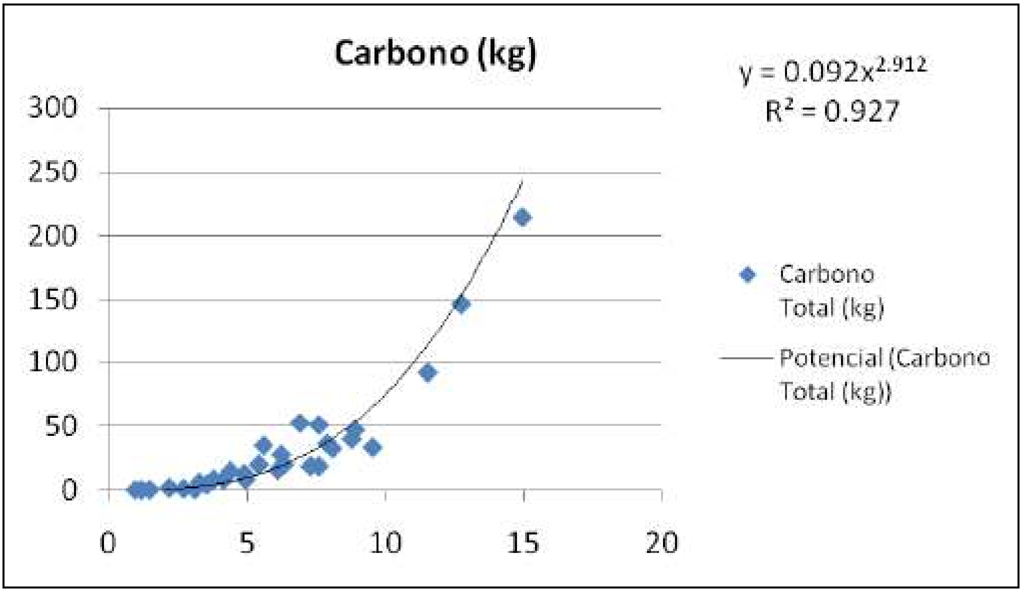

Figure 14. Graphic of allometric equation to estimate carbon in overo

III. Contributions in carbon quantification

AIDER has made carbon content inventories in coast, Andean and Peruvian amazon forest. Evaluating 961 plots (311 in coast, 41 in highlands, 223 in high forest and 386 in low forest), in table 1 is indicated the number of plots by project/activity by natural region. Furthermore, in figures 15 to 22 we can see the spatial distribution of the evaluated plots.

Table 1. Evaluated plots to estimate carbon by natural region

Project /activity	Coast	highland	Forest		Total
			High	Low	
Consultancy for the general direction of evaluation, valuation and financing for the natural (DGEVFPN for its acronym in Spanish) "Carbon estimation in highland wetlands"		10			10
Consultancy made for The Nature Conservancy "Design and implementation of activities and revaluation of local knowledge to mitigate the deforestation processes in four communities of the Ucayali region: Callería, Patria Nueva, Flor de Ucayali and Nuevo Saposoa"				56	56
Consultancy made for WWF "Parcels installation and tree aerial biomass estimation in forest of Madre de Dios – Manu"			12	14	26
SFMBAM consultancy to quantify wood potential and carbon content in the timber concession INBACO – Madre de Dios				74	74
Stored carbon estimation in the forest biomass of the high watershed in the Yuracyacu river, San Martín.			102		102
Proposal for the REDD+ project elaboration in the frame of the AIDER – Belgica Native community alliance.				43	43
Project " Support for the project elaboration to reduce deforestation and degradation emissions in Alto Mayo protected forest, Peru" to support International Conservation.			103	3	106
Project "Support to the implementation and design of the financial sustainability strategy of the natural protected areas on Northern coast of Peru".	23				23
Project "Reforestation and carbon sequestration in the Ignacio Távara's dry forest, Chulucanas – Piura"	116				116

Agrosilvopastoral practices towards the carbon market project, to support world Vision International		31			31
REDD+ project “Reduction of deforestation and degradation in Tambopata national reserve and Bahuaja-Sonene national park in the region of Madre de Dios –Peru”, under the PNA partial administration contract.				108	108
REDD+ project “Evio Kuiñaji Ese ‘Eja Cuana, to mitigate climate change, Madre de Dios – Peru”				49	49
REDD+ project “Forest management to reduce deforestation and degradation in Shipibo Conibo and Cacataibo indigenous communities of the Ucayali region”			6	39	45
REDD+ project “Reduction of deforestation and degradation of the tropical dry forest in Piura and Lambayeque”	172				172
Total	**311**	**41**	**223**	**386**	**961**

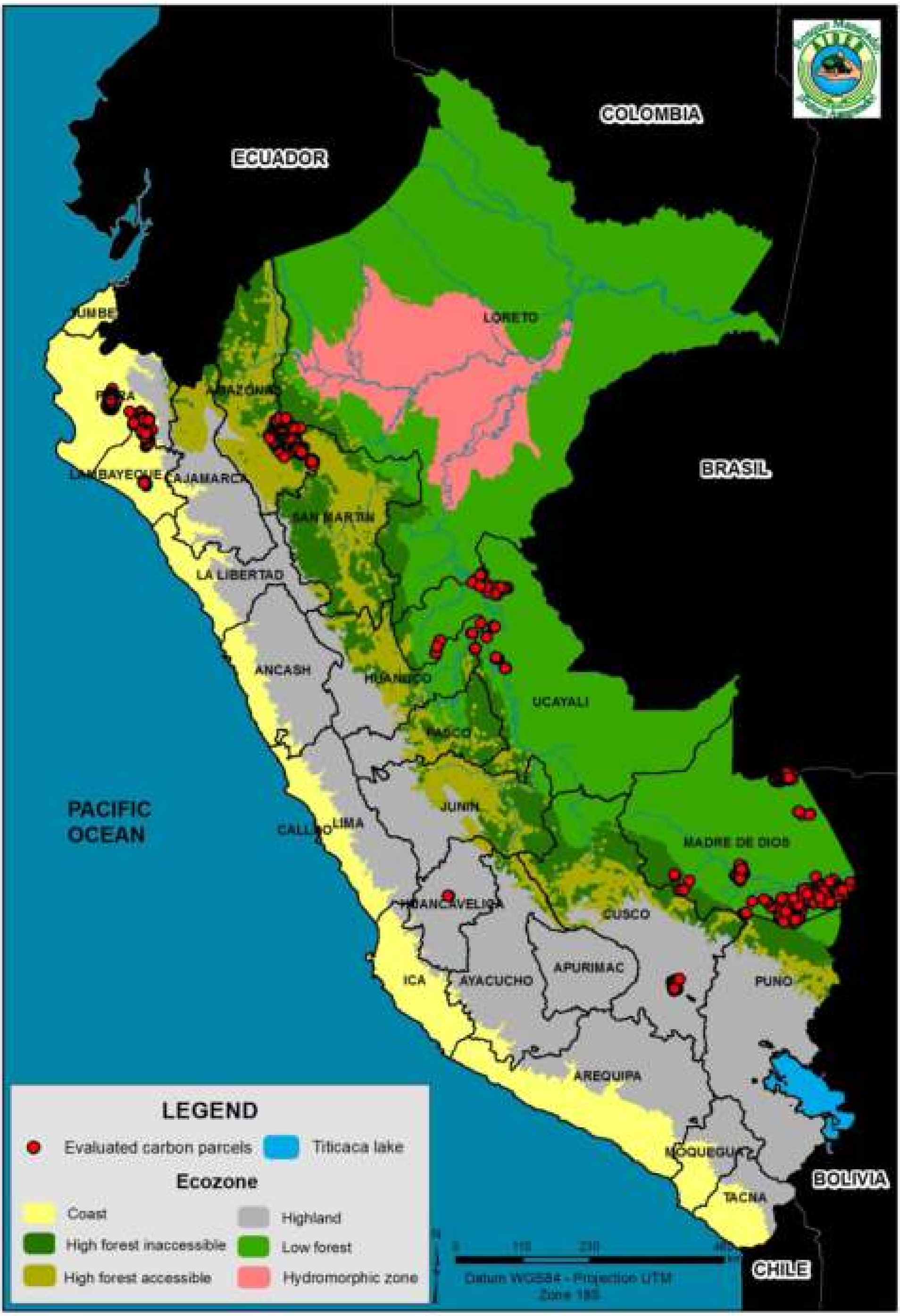

Figure 15. Distribution map of the evaluated carbon parcels by AIDER in Peru

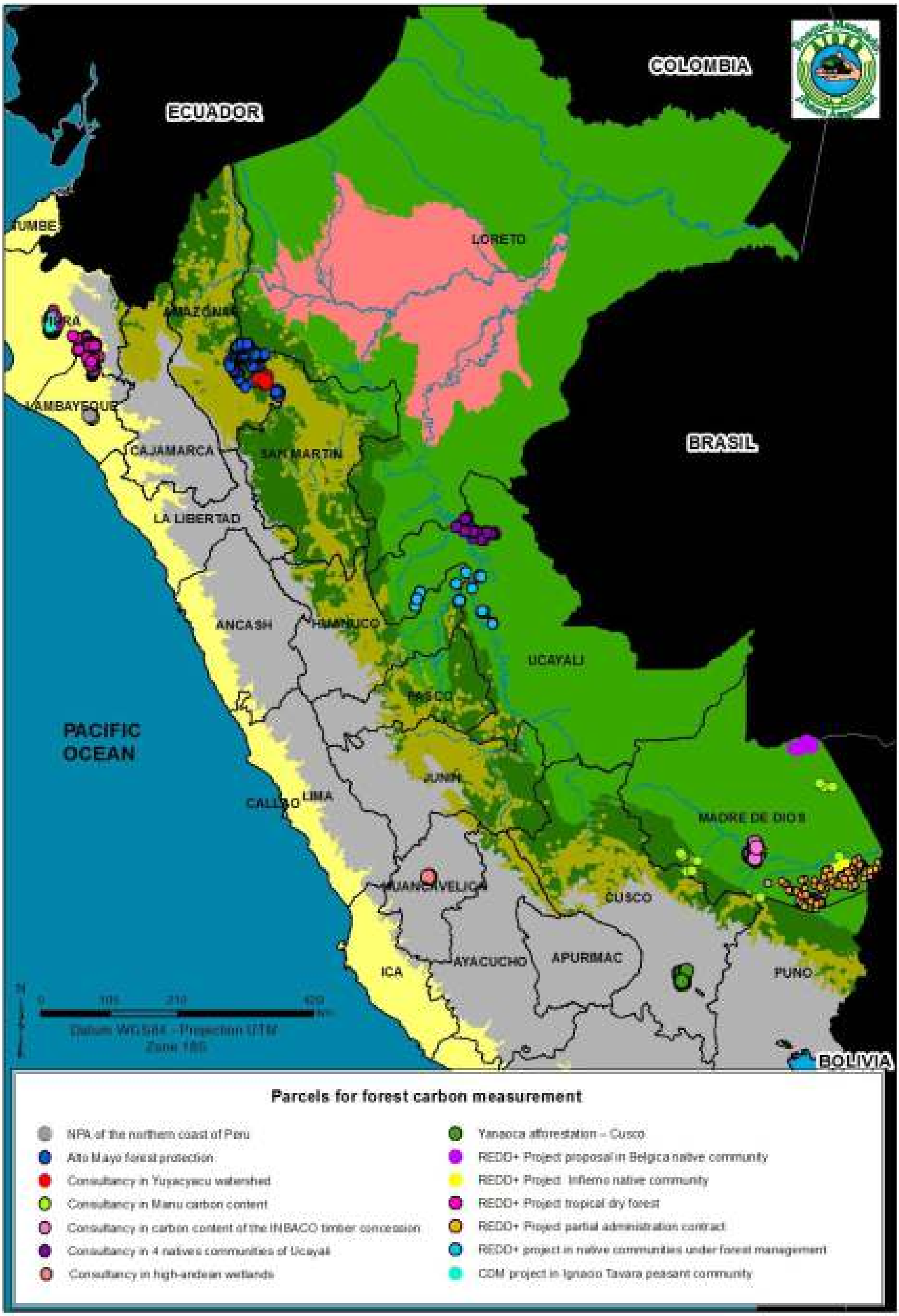

Figure 16. Distribution map of the evaluated carbon parcel by project/activity

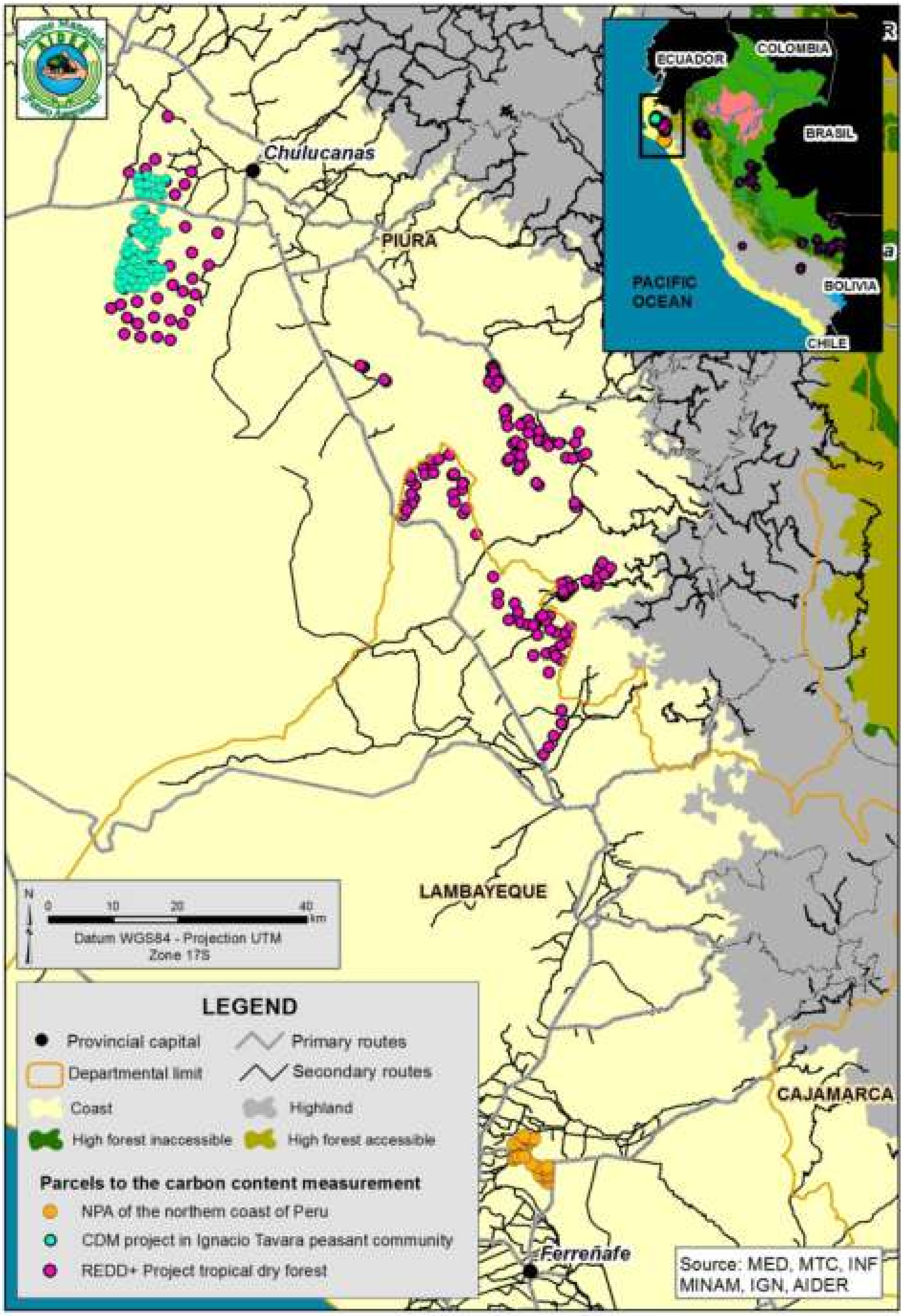

Figure 17. Distribution map of the evaluated carbon parcels in the Peruvian coast

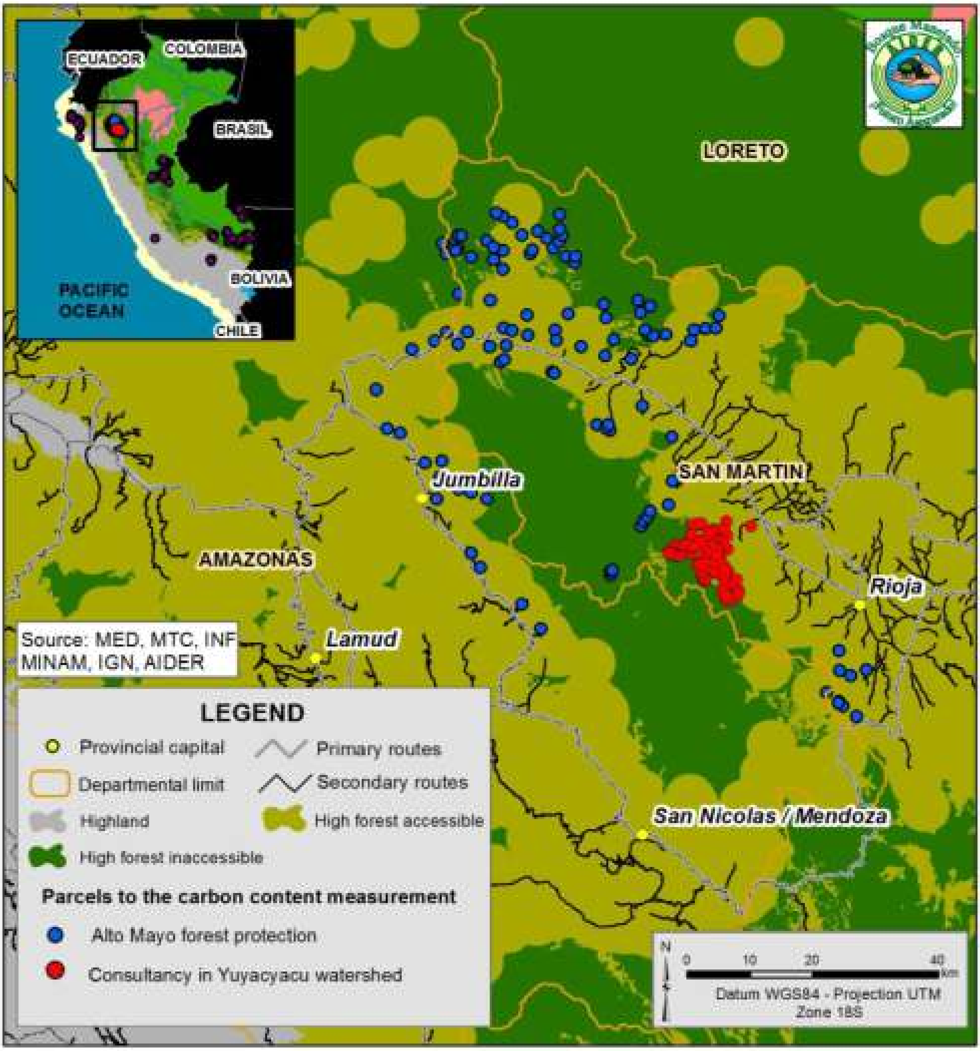

Figure 18. Distribution map of the evaluated carbon parcels in The Alto Mayo zone – San Martín

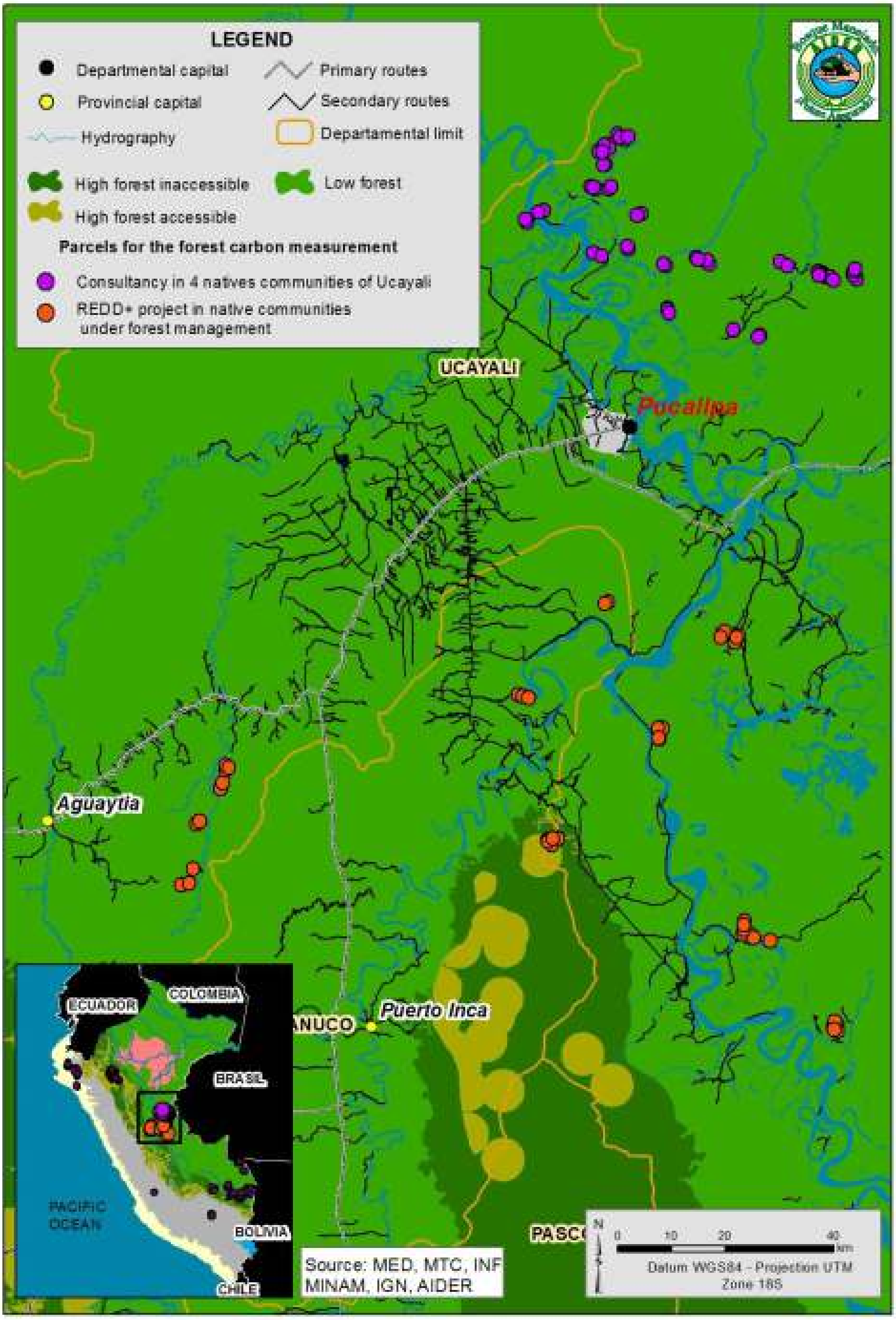

Figure 19. Distribution map of the evaluated carbon parcels in the Ucayali department

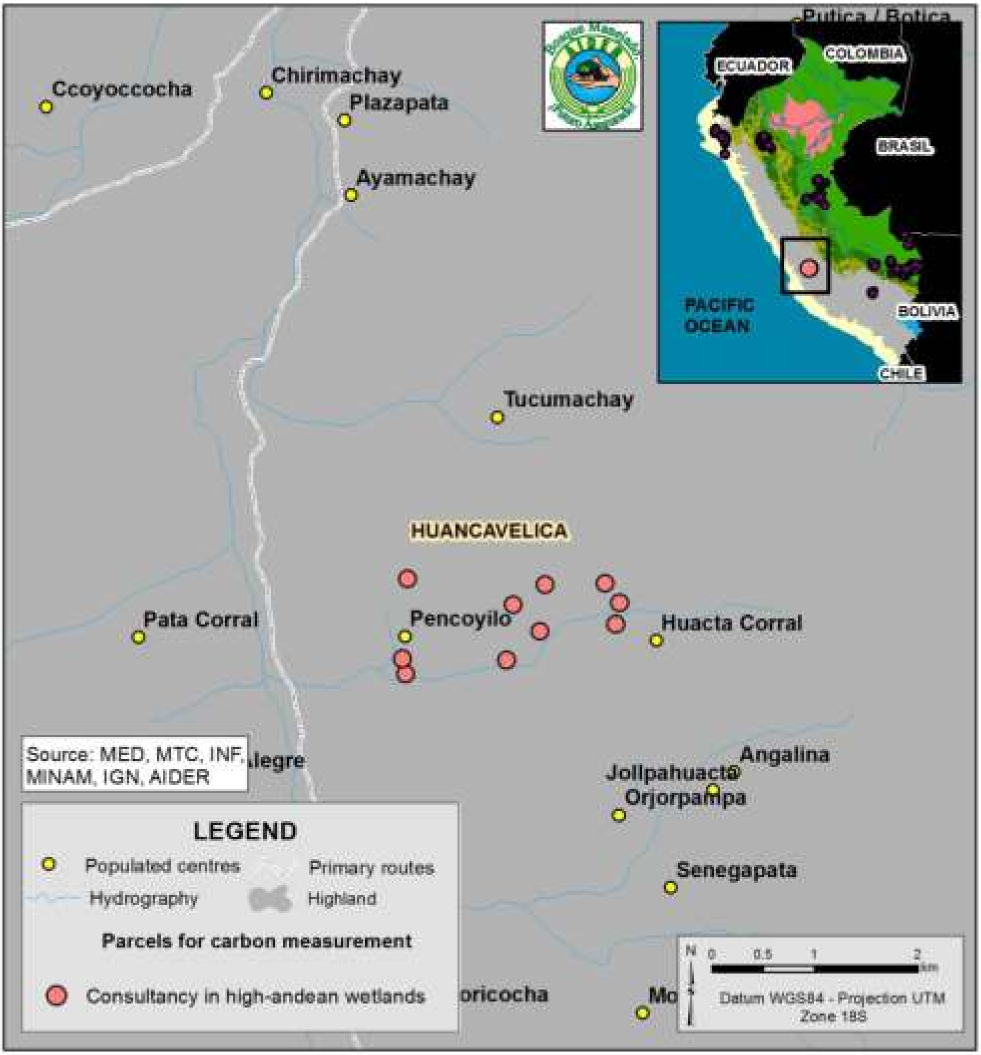

Figure 20. Distribution map of the evaluated carbon parcel in the high-andean wetlands

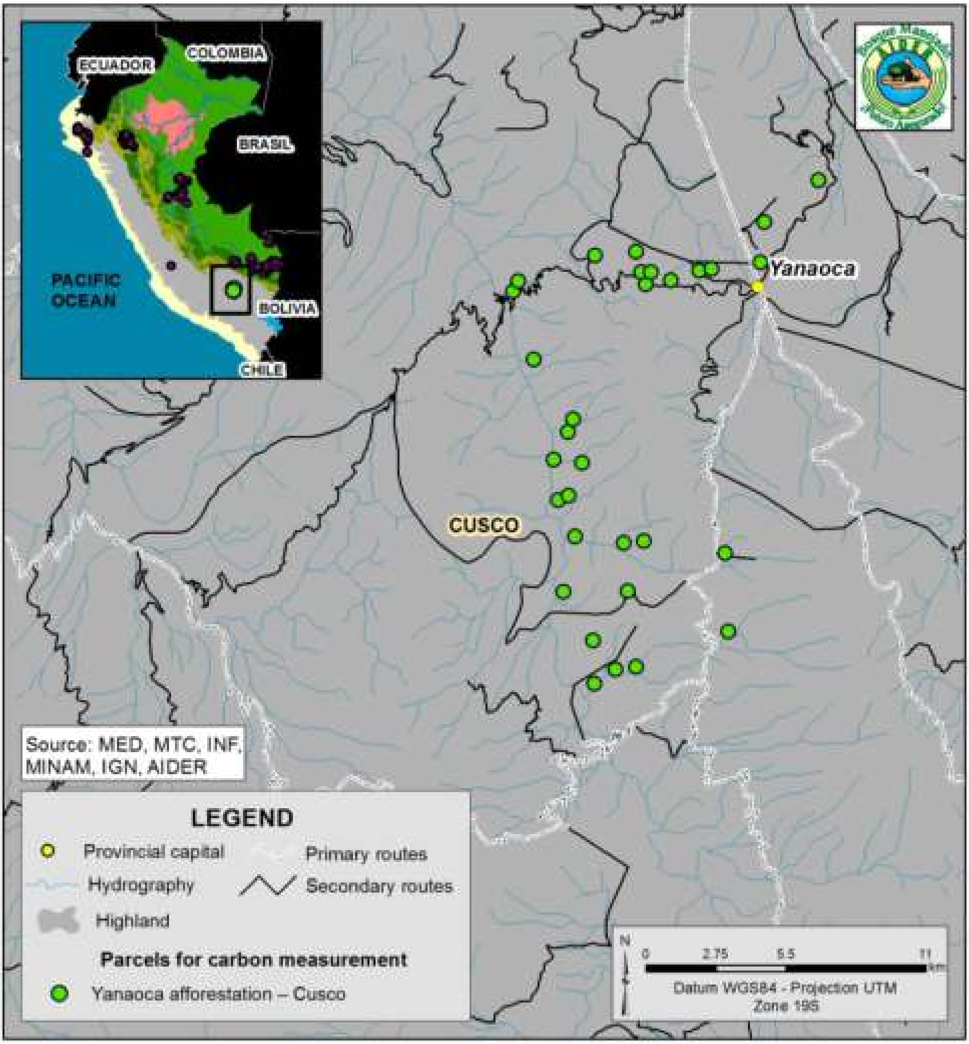

Figure 21. Distribution map of the evaluated carbon parcels in the high-andean grasslands

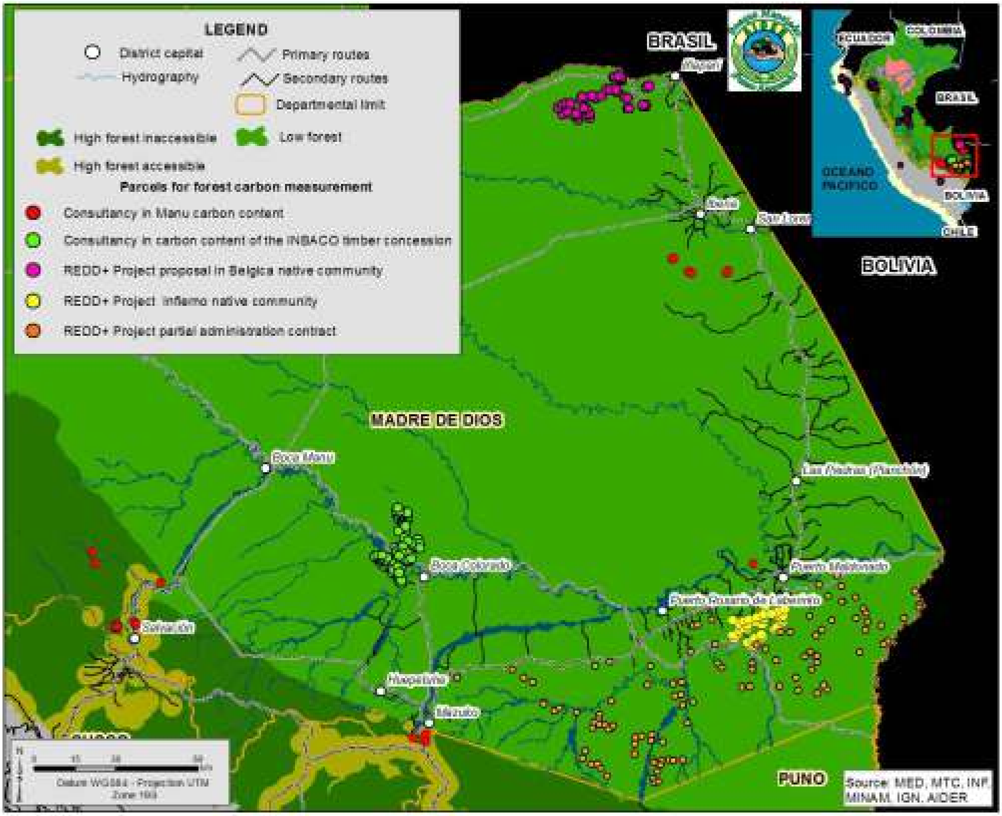

Figure 22. Distribution map of the evaluated carbon parcels in the Madre de Dios department

IV. Quantification and deforestation monitoring

The work of AIDER has been carrying out for the quantification and deforestation monitoring has been done in 3 departments of Peru for the 4 REDD+ Projects, covering a 14,155,751 ha of surface, which is detailed bellow.

4.1. Quantification and monitoring of the REDD+ project "Deforestation and degradation reduction in the Tambopata national reserve and Bahuaja-Sonene national park"

In this project a quantification of the historic deforestation for 1990, 1995, 2005, 2009 and 2010 was made. From 2011-2013 is been made the deforestation monitoring which will be continued until 2030. This work is been done for all Madre de Dios department, in an area of 8,504,586 ha. The deforestation advance and the respective monitoring can be seen in figures 23 and 24.

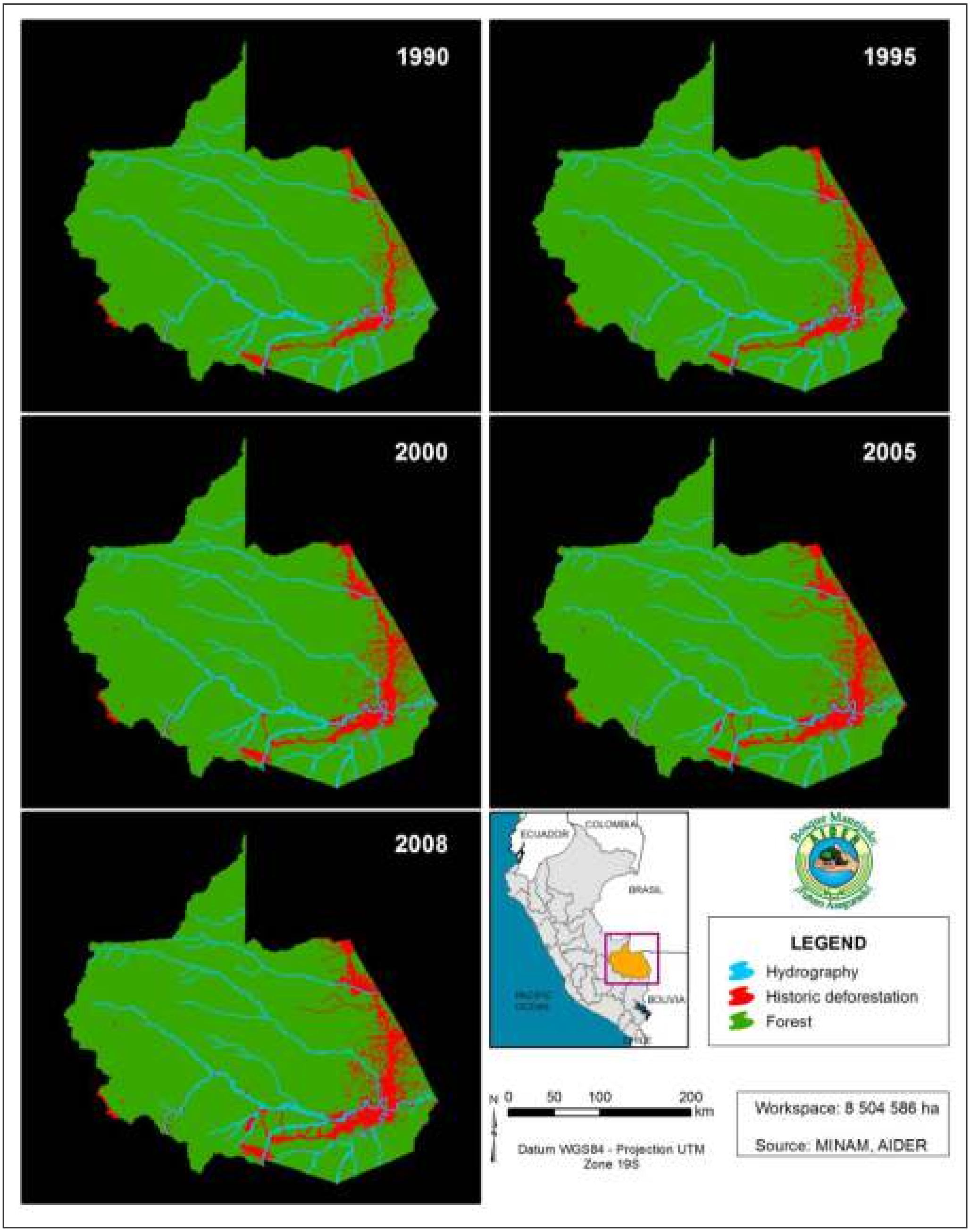

Figure 23. Historic deforestation in Madre de Dios department

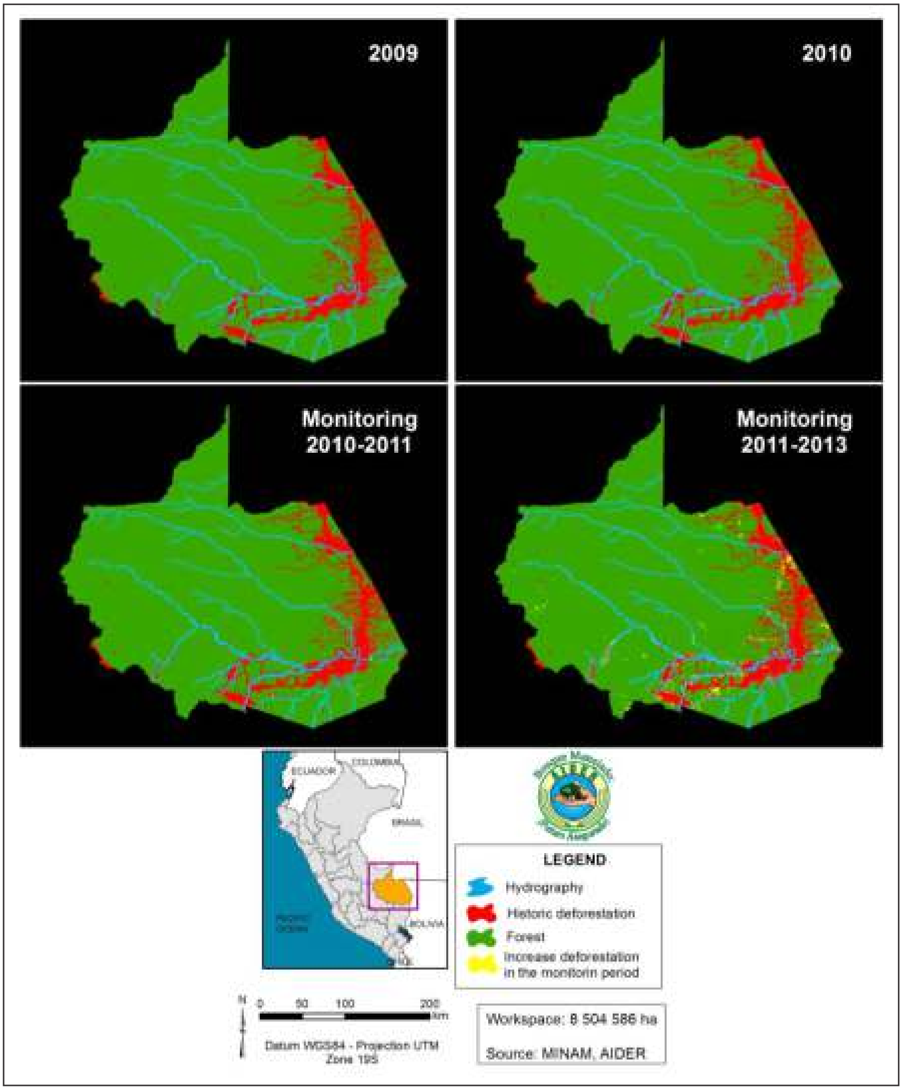

Figure 24. Historic deforestation and monitoring in Madre de Dios department

4.2. Quantification and monitoring the REDD+ Project "Forest management to reduce deforestation and degradation in the Shipibo Conibo and Cacataibo indigenous communities of the Ucayali region"

For this initiative a quantification of the historic deforestation for 2000, 2005 and 2010 was made. Since 2011 to 2013 is been made the deforestation monitoring which will continued until 2030. This work is been done for all Madre de Dios department, in an area of 4,735,649 ha. The deforestation advance and the respective monitoring can be seen in the figure 25.

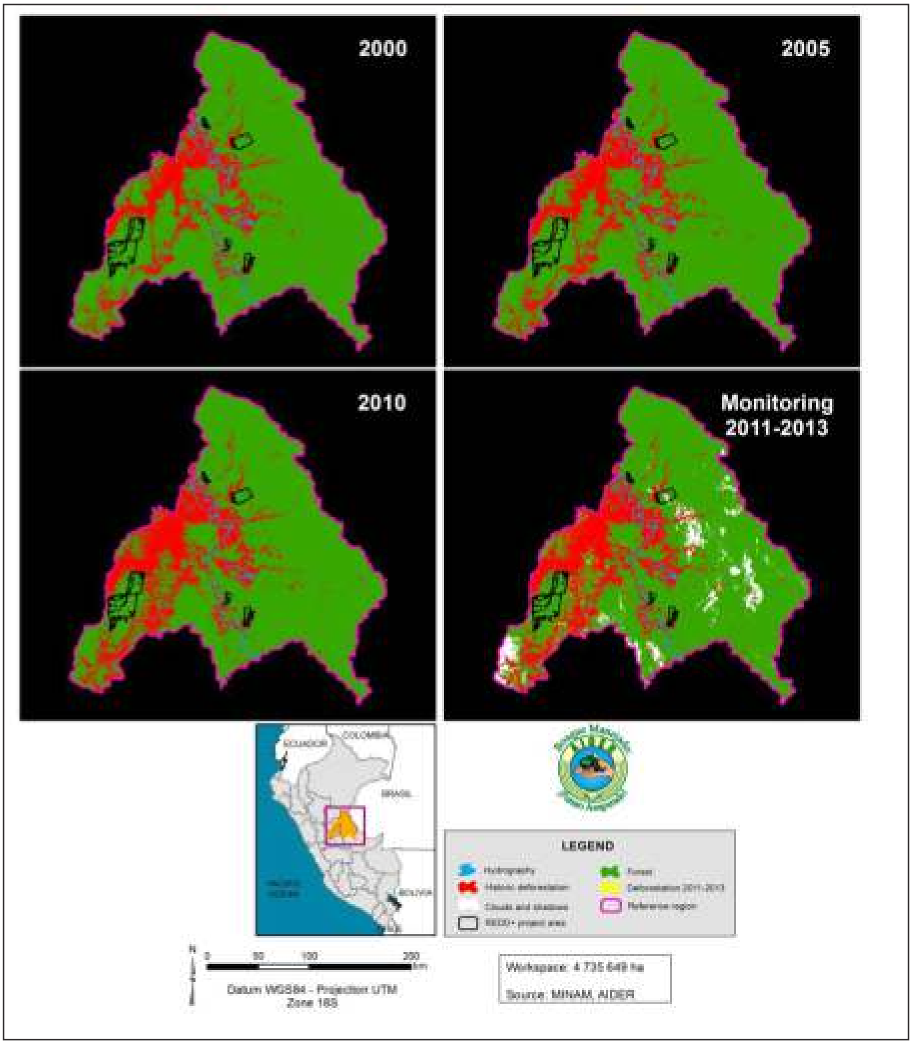

Figure 25. Historic deforestation and monitoring in the Ucayali department REDD+ project reference region

4.3. Quantification and monitoring the REDD+ project "Deforestation and degradation reduction of tropical dry forest in Piura and Lambayeque"

For this initiative a quantification of historic deforestation for 2000, 2007 and 2013 was made. Since 2014 will be made the deforestation monitoring which will continued until 2034. This work is bee done for all the project reference region in an area of 915,516 ha. In figure 26, could be seen the deforestation and degradation mentioned.

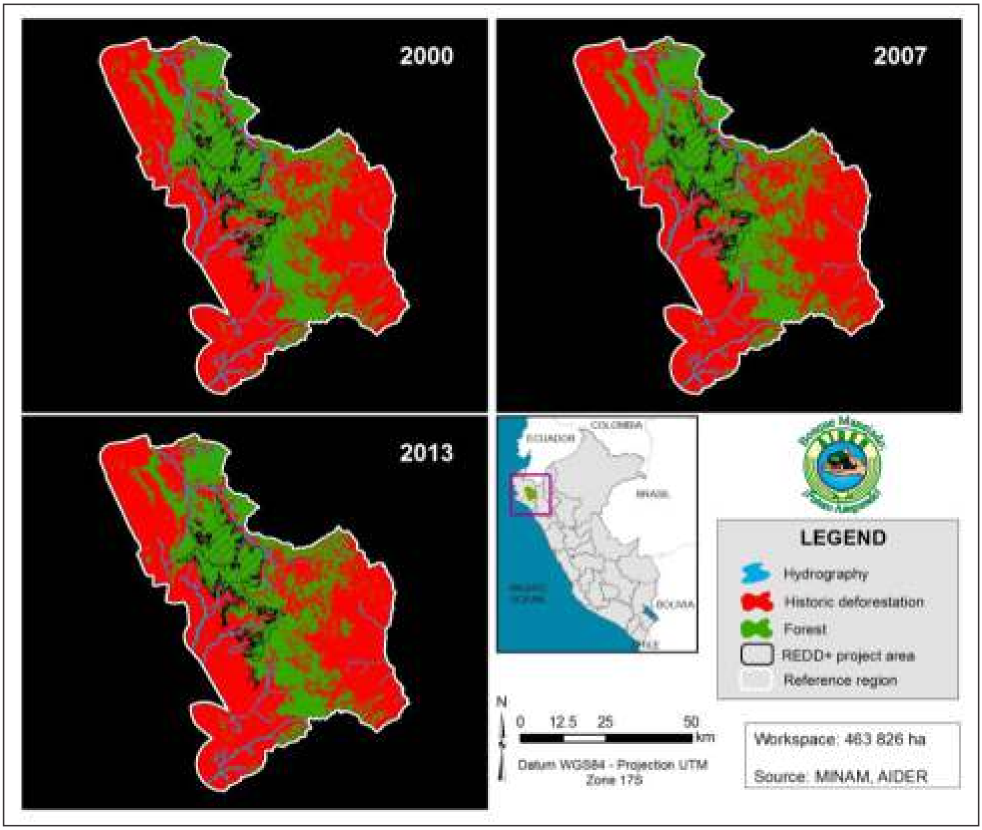

Figure 26. Historic deforestation and monitoring in the Piura department reference region

V. Contributiosn to avoided deforestation

In the avoided deforestation issue with the 4 REDD+ project, that has been implemented between 2010 and 2014, the avoided deforestation of 4,272 ha of forest was achieved and plans to prevent loss of 30,550 ha more forest between the 2013 – 2023[116], in table 2 can be seen the avoided deforestation for each REDD+ project.

[116] From 2013 – 2014, according to each Project. The verification is pending.

Table 2. Avoided deforestation and to avoid in REDD+ projects

REDD+ projects	Situation	2010 2011	2011 2012	2012 2013	2013 2014	2014 2015	2015 2016	2016 2017	2017 2018	2018 2019	2019 2020	2020 2021	2021 2022	2020 2023
Deforestation and degradation reduction in Tambopata national reserve and Bahuaja-Sonene national park	Deforestation to avoid (ha)					1,069	1,398	1,461	1,472	1,851	1,924			
	Real deforestation to avoid (ha)	424	681	681	908									
Evio Kuiñaji Ese 'Eja Cuana, to mitigate climate change	Deforestation to avoid (ha)			173	200	222	252	265	321	372	432	478		
	Real deforestation to avoid (ha)		133											
REDD+ project "Forest management to reduce deforestation and degradation in Shipibi Conibo and Cacataibo indigenous communities in Ucayali region"	Deforestation to avoid (ha)				1,370	1,416	1,722	2,289	2,441	2,693	2,944			
	Real deforestation to avoid (ha)	646	305	485.5										
REDD+ project "Reduction of degradation and deforestation in tropical dry forest in Piura and Lambayeque"	Deforestation to avoid (ha)				401	360	376	373	417	364	448	416	414	395
AIDER contribution to mitigate deforestation	**Real deforestation to avoid (ha)**			**173**	**1,971**	**3,067**	**3,748**	**4,387**	**4,650**	**5,280**	**5,747**	**893**	**413**	**394**
	Deforestation to avoid (ha)	**1,071**	**1,121**	**1,170**	**908**									

VI. Forestry plantations

Regarding to forestry plantations, AIDER has participated as consultant in the reforestation of 740 ha in Ucayali department, in Campoverde estate, property of the company Bosques Amazónicos, whose plantation has over 6 years installed and has achieved the commercialization of the captured carbon credit over this period of time. Furthermore, AIDER has participated as technical assessor in the carbon capture topic in the afforestation of 420 ha (from 1,198 ha to install) in the project "Agrosilvopastoral practices oriented to carbon market" in Cuzco department, executed for World Vision International.

VII. Management of assisted natural regeneration in tropical dry forest

Regarding the management of assisted regeneration in tropical dry forest is been working in the conservation and regeneration of 3,816 ha with the protection of 79,891 ha of algarrobo and zapote pole stage and saplings, that is an assisted and alternative model of the natural regeneration in dry forest.

VIII. Areas under forest management

The communal forest management has been working with 10 native communities of the Shipibo Conibo, Cacataibo and Ese'Eja ethnic groups in Ucayali and Madre de Dios departments, which comes intervening 160,874 ha, of which 85,429 ha are under management (74,780 under timber forest management and 10 649 under non-timber forest management); from this 10 communities, 5 have the voluntary forestry certification under the FSC principles and criteria. In table 3 can be seen details for each community.

Table 3. Details of areas under forest management of 10 native communities

Native communities	Total area of native communities (ha)	Area under timber forest management (ha)	Area under non-timber forest management (ha)	Total management areas (ha)	Voluntary Forestry Certification under the FSC P&C
Sinchi Roca	27,115	18,753	2,401	21,153	No
Callería	4,035	2,528	-	2,528	Yes
Roya	4,320	3,000	-	3,000	Yes
Curiaca	6,165	2,500	-	2,500	Yes
Puerto Nuevo	68,924	20,000	8,151	28,151	No
Pueblo Nuevo	6,985	2,840	-	2,840	Yes
Flor de Ucayali	21,291	12,500	-	12,500	No
Junín Pablo	3,550	724	-	724	Yes
Samaria	8,788	5,046	-	5,046	No
Infierno	9,701	6,888	97	6,985	No
Total	**16,087**	**74,779**	**10,649**	**85,427**	**-**

IX. Contributions to areas under REDD+ protection

Whit the designed REDD+ projects, strategies for protection have been implemented (to avoid forest deforestation and degradation) of 714,729 ha of forest since 2010, as shown in table 4. Also, deforestation of 503 366 ha are been monitoring, these are the leakage areas of the projects, in table 5 the area of each initiative is detailed. Through the activities of the four REDD+ projects, 1,218,095 ha of forest are being protected and monitored.

Table 4. Protected areas by the different REDD+ projects

REDD+ projects	Beginning of the projects and project area (ha)			
	2010-2011	2011-2012	2012-2013	2013-2014
"Deforestation and degradation reduction in Tambopata national reserve and Bahuaja-Sonene national park in the field of Madre de Dios department – Peru"	541,620			
"Evio Kuiñaji Ese'Eja Cuana, to mitigate climate change"		7,750		
"Forest management to reduce deforestation and degradation in the Shipibo Conibo and Cacataibo indigenous communities in Ucayali region"	127,004			
"Reduction of deforestation and degradation of tropical dry forest in Piura and Lambayeque"				38,355

Table 5. Monitored areas by the different REDD+ projects

REDD+ projects	Beginning of the projects and monitored leakage belt area (ha)			
	2010-2011	2011-2012	2012-2013	2013-2014
"Deforestation and degradation reduction in Tambopata national reserve and Bahuaja-Sonene national park in the field of Madre de Dios department – Peru"	197,497			
"Evio Kuiñaji Ese'Eja Cuana, to mitigate climate change"		9,358		
"Forest management to reduce deforestation and degradation in the Shipibo Conibo and Cacataibo indigenous communities in Ucayali region"	276,477			
"Reduction of deforestation and degradation of tropical dry forest in Piura and Lambayeque"				20,034

X. Contribution to the reduced emissions for forest deforestation and degradation

In contribution to the climate change, the 4 REDD+ projects implemented between 2010 and 2013 have avoided the emissions of 1,337,542 tCO_2-e and, it is planned to avoid the emissions of 11,857,763 tCO_2-e between 2013[117] and 2023, in table 6

[117] The verification from 2013 and 2014 each Project are pendiented.

Table 6. Avoided emissions and to avoid of the REDD+ projects

REDD+ projects	Situation	2010 2011	2011 2012	2012 2013	2013 2014	2014 2015	2015 2016	2016 2017	2017 2018	2018 2019	2019 2020	2020 2021	2021 2022	2020 2023
Deforestation and degradation reduction in Tambopata National Reserve and Bahuaja-Sonene National Park in the field of Madre de Dios department	Emissions to avoid (CO_2-e)					482,322	629,415	665,392	669,302	837,077	865,869			
	Avoided emissions (CO_2-e))	190,796	310,436	310,436	416,746									
Evio Kuiñaji Ese´Eja Cuana, to mitigate climate change	Emissions to avoid (CO_2-e)			78,551	90,692	100,540	114,889	120,285	147,421	171,653	202,667	225,327		
	Avoided emissions (CO_2-e)		47,895											
Forest management to reduce deforestations and degradation in Shipibo Conibo and Cacataibo indigenous communities in Ucayali region	Emissions to avoid (CO_2-e)				419,691	453,660	548,494	731,077	783,397	854,590	951,133	1,053,304	1,147,272	1,241,239
	Avoided emissions (CO_2-e)	218,036	95,870	157,743										
Reduction of deforestation and degradation of tropical dry forest in Piura and Lambayeque	Emissions to avoid (CO_2-e)					40,006	41,466	41,089	43,632	47,448	55,676	53,640	51,494	48,214
Total contribution from proyets promoted by AIDER to mitigate climate change	**Emissions to avoid (CO_2-e)**				59,277									
	Avoided emissions (CO_2-e)			**78,551**	**510,383**	**1,076,528**	**1,334,264**	**1,557,843**	**1,643,752**	**1,910,768**	**2,075,345**	**1,332,271**	**1,198,766**	**1,289,453**

Keywords

Additionality

Is the requirement that an activity or a REDD + project will generate benefits such as reduced emissions, which would not have given activity (ie, in the usual scenario) unsuccessful. Sometimes distinguishes between environmental additionality and financial additionality, which means they have not implemented a project without the support of REDD+. Under the Kyoto Protocol, "Additionality" means that the project must demonstrate real, measurable and long-term in reducing or preventing carbon emissions and that these would not have occurred if the project had not been made.

Aerial biomass

Living biomass above the soil, including stem, stump, branches, bark, seeds and foliage.Agriculture, Forestry and other land use (AFOLU). The sectoral scope covering GHG emissions and reductions and / or removals emissions from project activities in the agriculture, forestry and other land use / land use change and for which the VCS program established rules and requirements regarding specific categories of projects.

Allometric equation

Allometric equations are a statistical model used to express the quantitative relationship between the size of a tree and biomass. Are used to estimate the biomass of trees based on easy ways to measure, such as tree height and diameter at breast height (DBH).

Assisted natural regeneration

Natural regeneration assisted by human work through the elimination of external obstacles, such as weeds and biotic interference and sometimes the use of controlled disturbances to trigger germination of native species, eg loss: slashing ecological or tile or site preparation for germination, enabling the inherent resilience of the site for natural regeneration of native species.

Base line

This term is used in different ways, but generally refers to a situation of "usual scenario". In REDD +, is projected anthropogenic changes in forest carbon stocks that would occur in the absence of the project activity or intervention policy. Evaluations of projects, the "baseline" can also refer to the above conditions to the project (eg a "baseline study" is the collection of socioeconomic and ecological data is made before the start of a project, which is assumed by implication that any change should the project).

Biodiversity

It is the set of all forms of life on earth and the foundation of ecosystem services. The Convention on Biological Diversity of the United Nations (CBD) defines biodiversity as the variability of organisms from all sources, including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species (genetic diversity), between species and of ecosystems, with the corresponding elements, functions and structures. The different levels and aspects of biodiversity contribute directly and indirectly to the goods and ecosystem services.

Biomass

The amount of total dry mass of living organic matter.

Carbon content

The amount of carbon stored within a reserve, measured in tonnes of CO2.

Carbon fixation

See carbon sequestration

Carbon marked

Market where trades with reductions in carbon emissions, generally in the form of carbon credits (verified or certified emission reductions). Carbon markets are of two types: i) voluntary markets (where they are not regulated emissions reduction targets); or ii) compliance markets (where it is traded carbon credits to meet the targets for reducing emissions). The current largest carbon market is the European Emissions Trading System (ETS).

Carbon sequestration

The process of removing carbon from the atmosphere and deposit in a sump long term, like an ocean and terrestrial ecosystems through physical or biological processes such as photosynthesis.

Carbon sink

A reservoir (tank) that absorbs or captures carbon from the active part of the carbon cycle, and absorbs more of the releasing.

Carbon stock

The amount of carbon contained in a carbon.

Compulsory Market/Compliance/binding

Market created by national, regional or international legal systems to limit GHG emissions. These allocated or auctioned emission limits greenhouse gas (quotas or ceilings or caps caps) to national or sub-national unit's p. eg. Companies), and allow you to buy carbon credits to reach its limit, or sell them if they emit less than their maximum.

Clean Development Mechanism (CDM)

Kyoto Protocol instrument whose purpose is to help developed countries (Annex I) to comply with its commitments to reduce emissions. The mechanism allows the parties included in Annex I to finance and develop projects that reduce emissions in developing countries (non-Annex I) earn credits that can be used to meet their own emission reduction commitments. The CDM not only aims to reduce emissions or increase sinks but also contribute to sustainable development in developing countries.

Certification

In the current context of REDD +, certification is to verify that a project meets a standard of voluntary compensation (such as voluntary carbon standard or standard climate, community and biodiversity) through a third-party audit. Certification can also refer to credit verification of Clean Development Mechanism (CDM), ie, the Certified Emission Reductions (CERs).

Deforestation

It is the permanent conversion of forest land to non-forest land. In the Marrakesh Accords deforestation is defined as "direct conversion, produced by the hand of man, of forest land in non-forest land". The FAO defines deforestation as definitions also stipulate the minimum height of the trees (FAO "conversion of forest to another land use or the long-term reduction of tree cover below the minimum threshold of 10%." 5m in situ) and a minimum area (FAO: 0.5 ha), and that agriculture does not dominate land use. However, the definitions of canopy cover (forest), minimum height and area vary by country.

Deforestation agents

People or group of people responsible of the deforestation.

Deforestation drivers

They are the economic and social situations that attract or easy travel agents deforestation.

Degradation

It refers to changes in the forest that negatively affect the structure or function of the site or forest area, and therefore decrease the ability of the forest to supply products or services. In the context of a REDD + mechanism, forest degradation resulting in a net loss of ecosystem carbon. One way to measure degradation is to calculate the reduction in carbon stocks per unit area (eg a hectare).

In the context of REDD +, it is likely that the degradation is measured in terms of reduced carbon stocks in forests that remain as such. Not yet adopted a formal definition of degradation because many forest carbon stocks fluctuate due to natural cyclical causes or management practices.

Ecosistemic services

Are the goods and services provided by the environment that benefits and support human welfare. These services come from natural and modified ecosystems. While there is no single way and consensado to classify ecosystem services under the Millennium Ecosystem Assessment (MA for its acronym in English) service provisioning, regulating, supporting and cultural rights is widely accepted and I considered a useful starting point.

Endemic

Restricted to an exclusive area. It is used to qualify a species or organism and indicate that this confined / or a specific geographic region.

Estuary

Mouth of a river that is characterized by a shape resembling the longitudinal section of a funnel, through the influence of the tides at the junction of river water to the sea.

Eolic erossion

Event whereby removal of surface material, selection and transport by wind occurs. Knowing the process, quantify and make predictions about its effects, you can be the ways to achieve adequate control and prevents degradation. Wind erosion causes an effect "in situ" and another in neighboring regions. The in situ degradation is related to the degradation in the same soil, or vegetation cover as crops or implanted pastures.

Ex ante

"Before the event," usually used to describe estimates (or projections) made before the start of the project, for example, all baseline projections are ex ante (otherwise can not be measured ex post).

Ex post

"After the event," usually used to describe the monitoring results from the study, for example, real emissions reductions.

Forestation

Direct conversion of human-induced soil that has not been forested for a period of at least 50 years forest floor through planting, seeding and / or human-induced promotion of natural seed sources.

Kyoto Protocol

International legal instrument on climate change containing emission reduction commitments for countries.

It is an agreement signed in 1977 within the framework of the UNFCCC. The Annex I countries that ratify this protocol commit to reduce their emissions of carbon dioxide and five other greenhouse gases. The Kyoto Protocol covers more than 170 countries worldwide, but only 60% in terms of GHG emissions.

International cooperation

In its most general sense refers to anyone cooperative effort between two or more countries to address a topic, solve a problem or deal with negative situations by mutual agreement. Relationship between actors in the international system with similar interests to achieve certain ends (environmental, economic, military, sports, development, etc.)

Land tenure

It is the ratio defined in legal or customary manner, between people, in-law individuals or groups with respect to ground (for convenience, <land> is used here to include other natural resources such as water and trees). The tenure is an institution, ie a set of rules invented by societies to regulate behavior. The rules of tenure define how they can be assigned within societies rights to use, control and transfer land, as well as associated responsibilities and limitations. In other words, systems of land tenure determine who can use what resources, for how long and under what circumstances.

Leakage

In the context of climate change, carbon leakage occurs when interventions to reduce emissions in an area (national or subnational) cause an increase in emissions in another area. The official name that gives the UNFCCC is "displacement of emissions."

Leakeage belt

They are adjacent project areas where deforestation and forest degradation could be displaced due to the implementation of activities in the project area.In other words, it is the area where any deforestation above the baseline projection shall be considered as leakage.

Leakage belt area

It is the area (or areas) specifically designed to implement activities that reduce the risk of activities that move leaks. These areas are dedicated to improving farmland and soil management, agroforestry, forest grazing and reforestation activities. Upon start of the project management areas should be no leakage forest soils.

Low impact logging

Intensive logging planned and carefully controlled in order to minimize the impact of the use of residual stands and soils, usually selecting individual trees for harvesting.

Mitigation

Actions to prevent further accumulation of greenhouse gases in the atmosphere, reducing the amounts issued or increasing carbon storage sinks.

Monitoring period

The time period (in years) between two events monitoring and verification. Typically is a fraction of the baseline fixed period.

Payments for ecosystem service

A buyer who values ecosystem services make a payment to the provider or administrator land use rendering such services; in exchange, the seller continues lending them. In REDD +, the PSE refers to a results-based system in which payments are made by reductions in emissions or increases in removals relative to an agreed level of reference.

Project Design Document (PDD)

Is the key source of information and analysis that summarizes the characteristics of the project, quantifies carbon benefits and exposes the monitoring plan providing the basis for validation and independent verification of the project and its reductions.

REDD+ Project area

Corresponds to the area under the control of the project participants and in which project activities will be implemented and the reduction of GHG emissions accounted for. Importantly, this area corresponds to the total forest areas of REDD + project start year of the project.

Reducing emissions from deforestation and forest degradation (REDD and REDDD +)

REDD refers to mechanisms negotiated currently in the process of the Framework Convention of the United Nations Climate Change to reduce emissions from deforestation and forest degradation in developing countries. While REDD + includes enhancement of forest carbon stocks, ie 'negative degradation "or" liquidation "on land classified as forest.

Reference level (RL)

They can distinguish two different meanings and different uses of the RL. First, RL refers to BAU baseline or changes in carbon stocks, which is used as a benchmark to measure the impact of policies and actions of REDD + and to define emission reductions. In this sense, the baseline may refer to levels of gross emissions from deforestation and forest degradation (RL), and levels of net emissions of total emissions and removals from deforestation, forest degradation, the conservation, sustainable management of forests and enhancement of forest carbon stocks (REL). Second, in a system based on results, the reference level is used as a benchmark to estimate the payments to be made to countries, subnational units or projects in exchange for reductions in emissions.

Reference period

The historical period before the date of commencement of project that serves as the data source to define the baseline

Reference region

It is the place of reference for analysis and obtaining information deforestation rates, agents and drivers of deforestation and changing patterns of land use.

Reforestation

Reforestation is the direct conversion (by human activity) of non-forested land to forested land, plantations, crops and / or human promotion of natural sources of seeds within lands that have previously contained forests but were converted to non-forest land

Resilience (of ecosystems)

His ability to function and provide critical ecosystem services under conditions in flux.

Sapling

Stage in the development of a tree seedling and sapling between; although arbitrary, usually applied when a height of 1.37 m but less than 8 cm in DBH is reached.

Software "Dynamic Ego"

Software that enables spatial geographic analysis. It is a modeling tool comprising a set of algorithms that develop a specific function, these algorithms are called "functors". These "functors" are sequenced to establish a data flow graphically.

Sustainable forest management

The process of managing the forest to achieve one or more management objectives clearly defined with respect to the production of a continuous flow of desired forest products and services without unduly reducing its inherent values or future productivity, without causing any undesirable effect in the physical and social environment.

Terrestrial biomass

Living biomass of live roots, sometimes excludes thin roots of less than 2 mm in diameter because these often can not be distinguished empirically organic matter or soil cover or litter.

Verification

Independent assessment by third parties, current or projected reductions activity specified mitigation.

Voluntary marked

Functioning markets with compliance markets. Buyers are businesses, governments, NGOs and individuals voluntarily buy verified emissions reductions, for example to offset their own emissions.

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Anexxes

Annex 1. Monitoring actual net Gases Greenhouse removed by sinks

Data number	Variable	Recording frequency	Number of sample plots at which the data will be monitored
1	Plot location[118]	5 years	100%
2	Tree species[119]		100%
3	Age of plantation[120]		100% of sampling plots
4	Trees diameter at breast height (DBH)[121]		100% trees in sampling plots
5	Tree height[122]		100% trees in sampling plots
6	Carbon fraction[123]		100% of sampling plots
7	Root-shoot ratio[124]		100% of sampling plots
8	Carbon stock in aboveground biomass of each tree on plots		100% of sampling plots
9	Carbon stock in belowground biomass of each tree on plot		100% trees in sampling plots
10	Area of plot[125]		100% trees in sampling plots
11	Number of trees in each sampling plot[126]		100% of sampling plots
12	Carbon stock in aboveground biomass of trees on plot “p”		100% of sampling plots
13	Carbon stock in belowground biomass of trees on plot “p”		100% of sampling plots
14	Mean carbon stock in aboveground biomass per unit area per stratum per tree species		100% of strata
15	Mean carbon stock in belowground biomass per unit area per stratum per tree species		100% of strata
16	Area of stratum		100% of strata
17	Carbon stock in aboveground biomass of strata per tree specie[127]		100% of strata

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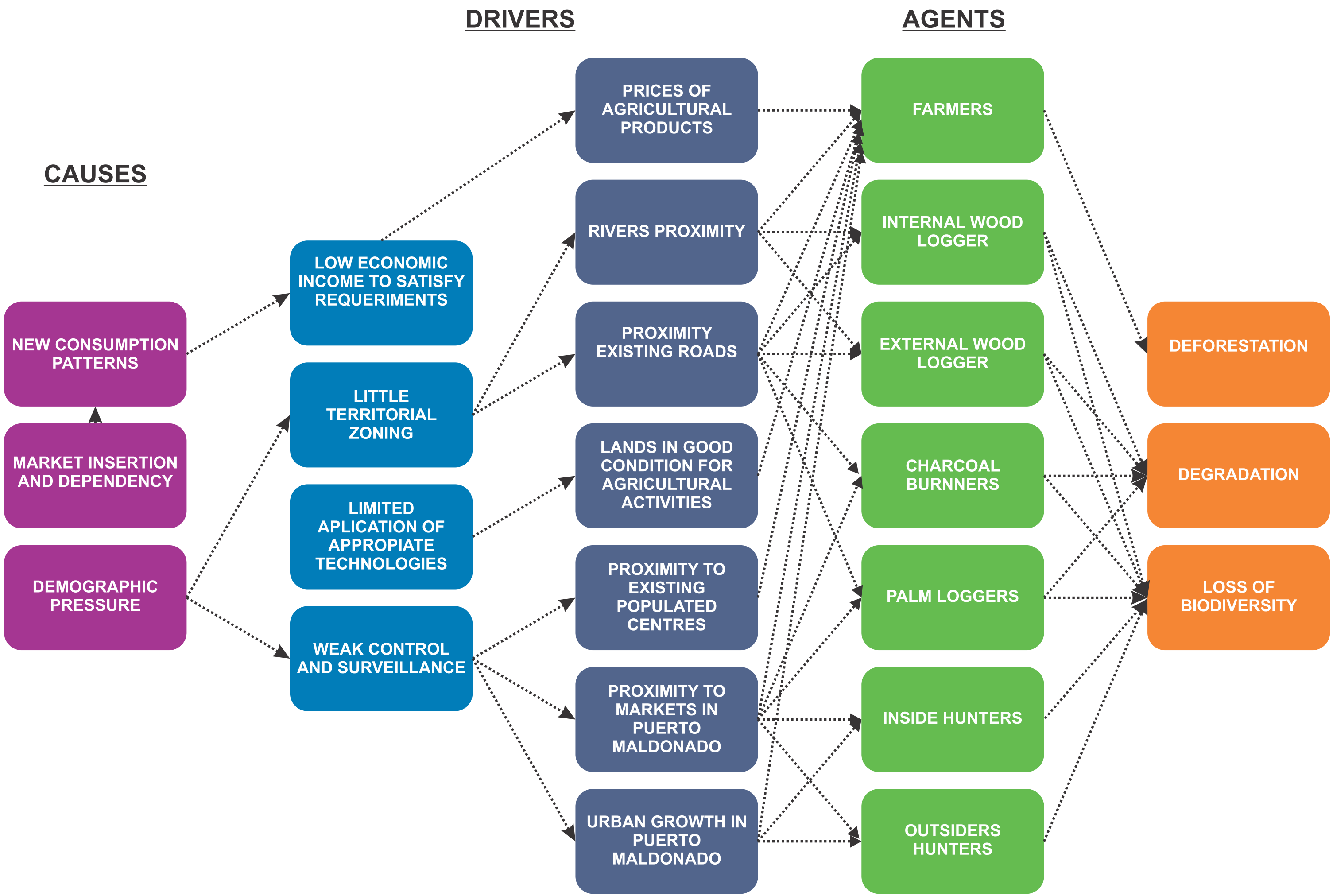
118 GPS use to place before the project start and before each verification
119 According PDD
120 Counted since the plantation year
121 Measured in each monitoring in all included trees in each simple plot
122 Measured in each monitoring in all included trees in each simple plot
123 Local derivatives and specific values in priority species
124 Local derivatives and specific values in priority species
125 Permanent sample plot area
126 Permanent sample plot area

18	Carbon stock in belowground biomass of strata per tree specie		100% of strata
19	Carbon stock in aboveground biomass per strata		100% of strata
+20	Carbon stock in belowground biomass per strata		100% of strata
21	Carbon stock change in aboveground biomass per strata		100% of strata
22	Carbon stock change in belowground biomass per strata		100% of strata
23	Disturbed ration of surface land area during site preparation	10 year	100% of strata
24	Total carbon stock change	5 years	100% of project area
25	Ration of molecular weights of carbon and CO_2 [128]		100% of project area
26	Total Project area		100% of project area
27	(BEF) Biomass expansion factor[129]		100% of project area
28	Cost of establishment of a sample plot for each stratum	Before the start of the project.	100% of strata
29	Increase in GHG emission as a result of biomass burning within the project boundary	5 years	100% of strata
30	Mean merchantable volume per unit area for stratum i, species j, time t		100% of strata
31	Maximum possible number of sample plots in the project area		100% of strata
32	Sample size for stratum i		100% of strata
33	Tree ID	At time of plantation	100% of strata
34	Plot expansion factor from per plot values to per hectare values	Before the start of the project.	100% of strata
35	Value of the statistic z (normal probability density function), for $\alpha = 0.05$		100% of strata

[127] Actual area of each stratum
[128] CO_2-e calculated
[129] Considering an alternative to the allometric equation

Annex 2. Identification of agents, drivers and causes of deforestation and degradation, and biodiversity lose in the project area



Annex 3. Social indicators adapted to the CCB Standards

CCB standards	Social Study Variables	Indicator	Actual situation	Measurement way
1. Socioeconomic situation	Land use system	Clear trend of communal property by the state	06 communities are registered in the SUNARP	Document analysis
		Knowledge of ancestral use of their communal territory	60% of population knows the ancestral use of communal territories and identifies areas as the potential of natural resources. Handle approximations of the zoned acres they own.	structured interviews
	Community infrastructure	Existence of collectives infrastructures	- 86% have communal water service. - 80% have no family latrine service. - 86% have no satellite service and telephone. - 100% have community center. - 100% of the utility that owns the community were built by state or private institutions, primarily timber companies.	Direct observation
	Employment existence	Number of households engaged in certain economic activities	- 10.8%of the population is engaged with agriculture. - 22% of the families are dedicated to timber resources extraction in a permanent way. - 17% of families are dedicated to the craft activity, being a more upscale women work.	structured surveys
	Expansion of the agricultural area	% Of existing agricultural area at community level	Each farmer has among 1-3 agricultural crop has maximum.	
	Products on the market	Number of species in agricultural and industrial market	Three are the most commercialized crops in local and national market (papaya, banana and maize)	
	Product price	% Annual increase in agricultural product on the market	Over a period of 08 years (2005 -2013)- - Payaya increased by 600% (S / .0.50 current S /. 3.00) - Banana 300% (S /. 4.00 and currently S / .12.00)	

<table>
<tr><td rowspan="2"></td><td>Transportation and market access</td><td>Number of paths for the marketing of products</td><td>- 100% of the communities entering the market through the lake.
- 5. 01 community (Sinchiroca), has the ability to access the market via road.</td><td rowspan="2">Interviews</td></tr>
<tr><td>Agribusiness projects</td><td>Number of projects to be implemented at community level</td><td>- Pueblo Nuevo. Cocoa Project 200 ha by the Municipality of Iparia.
- Roya. Cocoa Project to be defined with the Municipality of Iparia.
- 8. Sinchiroca and Puerto Nuevo. Cocoa Project defined with the Municipal Irazola.</td></tr>
<tr><td rowspan="7">2. Culture and Demography</td><td rowspan="7">Population growth</td><td>Number of people</td><td>Among the seven communities there is a population of</td><td></td></tr>
<tr><td>% of male population</td><td>51.7%</td><td></td></tr>
<tr><td>% of female population</td><td>48.3% are women</td><td></td></tr>
<tr><td>% of young people</td><td>Between the ages of 21 to 45 years 32.1%</td><td></td></tr>
<tr><td>Population density (inhabitants / ha) and (ha / person)</td><td><table>
<tr><th>Communities</th><th>Inhabitants /ha</th><th>Ha/Inhabitants</th></tr>
<tr><td>Pueblo Nuevo</td><td>0.045</td><td>14.675</td></tr>
<tr><td>Curiaca</td><td>0.078</td><td>12.762</td></tr>
<tr><td>Roya</td><td>0.084</td><td>11.922</td></tr>
<tr><td>Flor de Ucayali</td><td>0.004</td><td>237.229</td></tr>
<tr><td>Callería</td><td>0.076</td><td>12.974</td></tr>
<tr><td>Sinchi Roca</td><td>0.016</td><td>10.617</td></tr>
<tr><td>Puerto Nuevo</td><td>0.005</td><td>219.8</td></tr>
</table></td><td>Direct observation</td></tr>
<tr><td>Number of poor people in the community.</td><td>Poverty is widespread in communities, 40% child malnutrition in children under 0-5 year’s old, poor diet in most families, lower income 500 soles a month in most families, lack of drainage services and insecurity safe drinking water.</td><td>structured surveys</td></tr>
<tr><td>% Of the female</td><td>Agriculture and crafts are a flexible work roles:</td><td>Focus groups</td></tr>
</table>

		population engaged in agriculture and handicrafts	17% of households are engaged in handicrafts, and 10.8% make commercial agriculture.	
		% Of mestizo population in communities	6.4% of families in communities are mestizo, these are joined together indigenous women from the community.	Interview
	Social movility	Number of houses with permanent residence in the community	90% of population remains in the community except for the Flor de Ucayali community where over 50% of its population lives in Yarinacocha and Pucallpa.	structured surveys
		Number of families outside the community for more than 06 months	30% of the population remains outside the community by temporary, mainly on school days and holidays.	Interview
3. Tenure and land security	Territorial security	% Of defined boundaries with adjoining	85% Of communities has not defined its boundaries with adjoining.	Direct observation
		% Of existing landmarks in the limits	More than 85% of the communities have milestones partially placed in its boundaries, causing invasions.	
		Number of existing community groups monitoring	1. 57% of the communities have some kind of monitoring committee of the communal territory. 2. 100% of these groups do not have adequate logistics for conducting patrols.	Interviews
		% Of rural population puts pressure on communal lands		
	Land tenure	% Of communities registered in the Public Registry.	100% of the communities are already registered in the SUNARP	
	Deforestation	% of deforested areas		

		Land clearing occupied ancestrally		
4. Areas of high conservation value	Conservation zone	Number of small communities	0% of the communities are not technically zoned	
		Areas defined as high conservation value		
5. Governance	Organizational system	Ways to make decisions at community level	In 100% of the communities the Assembly is the highest authority and that is where the exercise of democracy and local governance becomes.	
		Legitimacy of agreements	100% agreements are legitimized in the communal assembly and are also revoked when they believe is not fulfilled by an external. All agreements with external by timber extraction are performed notary.	Interview
		% Of communities with economic transactions with logging companies.	43% of the communities (Sinchiroca, Puerto Nuevo and Flor de Ucayali), have been working with logging companies.	
		% Of communities working forest management	The 43% performed at Community level forest management and community members are working through organized groups (Callería, Curiaca and New Town). If the community Roya not yet have a general forest management plan.	Interview

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REDD TambopataBahuaja

The printing of 500 copies of the publication "Forest Carbon Projects in Peru: AIDER experience to Mitigate Climate Change" has generated 0.75 tons of carbon emissions. The carbon footprint of this publication has been offset with the project "Reducing deforestation and degradation in Tambopata National Reserve and Bahuaja-Sonene National Park in the scope of the department of Madre de Dios - Peru”. The carbon credits are verified under the VCS international standard and registered in Markit Registry.

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In his professional experience has developed projects and proposals of forest management focused in landscapes, within this has achieve the integration of timber and/or non-timber forest products, as well as forest ecosystem services, benefiting people who live in and of the forest.

Within his professional experience has designed and implemented projects which integrate forest carbon component as an adicionality in forest management, where has been manager and participant of the principal successful projects of carbon sequestration in forest plantations and emissions reduction because of avoided deforestation in

- Reforestation, sustainable production and carbon sequestration in dry forest of Jose Ignacio Tavara Pasapera peasant community – Piura
- Reforestation in degraded areas with wood production and carbon sale purpose – Ucayali
- Amazon REDD+ Project – Madre de Dios
- Reduction of deforestation and degradation in Tambopata National Reserve and in Bahuaja-Sonene National Park within Madre de Dios region
- Alto Mayo conservation initiative – San Martín
- Evio Kuiñaji Ese´Eja Cuana, to mitigate climate change – Madre de Dios
- Forest management to reduce deforestation and degradation in Shipibo Conibo and Cacataibo indigenous communities in Ucayali department
- Reduction of deforestation and degradation in tropical dry forest in Piura and Lambayeque

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