GUIDELINE FOR TACKLING THE DECREASE IN FOREST RESOURCE UTILIZATION OF CDM PROGRAMMES OF ACTIVITIES IN PARAGUAY

Realizing a low carbon farming town society

Japan International Research Center for Agricultural Sciences（JIRCAS）

Ministry of Agriculture and Livestock（MAG）
National Forestry Institute（INFONA）
National University of Asunción（UNA）
National University of Caaguazú（UNCA）

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Errata sheet

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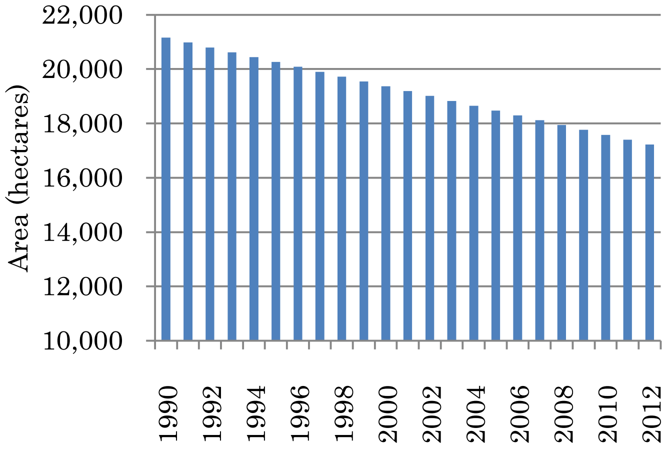
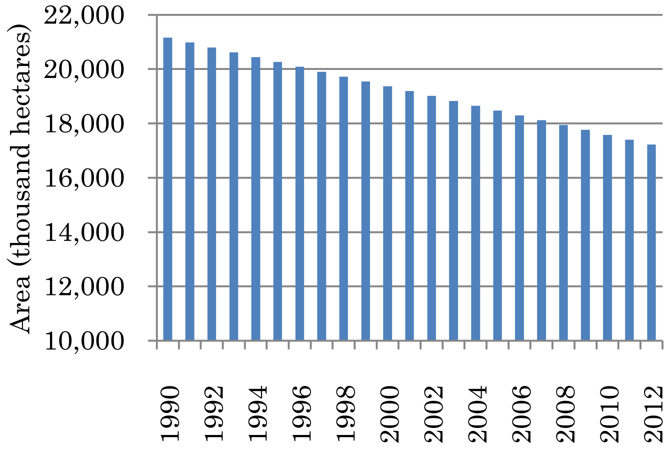
Page 2 Figure 1	 Figure 1 Changes in the Forested Area of Paraguay Source: FAO (2015) FAOSTAT	 Figure 1 Changes in the Forested Area of Paraguay Source: FAO (2015) FAOSTAT

Preface

In 2012, the Ministry of Agriculture and Livestock (MAG), National Forestry Institute (INFONA), National University of Asunción (UNA) and National University of Caaguazú (UNCA), in cooperation with Japan International Research Center for Agricultural Sciences (JIRCAS), Start the "Establishment of a Programmatic Rural Development Methodology Applying Clean Development Mechanism (CDM)". The important point in this joint research activity is that INFONA, UNA and UNCA, which are the implementing agency and institute of national policy and action of environmental conservation and mitigation of climate change, participate in the project.

In 2009, JIRCAS had experience of having the "reforestation of croplands and grasslands in low income communities of Paraguarí Department "registered by the United Nations as the first CDM project in Paraguay and acquisition of carbon credit (CER) for around 7 thousands tCO2. Taking advantage of the accumulated experience and techniques to a larger area, projects have been implemented in the eastern region of the country, including examinations, surveys, data collection, and analyses conducted in cooperation with officers of the MAG and the INFONA as well as university students and professors. Through these projects, methods for rural development programs to utilize CDM for applying to small-scale farmers have been examined, trialed, and verified. The accumulated results are contained within this guideline

The Paraguayan government has acknowledged that this guideline will be effective to those involved in supporting Paraguayan small-scale farmers. And this guideline will be that Paraguayan responses to the international promise on climate change.

It is my sincere hope that these guidelines will become widely known as a basis for the actualization of sustainable responses to climate change and aid given to small-scale farmers, and, thus, that these guidelines will contribute to efforts to address climate change and to the practical implementation of rural development in Paraguay.

Minister of Agriculture and Livestock, Paraguay
Ing. Agr. Jorge Gattini

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List of Abbreviations

Abbreviation	Formal Name	English
AF	Agroforestry	Agroforestry
AFF	Agro-Fruti-Forestal	Agro-Fruit-Forestry
AGR	Activités Générales de Revenu	Income generation activities
ANPP	Annual Net Primary Production	Annual Net Primary Production
AR	Afforestation and Reforestation	Afforestation and Reforestation
A/R CDM	Afforestation and reforestation project activities under the clean development mechanism	Afforestation and reforestation project activities under the clean development mechanism
ARP	Asociación Rural del Paraguay	Rural Association of Paraguay
BEF	Biomass Expansion Factor	Biomass Expansion Factor
CETAPAR	Centro Tecnológico Agropecuario del Paraguay	Paraguay Agricultural Technology Center
CDM	Clean Development Mechanism	Clean Development Mechanism
CEC	Cation Exchange Capacity	Cation Exchange Capacity
CER	Certified Emission Reduction	Certified Emission Reduction
CME	Coording or Managing Entity	Coording or Managing Entity
C/P	Counterpart	Counterpart
COP	Conference of the Parties (to the UNFCCC)	Conference of the Parties (to the UNFCCC)
CPA	Component Project Activity	Component Project Activity
DC	Direct Current	Direct Current
DEA	Dirección de Educación Agraria	Agriculture Education Bureau of Ministry of Agriculture and Livestock
DEAG	Dirección de Extensión Agraria	Agriculture Extension Bureau of Ministry of Agriculture and Livestock
DBH	Diameter at Breast Height	Diameter at Breast Height
Dgeec	Dirección General de Estadistica, Encuestas y Censos	General office of Statistics, Survey and Censuses
DMH	Dirección de Meteorologia e Hidrologia	Meteorology and Hydrology Bureau of Ministry of Defense
DMI	Dry Matter Intake	Dry Matter Intake
DNA	Designated national authority	Designated national authority
DGP	Dirección General de Planificación	General office of planning of Ministry of Agriculture and Livestock
DOE	Designated Operational Entity	Designated Operational Entity

Abbreviation	Formal Name	English
EPP	Ejército del Pueblo Paraguayo	Paraguayan People's Army
EUA	European Union Allowance	European Union Allowance
EXPO	Exposition	Exposition
FAO	Food and Agriculture Organization of the United Nations	Food and Agriculture Organization of the United Nations
FCA/UNA	Facultad de Ciencias Agrarias de la Universidad Nacional de Asunción	Faculty of Agricultural Sciences of National University of Asunción
FCP/UNCA	Facultad Ciencias de la Producción de la Universidad Nacional de Caaguazú	Faculty of Science Production of National University of Caaguazú
GC	Grazing Capacity	Grazing Capacity
GHG	Greenhouse Gas	Greenhouse Gas
GIS	Geographic Information System	Geographic Information System
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit	Deutsche Gesellschaft für Internationale Zusammenarbeit
GL	Ground Level	Ground Level
GPG	Good Practice Guidance	Good Practice Guidance
GPS	Global Positioning System	Global Positioning System
IGM	Instituto Geografico Militar	Military Geographical Institute
INDERT	Instituto Nacional de Desarrollo Rural de la Tierra	National Land and Rural Development Institute
INFONA	Instituto Forestal Nacional	National Forest Institute
IPCC	Intergovernmental Panel on Climate Change	Intergovernmental Panel on Climate Change
IPEF	Instituto de Pesquisas e Estudos Florestais	Instituto de Pesquisas e Estudos Florestais
IRR	Internal Rate of Return	Internal Rate of Return
JICA	Japan International Cooperation Agency	Japan International Cooperation Agency
JIRCAS	Japan International Research Center for Agricultural Sciences	Japan International Research Center for Agricultural Sciences
JOCV	Japan Overseas Cooperation Volunteer	Japan Overseas Cooperation Volunteer
JRA	Joint Research Agreement	Joint Research Agreement
lCER	long-term Certified Emission Reduction	long-term Certified Emission Reduction

Abbreviation	Formal Name	English
LULUCF	Land Use, Land Use Change and Forestry	Land Use, Land Use Change and Forestry
MAG	Ministerio de Agricultura y Ganadería	Ministry of Agriculture and Livestock
MoC	Modalities of Communication	Modalities of Communication
NAMA	Nationally Appropriate Mitigation Action	Nationally Appropriate Mitigation Action
NGO	Non-Governmental Organization	Non-Governmental Organization
ODA	Official Development Assistance	Official Development Assistance
PDD	Project Design Document	Project Design Document
PoA	Programme of Activities	Programme of Activities
PRSP	Poverty Reduction Strategy Paper	Poverty Reduction Strategy Paper
PVC	Polyvinyl chloride	Polyvinyl chloride
SEAM	Secretaría del Ambiente	Environment Agency
SD	Standard Deviation	Standard Deviation
SOP	Share of Proceeds	Share of Proceeds
SRTM	Shuttle Radar Topography Mission	Shuttle Radar Topography Mission
tCER	temporary Certified Emission Reduction	temporary Certified Emission Reduction
UNA	Universidad Nacional de Asunción	National University of Asunción
UNCA	Universidad Nacional de Caaguazú	National University of Caaguazú
UNDP	United Nations Development programme	United Nations Development programme
UNFCCC	United Nations Framework Convention on Climate Change	United Nations Framework Convention on Climate Change
URL	Uniform Resource Locator	Uniform Resource Locator
USB	Universal Serial Bus	Universal Serial Bus

Introduction

(1) Background and Objectives

The Fifth Evaluation Report issued by the United Nations' Intergovernmental Panel on Climate Change (IPCC) reconfirmed through measurements of atmospheric temperature, seawater temperature, and seawater levels that "there is no room to doubt the warming of the climate system." Moreover, it is quite possible that human activities are responsible for the changing climate. According to one scenario, an average global temperature increase of 0.3-4.8°C and a 0.26-0.82 m sea level rise are considered highly likely developments by the end of the 21st century. In order to curb climate change, it is crucial to drastically and permanently reduce greenhouse gas (GHG) emissions.

The same IPCC report notes that GHGs derived from agriculture and forestry, including the entirety of agricultural and other industries in the land use sector, account for nearly a quarter of the entire global net anthropogenic GHG emissions, with those emissions originating mainly from deforestation, soil and fertilizer management, and livestock. Thus, initiating a response to deforestation is an important step toward reducing emissions in the agricultural and forestry industries.

Approximately 400 million ha of global forests account for roughly one-third of the total land area of Earth. Yet deforestation, especially the conversion of tropical forests into farmland, can be seen around the world, with 13 million ha of forests converted to other uses annually for the last 10 years.

By region, 4 million ha in South America and 3.4 million ha in Africa have been lost from 2000 to 2010. It has been reported that Oceania is losing 700,000 ha annually. In Australia, deforestation has been progressing steadily since 2000, largely as a result of fires caused by drought.[1]

[1] FAO (2010) Global Forest Resources Assessment.

As of 2010, the forested area of Paraguay consisted of 17,582,000 ha[2] after having lost 179,000 ha annually from 1990 to 2010. The forested areas can be classified as follows: 1,850,000 ha of natural forest; 15,684,000 ha of naturally regenerated forest; and 48,000 ha of planted forest. Approximately 39% of forested land is nationally owned and 61% is privately held. According to the UN Food and Agriculture Organization Corporate Statistical Database (FAOSTAT) (as of Feb. 2015), the forested area of the country is in transition, and deforestation is progressing, as shown in Figure 1.

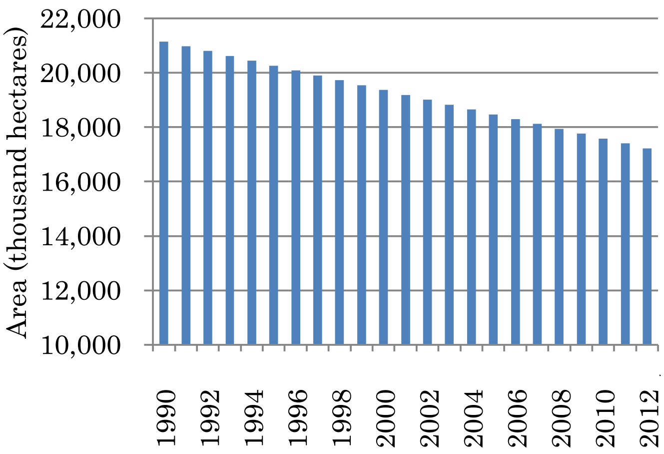

Figure 1 Changes in the Forested Area of Paraguay

Source: FAO (2015) FAOSTAT

According to Paraguay's GHG inventory, about 95% of total domestic CO_2 emissions originate from forestry industries and from changes in land use, all of which involve the transformation of forests and grasslands.[3] It is clear that CO_2 emissions will increase if this transformation of forests and grasslands continues. In response to climate change, the creation of policies addressing the transformation of forests and grasslands will have a significant impact on the reduction of CO_2 emissions. To be sure, the recovery of forest resources is an urgent issue that must be addressed by the entire country.

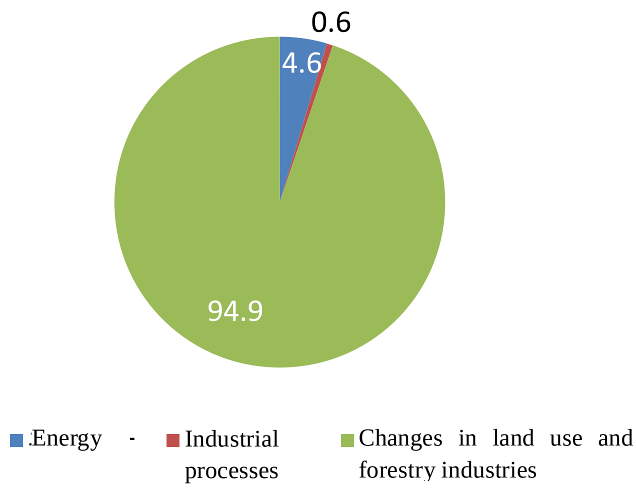

Figure 2 Breakdown of Paraguay's Total CO_2 and Greenhouse Gas Emissions

Source: Paraguay (2011) The Second National Communication on Climate Change in Paraguay

[2] FAO (2010) Global Forest Resources Assessment.
[3] Paraguay (2011) The Second National Communication on Climate Change in Paraguay.

Because forests fulfill many functions, such as global warming mitigation, biodiversity conservation, soil erosion prevention, and water resource cultivation, they are intimately connected to human life. Deforestation hastens the progress of global warming and soil erosion, and is connected to ecosystem destruction. The forest is a foundational part of life, particularly for small-scale farmers in Paraguay, as it provides a source of essential goods such as food and building materials. Farmers intend to use their limited land as effectively as possible, so when the land cannot support agriculture and livestock farming, some farmers want to utilize it as a forest because, in conjunction with the effective use of land, they hope to reap the profits of planting trees. Thus, small-scale farmers can benefit from afforestation. Moreover, such reforestation is an effective means to restore forest resources, and something that farmers are quite capable of accomplishing.

The Japan International Research Center for Agricultural Sciences (JIRCAS) initiated the "Paraguayan Low-Income Community Farmland and Grassland Replanting Project," Paraguay's first clean development mechanism (CDM) project. Citizens participating in the project planted trees on a total of 215 ha of rough, neglected farmland owned by 167 farming households. In addition to contributing to the restoration of forest resources, the project contributed to a reduction in GHGs as confirmed by measurements of the carbon sequestered as a result of the replanting.

One of the structures of the CDM utilized is a program of activities that provides broad support to promote policies for reducing GHG emissions. The CDM program can be described as an arrangement of CDM projects that can be effectively implemented across a wide region.

Therefore, the project described in these guidelines culminated in the creation of an afforestation/reforestation CDM program, based on citizen approval and with their participation, with the goal of a quick restoration of forest resources and income gains for the participating small-scale farmers in a broad region.

(2) Summary of Activities

The Japanese Ministry of Agriculture, Forestry, and Fisheries' investigation into subsidiary aid, the "Survey and Examination of Forms of Regional Resource Use and Application in Rural Agricultural Development" (hereinafter the "principal survey"), describes the project's attempt to realize the goals outlined above by promoting afforestation activities through a process of accounting for citizens' needs and citizen-based consensus building, as well as the verification of methods for calculating the amount of GHGs captured by the replanting, and an evaluation of economic impacts on farmers.

(3) Structure and Content of Guidelines

In addition to demonstrating how to create a CDM program in the area of afforestation, these guidelines also describe how afforestation CDM projects can become tools for rural development. The composition of contents is as follows:

Chapter 1	Overview of the Afforestation CDM Program
Chapter 2	Attempts to Establish Afforestation CDM Program in Paraguay
Chapter 3	Methods for Calculating Anthropogenic GHG Removals – Case Study of CPA Coronel Oviedo
Chapter 4	Profitability Analysis of Forest Management by Farmers
Reference Material	On the Eucalyptus Plantation
	Impact Assessment on the Soil Environment

Chapter 1 presents a general overview of the Programme CDM, including the structure, components, course of events leading to the formation, organization necessary to the formation, and so on.

Chapter 2 describes specific examples of actual efforts at program formation in Paraguay. It records how the reforestation CDM project was formed, drawing from the Paraguayan project to describe target site selection, required system maintenance, actual implementation of reforestation projects, and other processes.

Chapter 3 explicates the specific methods for calculating the GHG removals achieved by the reforestation Programme CDM, the formulae and data necessary for calculation, as well as methods of collection, monitoring, and verification of removals.

Chapter 4 evaluates the economic impacts of reforestation on farmers, as the reforestation Programme CDM conducted by JIRCAS was intended to promote the effective utilization of agricultural land by small-scale farmers and to support improvements to their livelihood. It suggests that tree plantations can be a tool in rural development.

The appendices contain the results of tests performed to determine the project's effect on the water and nutrient content of the soil and groundwater of the afforested land.

(4) Use of Guidelines

These guidelines can be used when creating and implementing a project designed to reduce GHGs through domestic reforestation or in the formation of individual projects after the creation of reforestation programme CDM. Because these guidelines make possible the calculation of GHG reduction amounts achieved by the implementation of reforestation in a wide area, we expect the guidelines to be utilized in the formulation of national plans to reduce GHG emissions and in Nationally Appropriate Mitigation Action (NAMA).

These guidelines are primarily intended for government employees of Paraguay (both central and regional government institutions), relevant donors, international and domestic NGOs, universities, those who plan and implement projects in the private sector, and especially anyone responsible for planning projects that promote the reduction of GHG emissions through reforestation.

Chapter 1　Overview of the Reforestation Programme CDM

1.1 Programme CDM Overview

A programme CDM is a type of clean development mechanism (CDM). These guidelines provide an overview of CDMs and present a detailed description of a programme CDM.

1.1.1 Overview of the CDM

An international treaty intended to reduce greenhouse gas (GHG) emissions, the United Nations Framework Convention on Climate Change, which came into effect in 1994, was designed to coordinate various countries' global warming policies. The Kyoto Protocol, a concrete policy action addressing global warming, was adopted at the third Conference of the Parties (COP3), held in December 1997. According to the Protocol, joint implementation and CDM emissions trading were adopted as mechanisms to achieve the legal obligation of GHG emissions reduction targets for Annex I Parties, a group composed of developed countries, including Japan. The CDM works as follows: Annex I Parties have fixed total GHG emission allowances, while developing countries do not have target values; therefore, emissions reduction (or increased removal) projects can be implemented in developing countries, and emissions reductions (or increased removals) thus created can be deemed a certified emission reduction credit (CER) that can be divided among project participants. Developed countries can enter into this emissions reduction credit market to achieve the reduction targets declared in the Kyoto Protocol (Figure 1.1.1).

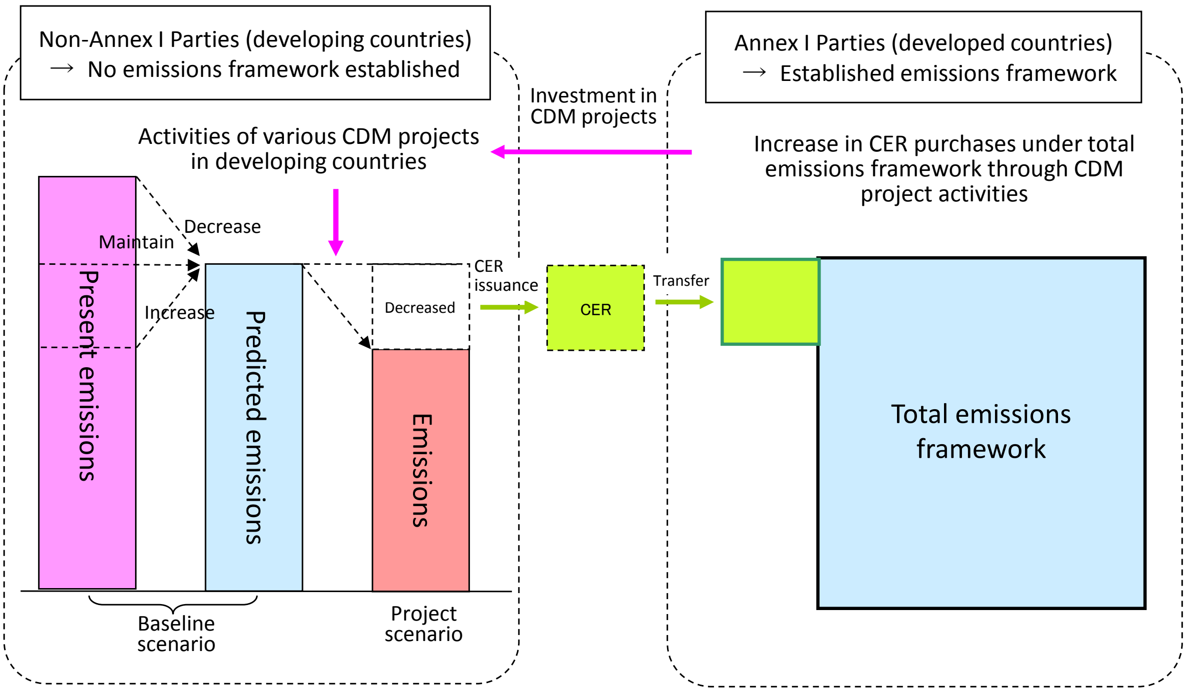

Figure 1.1.1 CDM Structure

Because the CDM is based on private investment, there is a strong tendency for the projects implemented to be specific to a given market sector and region and to be managed like businesses. In particular, the vast majority of credits that can be effectively guaranteed come from projects that reduce GHG emissions in equipment and machinery plants.

On the other hand, despite the fact that there is a great need for them in developing countries, few projects address rural development. It is believed that CDM projects can be effectively incorporated and successfully implemented into rural development efforts in developing countries. Nevertheless, the methodologies and practical techniques necessary to ensure success remain unclear, and investor interest in this sector remains low.

1.1.2 Overview of the Programme CDM

The programme CDM was systematized in 2005 to aid in the promotion of political measures to reduce GHG emissions across a wide area throughout developing countries. Figure 1.1.2 depicts how the programme CDM differs from a standard CDM. A programme CDM begins with the formation of a programme of activities (PoA) to reduce GHGs at the national and/or regional level. An unlimited number of individual CDM projects using identical techniques and methods can be added to the PoA as components of the project activity (CPA), thereby making possible the implementation of many small-scale, low-cost CDM projects to reduce emissions.[4,5] Moreover, the legal procedures have also been simplified in order to facilitate registering for commercialization, allowing further possibilities for the effective implementation of CDM projects across a wide area.

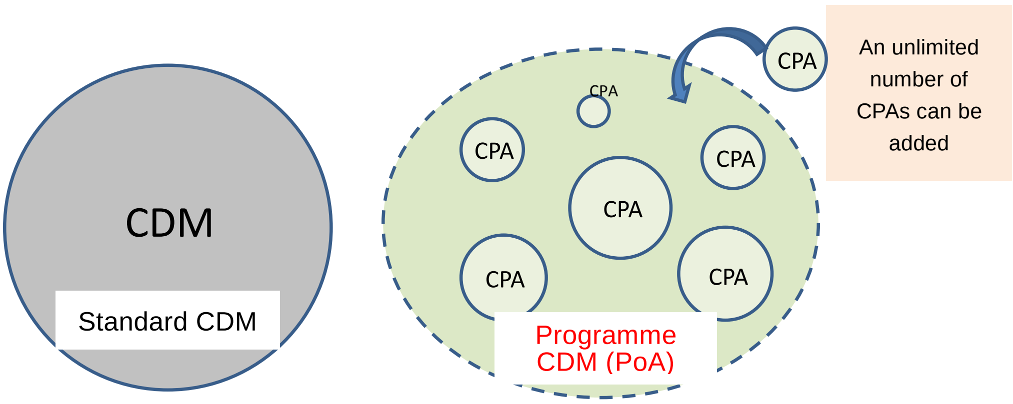

Figure 1.1.2 Differences between a Standard CDM and a Programme CDM

However, while the United Nations CDM Executive Board has registered 287 PoAs as of

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[4]The PoA is a general comprehensive plan (programme) concerned with a sphere of certain activities pertaining to the reduction of GHG emissions and/or an increase in removal. The PoA was registered by the United Nations CDM Board of Directors, making possible the formation and implementation of an unlimited number of individual CDM projects within its framework at the national and/or regional level.

[5]CPAs are individual CDM projects formed under a PoA.

September 15, 2015, there is not a single example in the afforestation and reforestation sector (Figure 1.1.3).

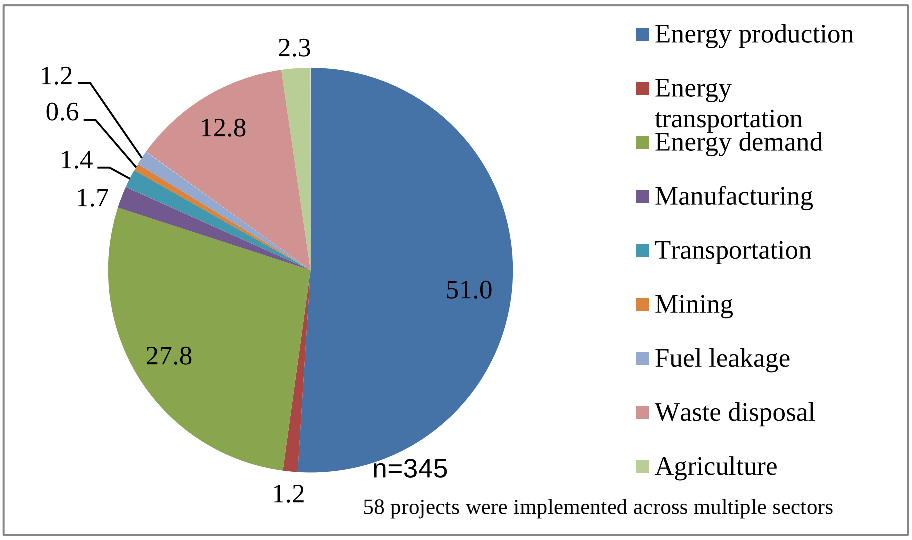

Figure 1.1.3 PoAs Classified by Sector

A programme CDM is made up of the PoA, which covers the entire target region, and the CPAs to be implemented therein; the relationship between the PoA and CPA is equivalent to that between a master plan and individual projects.

Moreover, just as CDM projects are formed on the basis of a project design document (PDD), the formation of a PoA requires the creation of a PoA project design document (PoA-DD), which generally includes the CPA project design document (CPA-DD).

1.2 Programme CDM Flowchart

Figure 1.2.1 depicts the general course of events in implementing a programme CDM. The course of events in the formation of CDM projects is similar to the process of CER issuance and distribution.

Figure 1.2.1 Flowchart of a Programme CDM

Table 1.2.1 outlines important considerations and the implementation details that are described above.

Table 1.2.1 Details of Programme CDM Implementation

	Item	Implementation details	Key points regarding implementation
①	Programme CDM planning	Project participants develop the plan for the programme CDM	➢ The various conditions and important issues in the CDM are considered from the planning stage of the project onward
②	Project design document (including creation of the PoA project design document and CPA project design document)	Project participants create the PoA and CPA project design documents (PoA-DD and CPA-DD)	➢ The PDD explains important technical and structural information about the project, which becomes the foundation for validating, judging, registering, and verifying the project In addition to project details, the PDD includes approved baseline methodologies and monitoring methodologies appropriate to the project
③	Approval depends on the host nation and relevant signatory nations	Project participants receive written approval for their proposed CDM project from the designated national authority (DNA) of the relevant signatory nations including the host country	➢ Approval from the DNA of the signatory nations depends on documentation from the relevant institutions indicating their approval of the CDM project or PoA and their voluntary participation ➢ During registration, a CDM project does not require the participation of Annex I countries ➢ The approval process varies by country → The approval process for Japan as an investor country has been established
		The written consent of the signatory nations can be obtained at either stage (1) or (2), or after stage (4)	➢ However, at minimum, the approval of the host country is required prior to the application for enrollment
④	Project validation review	The validation review is conducted by examining the project participants' PDD to judge whether it qualifies as a CDM, to evaluate whether the calculations of emissions reductions are correct, and so on	➢ The validation review is performed by the Designated Operational Entity (DOE) ➢ Those procedures are used in the validation review
⑤	Project registration	Projects that have passed the validation review can apply to register	➢ Registration is performed by the CDM Board of Directors ➢ Multi-step registration ➢ Project participants pay registration fees
		In cases where the contents of the PDD are modified	

		after the CDM project has been registered, the approval of the project participants must be obtained	
⑥	Monitoring	Project participants are required to conduct monitoring to determine the amount of GHG emissions offset by the CDM project	➢ Monitoring is conducted according to the plan described in the PDD ➢ Data is collected and recorded in order to hypothesize, calculate, and measure the amount of baseline GHG emissions reductions and as the project proceeds
		If there are changes in the monitoring plan, project participants can seek approval for the changes	
⑦	CER validation and approval	Validation is performed through periodic, independent reviews of project monitoring results; afterwards, registered CDM projects are certified according to the volume of reduced emissions	➢ Validation is conducted by the DOE ➢ Multi-step validation process
		Based on the results of the validation process, approval is granted by the DOE through written documentation certifying the emissions reductions	➢ Multi-step approval process
⑧	CER issuance	CERs corresponding to the amount of emissions reductions as approved by the DOE are issued by the CDM Board of Directors	➢ CER issuance (and distribution) takes place after the fees for application to the CDM system have been paid ➢ Multi-step issuance process
		A portion of issued CERs (2%) is levied and allotted to an Adaptation Fund to assist vulnerable developing countries cope with climate change	
⑨	CER distribution	CERs are distributed among project participants	➢ CERs are transferred to the registered accounts of signatory nations and project participants in accordance with the latter’s application

1.3 The coordinating and managing entity (CME)

1.3.1 The Necessity of the CME

In the CDM programme guidelines that follow, the coordinating and managing entity (CME) is described as working within the PoA to implement the CDM programme.

> *A.2 Purpose and General Description of the PoA*
> *Include a description of the:*
> *(a) Policy/measure or stated goal that the PoA seeks to promote;*
> *(b) Framework for the implementation of the proposed PoA. (Include a confirmation that the PoA is a voluntary action by the CME.)*
> *- Guideline for completing the programme design document form for small-scale afforestation and reforestation CDM programmes of activities, v.3.0 p.7*

1.3.2 The role of the CME

A CME is defined in the United Nations CDM Board of Directors' glossary of terms as follows:

> *An entity authorized by all participating host country DNAs involved in a particular PoA and nominated in the MoC [Modalities of Communication] statement as the entity that communicates with the Board and the secretariat, including on matters relating to the distribution of CERs, tCERs or ICERs, as applicable.*
> *- Glossary of CDM terms v.8.0 p.9*

1.3.3 CME Review

The PoA contains a wealth of policy components. Therefore, the CME is considered the appropriate institution for handling the policy measures. In Paraguay, policy regarding the agricultural and livestock industries and rural development is planned, scheduled, and executed by the Minister of Agriculture and Livestock (MAG).

Additional other main activities in reforestation CDM programmes include coordinating with the farmers participating in the project, producing and distributing seedlings, instructing farmers in reforestation techniques, monitoring trees, surveying biomass quantity, and performing various investigative research. Therefore, the various activities should be allocated to the appropriate institutions, as shown in the Table 1.3.1 below.

Table 1.3.1 Main Activities in the Formation of Reforestation CDM Programmes and Related Institutions

Principle activities	Classification of institutions
Manage farmers, coordinate entire project	Agencies responsible for agriculture, forestry, and fisheries
Instruct farmers on reforestation techniques; monitor trees Produce and distribute seedlings	Institutions responsible for forestry management
Survey biomass quantity and conduct various investigative research	Universities and research institutes

While the institutions listed above can all serve as the CME, in cases where the CME is composed of several institutions, it is essential to select one institution to fulfill the central role.

1.4 Adopting a Participatory Approach

The Japan International Research Center for Agricultural Sciences (JIRCAS) has promoted the formation of CDMs with the aim of improving farmers' income and standard of living through rural development while encouraging the effective utilization of regional resources. In rural development, sustainability and the development of independence are of utmost importance. In order to safeguard these values, it is necessary to encourage citizen participation. Rural development differs from top-down development models that do not reflect the will of the people. Rather, rural development should be based on the needs of residents, and enacted with their participation. Therefore, we believe reforestation CDM projects cannot be planned and implemented solely for the purpose of obtaining carbon credits; reforestation must be a link to rural development, and rural development must be pursued in ways that raise farmers' income and contribute directly to improving their lives. One benefit of participatory rural development is that beneficiary farmers voluntarily plant trees. This fosters ownership, reduces the risk of subsequent abandonment, and barring any meteorological disasters or damage from diseases, insects, and fires, ensures the sustainability of reforestation.

1.5 Contents and Organization of the Project Design Document

The PDD must be formulated in accordance with the latest format specified by the CDM Board of Directors for small reforestation CDM programmes, the *Programme design document form for small-scale afforestation and reforestation CDM programmes of activities* (v.4.0) and *Component project activity design document form for small-scale afforestation and reforestation CDM component project activities* (v.4.0).

The PoA-DD is divided into two parts: the PoA and the generic CPA. The PoA is divided into sections A through H, while the CPA is split into sections A and B. The main contents required for each item are listed in Table 1.5.1.

The CPA-DD is divided into sections from A to F, and the main contents required are listed in Table 1.5.2.

Table 1.5.1 Organization of the PoA-DD

Part I. PoA	
A. General description of the PoA	The title of the PoA, its objective, project participants, location of target areas, boundaries, applied technology, status of public funding, etc.
B. Demonstration of additionality and development of eligibility criteria	Demonstration of additionality for PoA, eligibility criteria for inclusion of a CPA in the PoA, application of methodologies, etc.
C. Management system	Management system in accordance with application requirements
D. Duration of the PoA	PoA start date, duration
E. Environmental impacts	Results and evaluation of environmental impact analysis (if required)
F. Socioeconomic impacts	Results and evaluation of socioeconomic impact analysis (if required)
G. Local stakeholder consultation	Summaries of comments from local stakeholders, report on consideration of comments received
H. Approval and authorization	Information on the approval letter
Part II. Generic CPA	
A. General description of a generic CPA	Purpose of generic CPA, approach for confirming that the proposed small-scale CPA is implemented by low-income communities or individuals
B. Application of a baseline and monitoring technology	Methodologies applied, specification of GHGs, specification of carbon pools, classification of strata, method for the calculation of the baseline, estimation of GHG removals by a generic CPA, monitoring plan
Appendix attached	

Table 1.5.2 Organization of the CPA-DD

A. General description of the CPA	CPA title, objective, institution responsible for management, environmental conditions (climate, water, soil, ecosystem), techniques applied, project participants, location of reforested region, CPA

	duration, credit duration, estimate of GHG removals, condition of land ownership and selection of short-term CER (tCER) or long-term CER (ICER), eligibility of the land, availability of public funding, etc.
B. Environmental analysis	Results and evaluation of environmental impact analysis (if required)
C. Socioeconomic impacts	Results and evaluation of socioeconomic impact analysis (if required)
D. Comments from local stakeholders	Summaries of comments from local stakeholders, report on consideration of comments received
E. Eligibility of CPA and estimation of emissions reductions	Applicability of methodologies, specification of carbon pools, identification of strata, baseline calculation method, estimation of GHG removals, monitoring plan
F. Approval and authorization	Information on the approval letter
Appendix attached	

A small-scale reforestation PoA-DD proposal is included in Appendix 1, and a small-scale reforestation CPA-DD proposal is included in Appendix 2.

Chapter 2 Development of a Reforestation Programme CDM in Paraguay

2.1 Introduction

As deforestation continues in Paraguay, the restoration of forest resources has become a major challenge. Through the implementation of a reforestation clean development mechanism (CDM) project in Paraguay, the Japan International Research Center for Agricultural Sciences (JIRCAS) confirmed that tree-planting by small-scale farmers can promote reforestation and the recovery of forest resources. Going a step further, JIRCAS introduced additional reforestation CDM projects that aim to promote reforestation and forest resource recovery by small-scale farmers in other regions of Paraguay. A program CDM was selected for implementation, as it is believed to be a form of CDM that can be executed effectively across a wider area, and an afforestation CDM program was conducted.

As described in Chapter 1, the formation of a reforestation CDM project requires the creation of a PoA-DD and a CPA-DD. An estimate of greenhouse gas (GHG) removals obtained by tree planting in a variety of registered locations is also required. This chapter describes the planting activities and the specific implementation methods used in the CDM project, while Chapter 3 explains the techniques employed in calculating GHG removals, as illustrated in the flowchart in Figure 2.1.1.

In addition, a case study highlights the implementation methods that were used.

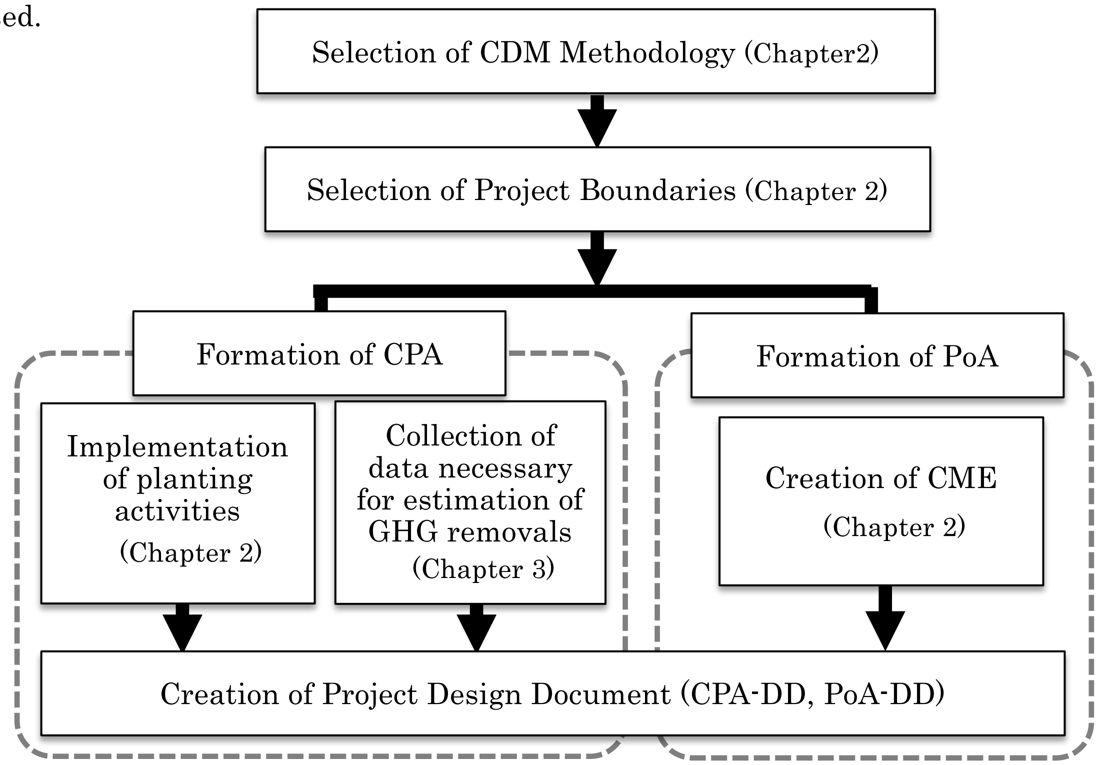

Figure 2.1.1 Flowchart of Reforestation CDM Program Formation

2.2 Type and Methodology of the CDM Used

The reforestation CDM project implemented by JIRCAS in Paraguay was a small-scale afforestation and reforestation clean development mechanism (A/RCDM). In general, CDMs are either small- or medium-scale. In order to be defined as a small-scale A/RCDM, a project must meet the conditions outlined in Table 2.2.1.

Table 2.2.1 Small-scale A/RCDM Conditions

① Project removals are less than 16,000t CO_2 annually. ② Development and/or implementation will take place within a "low-income community," as defined by the host country.

Small-scale A/RCDMs offer the advantage of simplified steps, as described in Table 2.2.2.

Table 2.2.2 Simplified Rules and Procedures for a Small-scale A/RCDM

① In comparison to the normal-scale CDM, the number of items included in the PDD is much smaller. ② To reduce baseline development costs, a simplified baseline can be applied to each type. ③ In order to reduce monitoring costs, in addition to simplified monitoring requirements, simplified monitoring plans are applicable. ④ It is possible to have the same DOE perform the validation review, verification, and certification.

In addition, the formation of a CDM project requires investigation using an appropriate methodology approved by the United Nations CDM Board of Directors. Approved methodologies for small-scale A/RCDMs can be viewed on the United Nations Framework Convention on Climate Change (UNFCCC) website at the following URL:

http://CDM.UNFCCC.int/methodologies/SSCAR/approved

As of September 2015, two methodologies have been approved, as described in Table 2.2.3.

Table 2.2,3 Approved Methodologies for Small-scale A/RCDM

①*AR-AMS0003: Afforestation and reforestation project activities implemented on wetlands, v.3.0* ②*AR-AMS0007: Afforestation and reforestation project activities implemented on lands other than wetlands, v.3.1*

2.3 Selection of Project Boundaries

The region in which the CDM program will be implemented is set as the project boundary. As described in Chapter 1, the CDM program consists of the PoA and CPA. The method for selecting target regions for the PoA and CPA are described in this section.

2.3.1 PoA Target Region

The PoA target region is required to satisfy the conditions described in Table 2.3.1 if the main project objective is the promotion of reforestation by smallholders.

Table 2.3.1 PoA Target Region Selection Criteria

① There is soil degradation.
②The area was no longer forest after January 1, 1990.
③ It is a low-income area.

The Alto Parana and Itapúa provinces along the Parana River were determined to be the areas with the most severe soil degradation due to water erosion, as shown in Figure 2.3.1. These two provinces are located in the fertile hill country of terra rossa soil, which is red soil from weathered basaltic rock. The provinces were once forested, but rapid agricultural development since the 1980's has caused soil erosion. However, these are currently the main agricultural regions in the country, and in comparison with other regions in Paraguay, the population is larger and the incomes higher. Therefore, the provinces of Itapúa and Alto Parana were removed from consideration as target regions.

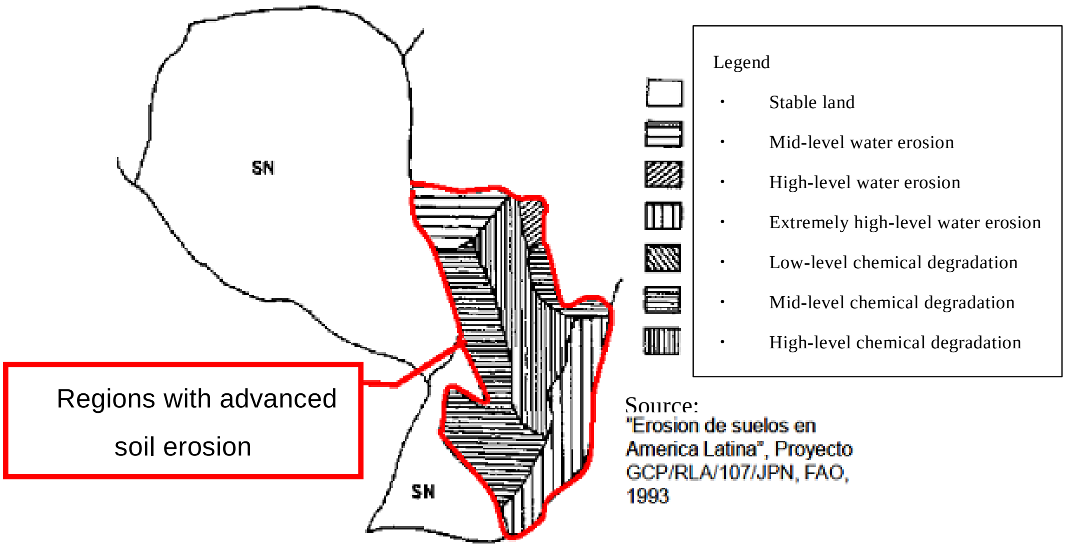

Figure 2.3.1 Soil Erosion Conditions in Paraguay

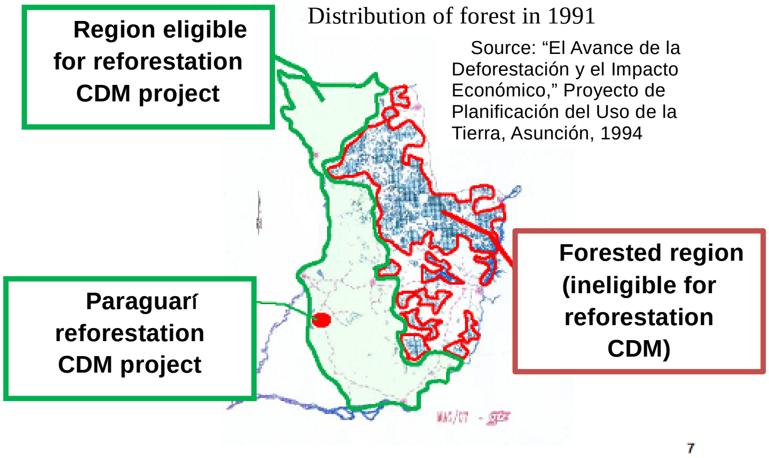

Figure 2.3.2 Distribution of Forests in the Eastern Region of Paraguay as of 1991 and Possible Regions for a Reforestation CDM

As a result of land requirements established by the 1990 Kyoto Protocol emissions reductions standards, candidate plots cannot have been forested after January 1, 1990. Figure 2.3.2 depicts the conditions of Paraguay's forests as of 1991, with forested areas represented in dark blue. The entirety of unforested land in 1991 (i.e., land that was not forested after January 1, 1990) can be seen in the north and central sections of the eastern region of the country.

Case study of the present survey

Figure 2.3.3 PoA Target Regions

For this study, the six regions that satisfied the conditions outlined in Table 2.3.1 were, from north to south, the departments of Concepcion, San Pedro, Caaguazú, Guairá, Paraguarí, and Caazapá. However, the department of Concepcion is the main location of activities of the Ejército del Pueblo Paraguayo (Paraguayan People's Army), an armed military group, and thus the region was removed from consideration due to safety concerns.

As a result, five departments were selected as target regions: San Pedro, Caaguazú, Guairá, Paraguarí, and Caazapá, as shown in Figure 2.3.3.

2.3.2 CPA Target Areas

The first CPA, which was formed at the same time as the PoA, will be the first model case for the PoA target regions. Thus, easy access and a large, visible outcome were important criteria in the selection of the CPA target areas.

Case study of the present survey

In this study, a geographical consideration centered on the five departments in the PoA target area led to the selection of Coronel Oviedo as the CPA target region. As the capital of the Caaguazú Department, this city is an important hub for regional traffic, which increases the chances of generating a strong, positive public image of the project. The CPA implemented in the city of Coronel Oviedo as part of this study is hereinafter referred to as "CPA Coronel Oviedo."

Upon selecting the target region of CPA Coronel Oviedo, the main goals of the project had to be explained to the Ministry of Agriculture and Livestock (MAG) agricultural extension office, the Coronel Oviedo office of the Agriculture Extension Bureau (DEAG).

2.4 Formation of the PoA

As shown in Figure 2.1.1, the next step in the process is the formation of the PoA and CPA. The formation of the PoA and CPA requires the creation of a PoA-DD and CPA-DD.

Because the PoA will be managed by the coordinating and managing entity (CME), it is necessary to include a description of the CME system in the PoA-DD. Therefore, when constructing a PoA, the CME must be formed before creating a PoA-DD.

2.4.1 Formation of the CME

An examination of institutions capable of serving as the CME was conducted in accordance with section 1.3.3 of these guidelines. Furthermore, roles were allocated to multiple institutions as needed.

CPA Coronel Oviedo Case Study

In Paraguay, the MAG is the institution responsible for agricultural and rural development policy-making, planning, and implementation. Additional project activities include coordinating the farmers participating in the project, producing and distributing seedlings, instructing farmers in reforestation techniques, monitoring trees, surveying biomass quantity, and conducting various types of investigative research. Therefore, the CME includes several institutions in addition to the MAG. The distribution of activities and relevant institutions is displayed in Table 2.4.1.

Table 2.4.1 Principle Activities and Relevant Institutions in the Formation of a Reforestation Programme CDM

Principle activities	Name of institution
Coordination with farmers System-level project management	MAG
Instruction to farmers in reforestation techniques Tree monitoring Seedling production and distribution	National Forest Institute (INFONA)
Biomass quantity surveys Various types of investigative research	Universities, etc.

Table 2.4.2 shows how the various activities were assigned in CPA Coronel Oviedo. The various roles were assigned according to function; the DEAG oversaw activities that required a close relationship with the farmers, INFONA handled the practical activities of reforestation, and the various research activities were taken on by universities. In order to ensure appropriate implementation, these roles were allocated to institutions normally engaged in similar activities.

Table 2.4.2 Institutional Activity Assignments in CPA Coronel Oviedo

Name of institution	Principle activities
MAG Coronel Oviedo DEAG Office	Coordinating with farmers; producing and distributing seedlings
INFONA Coronel Oviedo Office	Instructing farmers in reforestation techniques; monitoring trees
A Faculty of Science Production of National University of Caaguazú (FCP/UNCA)	Surveying biomass quantity and conducting various types of investigative research

As described in section 2.3.1, the PoA is focused on the departments of Caaguazú, San Pedro, Caazapá, Guairá, and Paraguarí. However, the structure of the CPA was expected to differ depending on whether it was implemented in the departments of San Pedro and Caazapá or in Guairá and Paraguarí. In other words, while administrative institutions like the DEAG and INFONA have branch offices in each department, but universities have not necessarily branch in each department. For example, there are branches of the Faculty of Agricultural Sciences of National University of Asunción (FCA/UNA) in the departments of San Pedro and Caazapá, but not in Guairá and Paraguarí. Therefore, a plan was crafted to have the agricultural school under the jurisdiction of the Agriculture Education Bureau (DEA) of MAG, assume system roles. Both DEAG and INFONA have branch offices in the various departments. Figure 2.4.1 shows the plan of organization for each department.

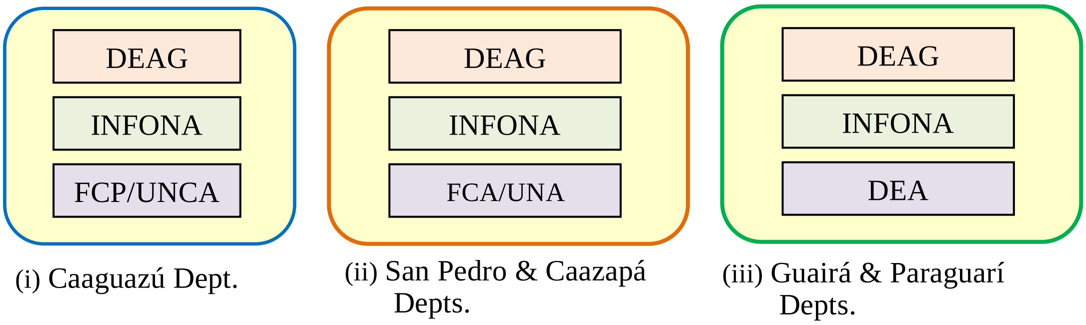

Figure 2.4.1 Planned Organizational Structure for CPA Creation in Each Department

Within the Secretariat of the Agriculture Minister at MAG is the general office of planning (DGP), which oversees planning, regulation, and evaluation. As noted in Figure 2.4.1, the institutions involved in the PoA and CPA implementation system include the DEAG and DEA, internal to MAG, as well as INFONA, an institution independent from yet related to MAG. Thus the DGP was established as the main coordinating and managing role within the CME.

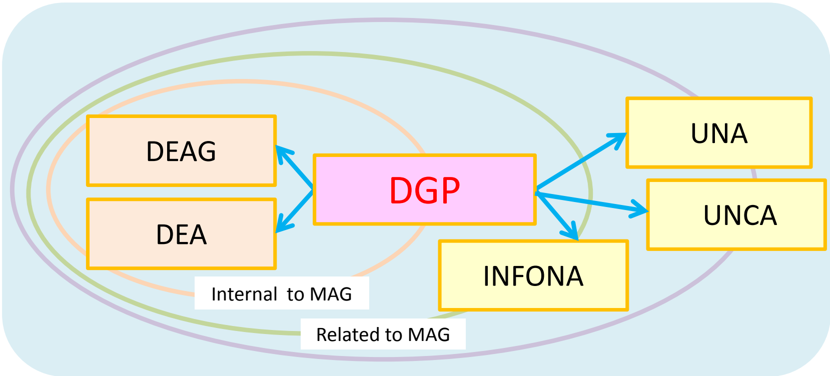

Figure 2.4.2　Relationships of Institutions Involved with the CME

The relevant agencies and institutions, MAG, INFONA, FCA/UNA, and FCP/UNCA, were combined into one CME system to make possible the management of the PoA.

In constructing the CME, it was necessary for the heads of the various institutions to comprehend the necessity and role of the CME. The organizational set up of the CME was explained to those in charge of the participating institutions, as follows:

(1) Director of the MAG DGP
(2) Dean of FCA/UNA
(3) Director of INFONA Forestry Education & Promotion
(4) Dean of FCP/UNCA

2.5 Formation of the CPA

This section mainly describes the reforestation activities involved in the formation of the CPA. The flow of reforestation activities is shown in Figure 2.5.1.

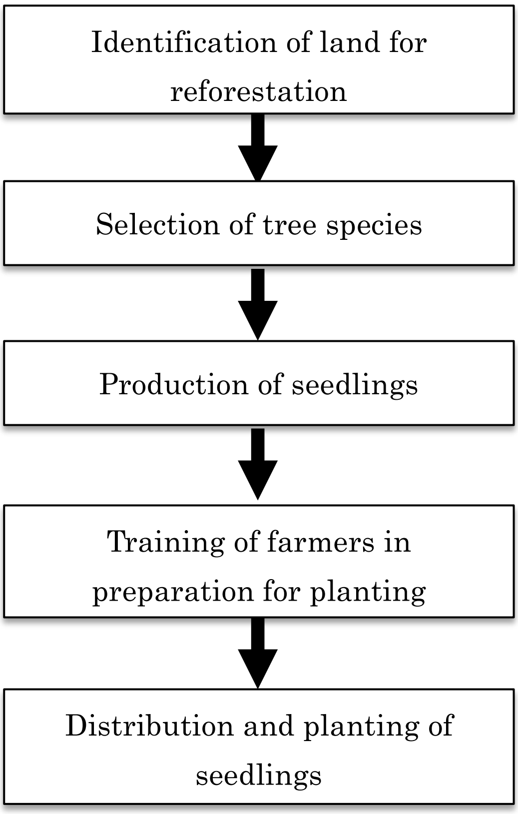

Figure 2.5.1 Flowchart of Reforestation Activities

2.5.1 Specification of Reforestation Land

(1) Selection of candidate communities

Plantation specifications are required for the formation of reforestation CDM. Because the project is designed to turn the land of farmers who desire reforestation into plantations, it is necessary to gain a better understanding of these farmers. Thus, lists of villages capable of carrying out the tree-planting were requested from the government institutions with direct connections to farmers (e.g., DEAG regional offices), and selecting a community from that list to engage in reforestation activities was deemed a suitable selection method.

CPA Coronel Oviedo Case Study

In this case, as DEAG regional office is the Coronel Oviedo DEAG office, and a list of villages requesting plantations was requested to the DEAG. The list received from the DEAG is shown in Table 2.5.1. The following overview was obtained from on-site visits to a number of the 14 villages and 16 committees listed. It should be noted that "committees" are collective citizen organizations below the level of a village.

Table 2.5.1 DEAG Reforestation Candidate List

Village	Committee	Desire for reforestation area	Remarks
Zarocaro	Batatero	15 houses, 7.5 ha	Many of the small-scale farmers want plantations
Aguapety	San Rafael	5 houses, 5 ha	Primarily dry field farming on hills Mostly small-scale farmers Experience with multiple rural development programs
Aguapety	Nueva Esperenza	5 houses, 5 ha	
Aguapety	25 de Abril	6 houses, 6 ha	
Blás Garay	Arroyo Moroti	5 houses, 5 ha	(unconfirmed)
Calle Guazu	Tiempo Pyahu	5 houses, 5 ha	2 m × 2 m wild animal compound implemented (in forest meadow)
Espinillo	Espinillo	7 houses, 5 ha	(unconfirmed)
Moreira	Moreira	5 houses, 5 ha	(unconfirmed)
Aguapey	Aguapey	10 houses, 5 ha	(unconfirmed)
Chircaty	San Blas	7 houses, 7 ha	A large pastoral area
Bordenabe	Bordenabe	10 houses, 5 ha	Small-scale farmers
Tacuruty	San Antonio	10 houses, 10 ha	Small-scale farmers
Ñurugua	Ñurugua	5 houses, 3 ha	A large pastoral area
Nueva Londres	Calle Mbyky y otros	10 houses, 10 ha	(unconfirmed)
Sta. Librada	Sta. Librada	10 houses, 10 ha	(unconfirmed)
San Antonio	San Antonio	5 houses, 5 ha	(unconfirmed)

(2) Selection of the target villages

Based on the list of villages that requested plantations, the steps given in Table 2.5.2 were used to identify farmers that want plantations and to schedule the reforestation of the land.

Table 2.5.2 Steps for Identifying Reforestation Land

① 1st Community Meeting: explain the purpose and outline of the project
② 2nd Community Meeting: identify those who want plantations by administering a survey on reforestation
③ Confirm present conditions and take GPS measurements of land scheduled for reforestation with the farmers who would like to plant

CPA Coronel Oviedo Case Study

① 1st Community Meeting

At this town hall-style meeting, we first explained the project research objectives, provided a summary, and detailed important points regarding project activities (Photo 2.5.1). Important points on the portion conducted by the project side and the portion conducted by the farmer side were explained as follows:

Photo 2.5.1 Town Hall Meeting in the Village

- The project side will provide seedlings for reforestation as well as technical assistance
- Farmers will conduct the actual management of the plantations
- The trees will remain the property of the farmers, and the carbon credits will be provided free of charge for the project side.

We also explained that project operators will handle the complex process of applying for carbon credits based on the amount of CO_2 absorbed by the trees.

This informational meeting was conducted in 22 villages (with more than 300 participants).

② 2nd Community Meeting (questionnaire survey)

Photo 2.5.2 Questionnaire Survey in the Village

After the first community meetings, we conducted surveys to determine which villages would like to participate in CPA Coronel Oviedo (Photo 2.5.2).

Most survey questions were about reforestation, including area of land owned, area of land to be reforested, land use (arable or pasture), whether the land was once forested, desired species of tree, and desired spacing between plantation trees.

Some villages where we held the community meetings opted out of the questionnaire survey because these areas were already experiencing a shortage of land (approximately 0.5 ha per person) and most of the farmers in these villages could not maintain plantations.

According to the survey results, many farmers wanted to turn underutilized land into plantations. We ensured that planting would occur on land in accordance with the conditions of the reforestation CDM because we were able to determine if land was forested after 1990 by juxtaposing the GPS coordinates of the locations scheduled for reforestation with satellite image data of the entire region.

③ GPS Measurements of Planned Reforestation Land

In villages that completed the questionnaire, we took GPS measurements (coordinates and area) of the planned reforestation land and checked the conditions of the sites.

The two essential conditions for the reforestation CDM and reforestation are that each parcel of the target area be larger than 0.5 ha in area, and that the land was not forested at any time after 1990. The sites with GPS measurements that failed to satisfy these criteria were removed from consideration.

Because many farmers who had not taken the survey still declared a desire to participate, we visited each farmer's home while GPS measurements were underway, explained the outline of the project, conducted the survey, and took GPS measurements of the land (Photo 2.5.3). GPS measurements were taken in the presence of farmers who had finished the questionnaire (Photo 2.5.4). Although some farmers had undertaken preparations for plantations by spreading soil conditioner and installing a fence (Photo 2.5.5), there was also land that was removed from consideration because the forest was already recovering after deforestation in 1989 (Photo 2.5.6).

Photo 2.5.3 Providing Information to Farmers Who Did Not Take the Survey

Photo 2.5.4 Taking GPS Coordinates Alongside Farmers

Photo 2.5.5 Land Prepared for Reforestation

Photo 2.5.6 Section of Land That Has Returned to Forest

2.5.2 Selection of Tree Species

When considering CO_2 absorption, a tree species capable of generating a large amount of biomass in a short amount of time is necessary. Also desirable is a species of tree that can be grown and managed by farmers, that is suitable to the locale, and that will be profitable for the farmers.

CPA Coronel Oviedo Case Study

Tree species for CPA Coronel Oviedo were selected in reference to the reforestation CDM project in Paraguarí. Two species of eucalyptus (*Eucalyptus grandis* and *Eucalyptus camaldulensis*) were chosen for the Paraguarí reforestation CDM project.

Eucalyptus, which grows quickly and can be harvested within 12 years of planting, is economically advantageous to the small-scale farmers who must be guaranteed an income as fast as possible. Furthermore, eucalyptus groves are easy to manage, are unsusceptible to major diseases, and have flowers that are suitable for beekeeping. These are the considerations that went into the selection of eucalyptus for the project. Of possible varieties, the species *E. grandis* was suggested for its large size, moderate strength, and durability. In addition, *E. camaldulensis* was recommended for its suitability to wetlands and low areas susceptible to flooding. Both trees are suited to the locale of the Paraguarí reforestation CDM project, and were readily planted by the farmers.

Therefore, these two species of eucalyptus were selected as the target species for CPA Coronel Oviedo.

However, a hybrid of *E. grandis* x *E. camaldulensis* that contains the best traits of both species was selected as an alternate.

2.5.3 Seedling Production

Efficient methods are essential to produce a large amount of plants in a short period of time.

CPA Coronel Oviedo Case Study

Seedling production at CPA Coronel Oviedo was conducted according to the following methods:

(1) Plastic tubes full of planting soil were lined up in the seedling crates.

(2) Using a planting tool, one seed of each species was planted in the tube (Photo 2.5.7).

(3) Germination began after 1-2 weeks (Photo 2.5.8). Approximately one month after germination, the seeds were transferred to Nursery #1 and watered by a micro-sprinkler (Photo 2.5.9).

(4) Next, the seedling crates were transferred to Nursery #2 and raised for another month (in case of cold weather, the seedlings could spend several months inside the nursery).

(5) By the time the seedlings were distributed to the farmers, they had been acclimatized to outdoor air for at least one month (Photo 2.5.10). At that point the tubes were removed from the crates and lined up in wire mesh. A spacing interval between each seedling was used to promote growth. The seedlings were watered with a sprinkler.

(6) The seedlings were packaged with specialized vinyl and distributed to farmers in units of 50 seedlings.


Photo 2.5.7 Sowing Seeds


Photo 2.5.8 Seedlings Sprouting

Photo 2.5.9　Watering the Seedlings

Photo 2.5.10　Strengthening Seedlings Outdoors

To implement this approach, the following seeds, materials, and facilities were provisioned and prepared:

- The seeds were procured from Brazil's Institute of Forest Research and Studies (IPEF). Seeds from INFONA tended to vary in quality, so they were not used. The types of seeds were *E. grandis*, *E. camaldulensis*, and the *E. grandis* × *E. camaldulensis* hybrid.
- Seedling crates, tubes (length 12 cm, top φ 2.5 cm, bottom φ 1.0 cm), and potting soil (coconut husk compost) were supplied by Coronel Oviedo seedling production companies (Photos 2.5.11 and 2.5.12).
  (Depending on the growth of the seedlings, NPK fertilizer 15:15:15, insecticide, and fungicide were added to the potting soil.)
- Two greenhouse facilities were prepared, and vinyl (Photo 2.5.13), cheesecloth, and micro-sprinklers were installed.
- Sprinklers and metal nets (Photo 2.5.14), used to line up the tubes and create airflow space between them, were installed.
- Water tanks were installed for irrigation.
- Storage cabinets for materials and a covered workspace were prepared.
- A fence was erected to prevent the theft of plants and materials.

Photo 2.5.11 Tube and Potting Soil Mix

Photo 2.5.12 Seedling Crates

Photo 2.5.13 Seedling Nursery

Photo 2.5.14 Metal Net for Strengthening Seedlings

Table 2.5.3 Advantages and Disadvantages of Changing From Potted Seedlings to Tubed Seedlings

Advantages	Disadvantages
・lightweight for easy transport ・reduces difficulty of planting ・economizes potting soil mix ・works well in small nursery house ・prevents bent roots	・due to the small amount of potting soil, problems with sufficient water and nutrients may arise
 Potted seedling Diameter 10 cm Height 13 cm Approx. 1,000 cm³	 Tubed seedling Diameter (top) 2.5 cm (bottom) 1.0 cm Height 12 cm Approx. 60 cm³ (~ 1/16 size of potted seedling)

2.5.4 Training Farmers in Preparation for Planting

In order to ensure successful planting, it is advisable to hold a briefing with the farmers before distributing the seedlings. At the meeting, confirm the area available for cultivation with each farmer individually, while providing step-by-step planting instructions. To ensure a successful planting process, it is helpful to explain that seedlings will be distributed to farmers who have already finished preparing their land.

CPA Coronel Oviedo Case Study

For CPA Coronel Oviedo, participating farmers assembled in the community building of each committee and briefings were held. At the meetings, the overall purpose and goals of the project were reiterated; afterwards, the planting instructions and procedures were explained while the area available for cultivation was confirmed with each farmer (Photos 2.5.15 and 2.5.16).

Photo 2.5.15 Farmer Training (Held on Farmer's Porch)

Photo 2.5.16 Farmer Training (Held in a Classroom)

The main topics explained were as follows:

(1) Background in reforestation

Project leaders described the influence of GHGs, the present condition of deforestation in Paraguay, and the necessity of reforestation.

(2) Suitable land for planting each tree species

Species characteristics were drawn on to plan locations for planting: in low wetlands, *E. camaldulensis*; in dry lowlands, *E. grandis* × *E. camaldulensis*; and elsewhere, *E. grandis*.

(3) Planting interval

For 1 ha, the recommendation was 1,000 seedlings at 4 m × 2.5 m. After 50%

thinning, the interval would increase to 4 m × 5 m.

We suggested somewhat wide intervals, as it makes thinning easier and allows for agroforestry and forest pasturing.

(4) Preparation of the land for planting seedlings

We suggested the following as a method for preparation, although farmers were instructed to select the method that works best for them: (i) till the entire surface of the area to be planted, (ii) plow a width for planting (about 1 m) including a portion for weeding, (iii) plow the planting row (approximately few tens cm), and (iv) dig a hole for planting.

(5) Planting method

We proposed planting in a square grid along the fence line.

(6) Handling the trees and the carbon they accumulate

It was explained that while the trees (including the wood) belong to the farmers, the carbon that the trees accumulate belongs to the project.

After the explanatory portion of the meetings, the farmers' questions were answered, the condition of the land to be planted was checked, and a date was set for seedling distribution. Seedlings were distributed to all who completed training and prepared their land.

2.5.5 Seedling Distribution

> A large amount of seedlings were to be distributed, so an efficient distribution method was crucial.

CPA Coronel Oviedo Case Study

In order to distribute seedlings for CPA Coronel Oviedo, the seedlings were extracted from their tubes and 50 at a time were wrapped in vinyl packaging. Bundling the seedlings allows for more efficient transport, since a bundle of 50 seedlings, at only 20 cm in diameter, is extremely compact and easy to carry (Photos 2.5.17 and 2.5.18). After packaging, growth is possible in a few weeks, depending on irrigation.

Photo 2.5.17 Packaging Seedlings

Photo 2.5.18 Seedling Package Wrapped in Vinyl

Seedlings were distributed to the farmers by delivery to committee buildings or directly to the farmers' houses (Photo 2.5.19). During distribution we explained that planting was to be performed within two weeks, and that if it did not rain, the farmers were to use a water retention material (a high molecular compound that expands into a gel when it absorbs water). We also explained how to use the material (Photo 2.5.20).

Photo 2.5.19 Distribution to Farmers

Photo 2.5.20 Explaining the Water Retention Material to Farmers

2.5.6 Confirmation and Configuration of Land Ownership

According to the CPA-DD of the A/RCDM, to demonstrate ownership of the plot of land to be planted in accordance with regulation, one must:

> *Provide a summary of legal titles, current land tenure in respect of the land included in the project boundary.*
>
> - *Guidelines for Completing the Component Project Activity Document Form for Small-Scale Afforestation and Reforestation Component Project Activities, v.1.0*

While land ownership cannot always be demonstrated, in Paraguay the civil code states that “an occupant who has resided on the land for 20 years or more on an ongoing basis without interruption can apply through the appropriate legal means to obtain a certificate.” The administrative authority that issues these certificates is the Instituto Nacional de Desarrollo Rural de la Tierra (INDERT), the national agricultural rural development institute. A “certificate of occupation” is issued prior to an official certificate.

Thus, the following approach was taken to clearly demonstrate ownership of the land to be planted:

(1) For the areas over which land ownership could be demonstrated, an explicit statement of ownership was accepted as proof.

(2) For parcels over which land ownership could not be demonstrated, land ownership certificates or occupancy certificates were accepted as proof.

Although we consulted with agencies in the project area, such as INDERT, there remains a need to investigate more efficient methods of performing this validation process.

Chapter 3 Calculation Methods for Anthropogenic GHG Removal: Insights from the CPA Coronel Oviedo Case Study

3.1 Introduction

This chapter elucidates methods for greenhouse gas (GHG) removal estimations, as required in the creation of a project design document for the formation of afforestation clean development mechanism (CDM) program (see Chapter 2, section 2.1). The latest CDM methodologies and tools for calculating GHG removals are discussed and a calculations case study is offered.

3.2 Applying CDM Methodology (AMS0007 v.3.1)

As the target region CPA Coronel Oviedo is not a wetland, the appropriate methodology adopted to calculate actual GHG removals accomplished through the implementation of the project was the following: AR-AMS0007 "*Afforestation and reforestation project activities implemented on lands other than wetlands, Version 3.1*" (Sept. 2015). The methodological requirements applied to the project, as well as related tools, are described below. The "project" here refers to CPA Coronel Oviedo, a small-scale afforestation CDM project located in Caaguazú Department, Paraguay.

Table 3.2.1 Applicability Requirements for Methodology and Parameters for Calculation

Item	Contents
GHG removal target activities	・ Above- and below-ground biomass ・ Carbon in dead trees, fallen branches and leaves, and soil
Requirements for application of methodology	・ The land subject to the project activity is not a wetland ・ Soil disturbance attributable to the project activity does not cover more than 10% of the area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils (ii) Land which, in the pre-project baseline condition, is subjected to land-use and management practices and receives inputs listed in Appendices 2 (Cropland in which soil disturbance is restricted) and 3 (Grassland in which soil disturbance is restricted) to this methodology * Soil disturbances are considered to be activities that disrupt the soil profile; e.g., tilling, scratch plowing, ground leveling, soil compacting, etc.
Parameters important for calculation	During verification: ・ Area of tree and bush canopy at start of project (flat area for foliage growth) ・ To calculate tree biomass, a growth formula (allometry) for non-target species trees; biomass expansion factor (ratio of

	leaves and branches to trunk); tree volume factor; ratio of above-ground portions to below-ground portions; tree density* The process of verification is conducted during the project to confirm the results of monitoring. During monitoring: ・ Area of tree biomass by strata and area of canopy ・ Area, number of trees, diameter at chest height, and height of trees by species ・ Area of land burned in preparation, area of land uprooted post-harvest, and area of forest fires

Note: generally "shrub" and "tree" are used to denote short and tall trees, respectively. However, here we use "tree" inclusively to refer to both types.

Table 3.2.2 Related methodological tools

AR-Tool 3	*Calculation of the number of sample plots for measurements within A/R CDM project activities*	Version 2.1.0
AR-Tool 8	*Estimation of non-CO_2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*	Version 4.0.0
AR-Tool 12	*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*	Version 3.1
AR-Tool 14	*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*	Version 4.2
AR-Tool 15	*Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity*	Version 2.0
AR-Tool 16	*Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*	Version 1.1.0

In addition, the "*Simplified baseline and monitoring methodology for small scale CDM afforestation and reforestation project activities implemented on lands other than wetlands, Version 02.0.0*" has been eliminated with the integration of AR-AMS0001-AMS0006.

3.3 Calculating Net Anthropogenic GHG Removals by Sinks

The concept of calculating anthropogenic GHG removals, from methodology AR-AMS0007 v.3.1 paragraph 22, is represented in Figure 3.3.1, and the calculations are performed below.

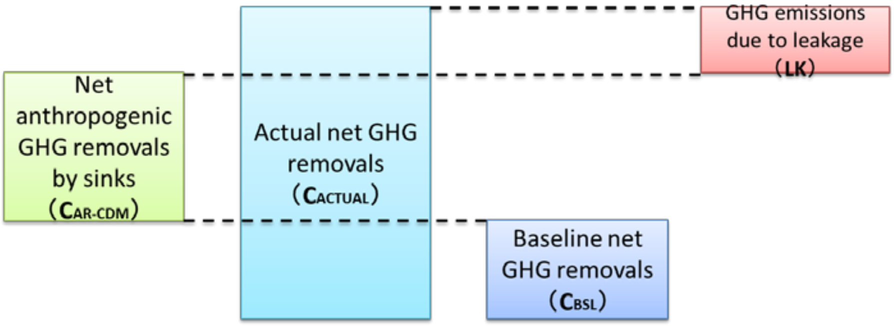

Figure 3.3.1 Concept of Anthropogenic GHG Removals

> **Net anthropogenic GHG removals by sinks**
>
> =Actual net GHG removals−baseline net GHG removals−GHG emissions due to leakage

$$\Delta \boldsymbol{C}_{AR-CDM,t} = \Delta \boldsymbol{C}_{ACTUAL,t} - \Delta \boldsymbol{C}_{BSL,t} - \Delta \boldsymbol{LK}_t$$

Where:

$\Delta C_{AR-CDM,t}$	Net anthropogenic GHG removals by sinks, in year *t*; tCO_{2e} GHG basis for calculation of accumulated carbon and size of credit issued
$\Delta C_{ACTUAL,t}$	Actual net GHG removals by sinks, in year *t*; tCO_{2e} Amount of carbon accumulated after project activity completion (project scenario)
$\Delta C_{BSL,t}$	Baseline net GHG removals by sinks, in year *t*; tCO_{2e} Accumulation of carbon had there been no project activity (baseline scenario)
ΔLK_t	GHG emissions due to leakage, in year *t*; tCO_{2e} Increase in GHG emissions outside the project boundaries due to project activities

The various equations for the above values are presented below, along with examples of calculations from CPA Coronel Oviedo.

3.3.1 Calculating Baseline Net GHG Removals

The baseline scenario represents changes in carbon stocks of carbon pools (systems capable of absorbing or releasing carbon; e.g., forest biomass, soil, etc.[1]) during the project period had the project not been implemented.

[1]IPCC (2003) Annex A, Glossary IPCC Good Practice Guidance for LULUCF.

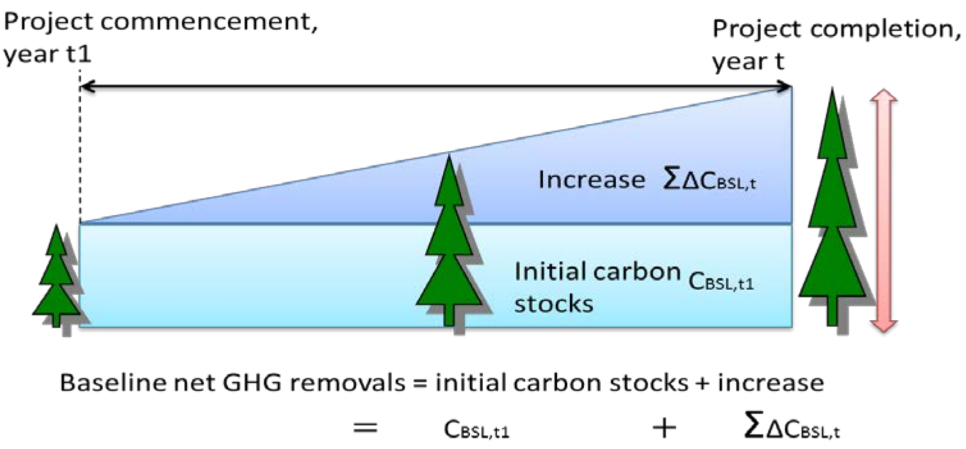

Figure 3.3.2 Concept of Baseline Net GHG Removals

According to methodology AR-AMS0007 v.3.1 paragraph 17, the equation to calculate baseline net GHG removals is as follows:

$$\Delta \boldsymbol{C}_{\boldsymbol{BSL,t}} = \Delta \boldsymbol{C}_{\boldsymbol{TREE_{BSL},t}} + \Delta \boldsymbol{C}_{\boldsymbol{SHRUB_{BSL},t}} + \Delta \boldsymbol{C}_{\boldsymbol{DW_{BSL},t}} + \Delta \boldsymbol{C}_{\boldsymbol{LI_{BSL},t}}$$

Where:

$\Delta C_{BSL,t}$	Baseline net removals by sinks; tCO_{2e}
$\Delta C_{TREE_{BSL},t}$	Change in carbon stock of trees due to the implementation of project activities in year *t*, as estimated in the tool AR-Tool 14; tCO_{2e}
$\Delta C_{SHRUB_{BSL},t}$	Change in carbon stock of shrubs due to the implementation of project activities in year *t*, as estimated in the tool AR-Tool 14; tCO_{2e}
$\Delta C_{DW_{BSL},t}$	Change in carbon stock of dead wood, fallen leaves, and branches due to the implementation of project activities in year *t*, as estimated in the tool AR-Tool 12; tCO_{2e}
$\Delta C_{LI_{BSL},t}$	Change in soil organic carbon stocks due to the implementation of project activities in year *t*, as estimated in the tool AR-Tool 16; tCO_{2e}
t	Number of years elapsed since t

(1) Stratification of carbon pool	Select carbon pools based on the character of the project and conduct stratification from current land use conditions.
(2) Selection of survey item	Implement accordingly in cases where the host country has defined procedures for forest inventory surveys. Otherwise, select survey items and set methodology. Decide which parameters are necessary for the calculation. If none can be applied, the configuration of a survey will be necessary.
(3) Configuration of sample sections	Configure the sample section surveys in accordance with the methodology tools.
(4) Implementation of biomass volume survey	Must be conducted over several years in order to calculate the change in stocks.

(5) Estimation of baseline carbon stocks	Estimate changes in carbon stocks using parameters decided in (2) and the survey results of (4).
⇩	
(6) Calculation of baseline net GHG emissions/removals	Calculate using the early phase estimates from (5) to determine the change over multiple years.

Figure 3.3.3 Flowchart for Calculation of Baseline Net GHG Removals

(1) Stratification of carbon pools

The changes in carbon pools selected for accounting of carbon stock, from methodology AR-AMS0007 v.3.1 section 5, "Baseline and monitoring methodology" (paragraph 12 and 13), are shown below.

5. Baseline and monitoring methodology
5.1. Project boundary and eligibility of land
12. The carbon pools selected for accounting of carbon stock changes are shown in table 1.

Carbon pool	*Whether selected*	*Justification/Explanation*
Above-ground biomass	*Yes*	*This is the major carbon pool subjected to project activity*
Below-ground biomass	*Yes*	*Carbon stock in this pool is expected to increase due to the implementation of the project activity*
Dead wood	*Optional*	*Carbon stock in these pools may increase due to implementation of the project activity*
Litter and		
Soil organic carbon		

13. The emission sources and associated GHGs selected for accounting are shown in table 2.

Sources	*Gas*	*Whether Selected*	*Justification/Explanation*
Burning of woody biomass	CO_2	*No*	*CO_2 emissions due to burning of biomass are accounted as a change in carbon stock*
	CH_4	*Yes*	*Burning of biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology*
	N_2O	*Yes*	*Burning of biomass for the purpose of site preparation, or as part of forest management, is allowed under this methodology*

For example, selecting a fast growing tree species like eucalyptus instead of a deciduous tree will result in very little dead wood and fallen leaves, and have almost no impact on soil fertility.

Methodology AR-AMS0007 v.3.1 paragraph 16, section (a), describes carbon pool stratification in the following terms:

5.3 Stratification
16. If biomass distribution over the project area is not homogeneous, stratification should be

carried out to improve the precision of biomass estimation. Different stratifications may be appropriate for the baseline and project scenarios in order to achieve optimal precision of estimation of net GHG removals by sinks. In particular:

(a) For baseline net GHG removals by sinks, it is usually sufficient to stratify the area according to major vegetation types and their crown cover and/or land use types;

(b) For actual net GHG removals by sinks the stratification for ex ante estimations is based on the project planning/management plan and the stratification for ex post estimations is based on the actual implementation of the project planning/management plan. If natural or anthropogenic impacts (e.g. local fires) or other factors (e.g. soil type) significantly alter the pattern of biomass distribution in the project area, then the ex post stratification is revised accordingly.

CPA Coronel Oviedo Case Study

Eucalyptus was selected for planting in CPA Coronel Oviedo. Therefore, project activities targeted two carbon pools: above-ground biomass and below-ground biomass.

Accordingly, the calculations were performed as follows:

$$\Delta \boldsymbol{C}_{\boldsymbol{BSL,t}} = \Delta \boldsymbol{C}_{\boldsymbol{TREE}_{\boldsymbol{BSL}},\boldsymbol{t}} + \Delta \boldsymbol{C}_{\boldsymbol{SHRUB}_{\boldsymbol{BSL}},\boldsymbol{t}}$$

The stratification of the CPA Coronel Oviedo baseline scenario was established with reference to farmers' land use prior to the project. Two strata, as described in Table 3.3.1, were used to determine whether the land within the project boundaries was being put to agricultural (including fallow fields) or pastoral use.

Table 3.3.1 Baseline Scenario

Strata no.	Strata classification
S1	Agricultural
S2	Pastoral

(2) Survey items to establish a baseline scenario

The methods for calculating the carbon stocks of trees and shrubs in the AR-Tool 14 differ and, thus, the required items also differ. A calculation of the tree volume requires details on tree species, tree height, and diameter at breast height (DBH, H = 1.3 m). For shrubs, only the canopy area is required.

In addition, as shown in paragraph 14 of AR-Tool 14, section 6, "Estimating change in carbon stock in trees between two points of time," an estimation should proceed with one or more of the items listed below. Accordingly, it is necessary to calculate changes in carbon stock over several years to determine the overall change.

14. Change in carbon stock in trees between two points of time is estimated by using one of the following methods or a combination thereof:

(a) Difference of two independent stock estimations;
(b) Direct estimation of change by re-measurement of sample plots;
(c) Estimation by proportionate crown cover;
(d) Demonstration of "no decrease".

In addition, while it is possible to have baseline values of zero if they meet the conditions of AR-Tool 14 paragraph 11 (see below) before beginning project activities (during inspection of validity), it is impossible to prove that these conditions have been met. Therefore, the verification must occur after planting, which requires a special investigation.

11. Carbon stock in trees in the baseline can be accounted as zero if all of the following conditions are met:
(a) The pre-project trees are neither harvested, nor cleared, nor removed throughout the crediting period of the project activity.
(b) The pre-project trees do not suffer mortality because of competition from trees planted in the project, or damage because of implementation of the project activity, at any time during the crediting period of the project activity;
(c) The pre-project trees are not inventoried along with the project trees in monitoring of carbon stocks but their continued existence, consistent with the baseline scenario, is monitored throughout the crediting period of the project activity.

CPA Coronel Oviedo Case Study

Because Paraguarí has no established forest inventory method, the following method was used in CPA Coronel Oviedo. All trees and shrubs in the sample sections that met the measurement criteria were surveyed. Furthermore, because changes in carbon stocks must be measured after several years, trees larger than 5 cm DBH were numbered and their GPS coordinates were recorded in order to identify their individual positions.

Table 3.3.2 Survey Items for Calculation of Baseline Tree Carbon Stock

Measurement criteria	DBH of 5 cm or more	DBH from 1 cm to 5 cm
Survey item	Name of tree species, DBH, tree height, GPS coordinates, and number	Name of tree species, DBH, and tree height

Table 3.3.3 Survey Items for Calculation of Baseline Shrub Carbon Stock

Measurement criteria	DBH of 5 cm or more	DBH from 1 cm to 5 cm
Survey item	Name of tree species, area of canopy coverage, GPS coordinates, and number	Name of tree species and area of canopy coverage

(3) Number of sample sections in baseline survey

Estimates of baseline above-ground biomass within the project area are acquired through sampling surveys.

The number of samples is calculated with the following formula according to the AR-Tool 3.

$$\boldsymbol{n} = \frac{\boldsymbol{N} \times \boldsymbol{t_{VAL}} \times (\sum_i \boldsymbol{wi} \times \boldsymbol{si})^2}{\boldsymbol{N} \times \boldsymbol{E}^2 + \boldsymbol{t_{VAL}}^2 \times \sum_i \boldsymbol{wi} \times \boldsymbol{si}^2}$$

Where:

n	=	Number of sample plots required for estimation of biomass stocks within the project boundary
N	=	Total number of possible sample plots within the project boundary (i.e., the sampling space or the population)
t_{VAL}	=	Two-sided Student's t-value, at infinite degrees of freedom, for the required confidence level * According to the AR-Tool 3 table, a confidence level of 90% and infinite degree of freedom yields 1.645
Wi	=	Relative weight of the area of stratum i (i.e., the area of the stratum i divided by the project area)
Si	=	Estimated standard deviation of biomass stock in stratum i (t.d.m/ha)
E	=	Acceptable margin of error (i.e., one-half the confidence interval) in estimation of biomass stock within the project boundary; (t.d.m/ha) * Default value is 10% of average biomass
I	=	1, 2, 3, … biomass stock estimation strata within the project boundary

CPA Coronel Oviedo Case Study

The results of calculations using the parameters required by this survey are listed in Table 3.3.4; a total of 30 plots were sampled.

N : As of 2013 there were 212 project plots

Si : Assumed to be 30% of biomass

i : Two strata, "agricultural" and "grassland"

Table 3.3.4 Calculation of Number of Sample Plots

Strata	area (ha)	w_i	s_i	$wi \times si$	$(\Sigma wi \times si)^2$	t_{VAL}^2	E^2	si^2	$w_i \times s_i^2$	n	$wi \times Si / \Sigma wi \times si$	No. of samples
S1	123.0	0.5802	1.5	0.8703					1.3054	29	0.5	15
S2	123.0	0.5802	1.5	0.8703					1.3054		0.5	15
2	**246.0**			1.7406	3.0296	2.7060	0.2500	2.25	2.61			30

Since some farmers might abandon the project, sampling was set at a total of 42 plots. For CPA Coronel Oviedo, the area of one afforestation plot is between 0.5 ha and 10 ha, so the sample size was set after considering the scale of the afforestation project (Table 3.3.5).

Table 3.3.5 Configuration of Sample Plots by Scale of Afforestation

Size of afforestation plot	Number of afforestation plots	Number of sample plots
larger than 10 ha	3	1
5 ha ~ 10 ha	2	1
3 ha ~ 5 ha	4	1
2 ha ~ 3 ha	13	3
1 ha ~ 2 ha	47	9
0.75 ha ~ 1 ha	39	7
0.50 ha ~ 0.75 ha	104	20
Total	212	42

A random selection of the afforestation plots yielded an area of 60.8 ha (25% of the total area); the results are displayed in Table 3.3.6.

Table 3.3.6　Target Plots for Baseline Survey

No	Village name	Code	Plantation area (ha)	No	Village name	Code	Plantation area (ha)
N-1	San Gregorio	YSG09-1	1.50	E-1	San Antonio	SA05-1	0.60
N-1	San Gregorio	YSG10-1	1.44	E-2	Santo Domingo	SAD06-1	0.60
N-2	Teko Porá Rekavo	CTPR05-1	0.56	E-3	San Miguel	PSM05-1	0.65
N-2	Teko Porá Rekavo	CTPR06-1	1.32	E-3	San Miguel	PSM07-1	1.61
N-2	Teko Porá Rekavo	CTPR08-1	0.73	E-3	San Miguel	PSM22-1	0.62
N-2	Teko Porá Rekavo	CTPR09-1	3.53	E-3	San Miguel	PSM22-2	0.57
N-3	Santa Librada	CSL01-1	0.55	E-4	Calle Moreira	MOM05-1	0.81
N-5	Niño Jesús	PNJ02-1	0.65	O-1	Espinillo	EE04-1	0.98
N-5	Niño Jesús	PNJ04-1	1.11	O-1	Espinillo	EE07-1	0.60
N-5	Niño Jesús	PNJ08-1	0.74	O-1	Espinillo	EE12-1	1.66
N-5	Niño Jesús	PNJ12-1	0.93	S-2	Nueva Esperanza	ANE02-1	2.85
N-6	Copitan Roa	PCR06-1	2.88	S-2	Nueva Esperanza	ANE03-1	0.72
N-6	Copitan Roa	PCR06-2	0.74	S-2	Nueva Esperanza	ANE04-1	0.89
N-6	Copitan Roa	PCR07-1	0.95	S-3	Santa Rita	KSR03-1	0.71
N-8	San Juan Bautista	SJB01-1	1.76	S-3	Santa Rita	KSR04-2	1.15
N-8	San Juan Bautista	SJB02-1	0.61	S-3	Santa Rita	KSR05-1	0.51
N-9	Tiempo Pyajhú	GTP01-1	0.61	S-3	Santa Rita	KSR06-1	0.57
N-9	Tiempo Pyajhú	GTP07-1	2.27	S-3	Santa Rita	KSR13-1	0.61
N-10	Chircaty,San Blas	CSB01-1	1.10	A-1	ARP	ARP01-1	7.87
N-10	Ycuá Porá,San Blas	CSB02-1	0.54	A-1	ARP	ARP01-2	10.00
N-11	San Blas	YSB02-1	0.94				
N-11	San Blas	YSB05-1	0.80	42			60.83

(4) Implementation of the biomass survey

The established survey items are used to implement a measurement survey of the biomass in the sample plots.

CPA Coronel Oviedo Case Study

A survey of CPA Coronel Oviedo was conducted for two years, 2013-2014 (Photo 3.3.1). Because there were no shrubs within the project boundary, only trees were surveyed. The results of the survey are displayed in Table 3.3.7.


Photo 3.3.1 Implementing the Baseline Tree Survey

The most common tree species was No. 34, Yvyra pyta (*Peltophorum dubium*), followed by No. 37, Yvyraro (*Pterogyne nitens*), and No. 1, Mbocaya (*Acrocomia totai*). In addition, from 2013 to 2014 a decrease of 104 trees was observed. Most of these trees were *Peltophorum dubium* and *Pterogyne nitens*, which are favored as firewood; farmers felled the trees for firewood prior to afforestation.

Also observed were two species, No. 41, Tajy (*Tabebuia* sp), and No. 7, Cedro (*Cedrela pissilis*), which have been registered as endangered species by the national environmental agency, Secretaría del Ambiente (SEAM). Occurrences of these trees were rather rare, accounting for only 3.2% of the total number of trees within the survey plots. Decisions on what to do with the trees inside the afforestation plot boundaries ultimately lie with the property owners, although a requirement of the afforestation CDM project is an emphasis on environmental conservation. Therefore, the CPA Coronel Oviedo project members appealed to the participating farmers to preserve the endangered species when preparing for afforestation, and to leave a fixed amount of space around the trees during planting. In addition, the project members grew seedlings of the endangered species and distributed them to interested operators of public buildings and farmers in an effort to increase the number of these trees.

Table 3.3.7 Results of 2013-2014 Tree Survey by Species and Stratum

Local name	2013				2014				2014-2013						Total
	Farmland		Grassland		Farmland		Grassland		Farmland			Grassland			
	DBH>=5	5>DBH>1	DBH>=5	5>DBH>1	DBH>=5	5>DBH>1	DBH>=5	5>DBH>1	Total	DBH>=5	5>DBH>1	Total	DBH>=5	5>DBH>1	
Mbocaya	59		4		61		2		2	2		-2	-2		
Kai kyhyjeha	7	6			10	4			1	3	-2				1
Kai kyhyjeha			1	1								-2	-1	-1	-2
Kurupay		1	2				1		-1		-1	-1	-1		-2
Doctoraito		1							-1		-1				-1
Burro kaa	1	1	1			1	1		-1	-1					-1
Cedro	3				3										
Paloma Karuha	1								-1	-1					-1
Naranjo agrio	10	2			11				-1	1	-2				-1
Limonero		1	3			1	2					-1	-1		-1
Pomelo	1				1										
Mandarino	1	1			1				-1		-1				-1
Petereby	3				4				1	1					1
Sangreado								1				1		1	1
Kaki	1				1										
Timbo	1	2			1		1		-2		-2	1	1		-1
Ceibo			8				7					-1	-1		-1
Eucalipto			1	2			2	1					1	-1	
Eucalipto			7	29			27					-9	20	-29	-9
Ñangapiry							1					1	1		1
Tembe tary	3				1		1		-2	-2		1	1		-1
Guapoy			1				1								
Kamba aka	4				7				3	3					3
Inga			1				1								
Piñon manso			1				1								
Morosyvo	1				1										
Kagueti			1					2				1	-1	2	1
Sapyy moroti	11	6	1		10	1	1		-6	-1	-5				-6
Mango	1				1										
Paraiso gigante	5	1			4	1			-1	-1					-1
Ñuï		0	1	1								-2	-1	-1	-2
Kurupayra		0	2									-2	-2		-2
Guajayvi		1	1		1					1	-1	-1	-1		-1
Yvyra pyta	20	38	24	16	24	20	18	3	-14	4	-18	-19	-6	-13	-33
Kurupay						1			1		1				1
Guayabo	1	1	5	5	2	5	1	3	5	1	4	-6	-4	-2	-1
Yvyraro	11	47	10	1	10	5	7		-43	-1	-42	-4	-3	-1	-47
Kurupi kay			2		1		2	1	1	1		1		1	2
Kurupi kay				1								-1		-1	-1
Pindo	2		6		2		6								
Tajy	5	4	1	1	5	4	1					-1		-1	-1
Sapirangy	2	1	22	1	3	3		22	3	1	2	-1	-22	21	2
Karaja bola	1				1										
Karanday			2				2								
	155	114	108	58	166	46	86	33	-57	11	-68	-47	-22	-25	-104

(Note: species names are in alphabetical order. Species of No. 31 could not be distinguished.

(5) Calculating changes in baseline carbon stocks

The calculation of baseline net GHG removals is implemented as follows:

Step 1: Measure the DBH and height of trees and the canopy coverage area (m^2) of shrubs within the sample plot boundaries of each strata before project activities begin.

Step 2: Calculate the above-ground volume of each tree using data from the tree survey with the following formula:

$$SV_{j,t} = \pi \times DBH_{j,t}^2 \times \frac{1}{4} \times Height_{j,t} \times SVF_j$$

Where:

$DBH_{j,t}$	=	DBH of tree species j at year t; cm

$Height_{j,t}$	=	Height of tree species *j* at year *t*; m
$SV_{j,t}$	=	Volume of tree species *j* at year *t*; $m^3/tree$
SVF_j	=	Volume coefficient of tree species *j*; dimensionless

Step 3: Calculate the carbon stock of the above-ground tree biomass from the volume of the above-ground tree biomass using the following formula:

$$C_{TREE\_AG_{i,sp,j,l,t}} = SV_{i,sp,j,l,t} \times WD_j \times BEF_j \times CF_j$$

Where:

$C_{TREE\_AG_{i,sp,j,l.t}}$	=	Carbon stock of above-ground biomass of tree species *j* in sample plot of stratum *i* in year *t*; tC
$SV_{i,sp,j,l,t}$	=	Volume *l* of tree species *j* in sample plot of stratum *i* in year *t*; $m^3/tree$
WD_j	=	Basic density of tree species *j*; $t.d.m/m^3$
BEF_j	=	Biomass expansion factor for tree species *j*; dimensionless
CF_j	=	Carbon density of tree species *j*; $tC/t.d.m$

Step 4: Calculate the below-ground carbon stock of trees from the carbon stock of the above-ground tree biomass using the following formula:

$$C_{TREE\_BG_{i,sp,j,l,t}} = C_{TREE\_AG_{i,sp,j,l.t}} \times R_j$$

Where:

$C_{TREE\_BG_{i,sp,j,l.t}}$	=	Carbon stock of below-ground biomass of tree species *j* in sample plots of stratum *i* in year *t*; $tC/tree$
$C_{TREE\_AG_{i,sp,j,l.t}}$	=	Carbon stock of above-ground biomass of tree species *j* in sample plots of stratum *i* in year *t*; $tC/tree$
R_j	=	Ratio of above- to below-ground biomass of tree species *j*; dimensionless

Step 5: Calculate the carbon stock of above-ground and below-ground biomass of trees within sample plots in both strata using the following formula:

$$C_{TREE,i,sp,t} = \sum_{l=1}^{N_{J,sp,i,t}} \left(C_{TREE\_AG_{l,j,sp,t}} + C_{TREE\_BG_{l,j,sp,t}} \right)$$

Where:

$C_{TREE,i,sp,t}$	=	Carbon stock of trees in sample plots of strata *i* in year *t*; tC
$C_{TREE\_AG_{l,j,sp,t}}$	=	Carbon stock of above-ground biomass of tree species *j* in sample plots of stratum *i* in year *t*; $tC/tree$
$C_{TREE\_BG_{l,j,sp,t}}$	=	Carbon stock of below-ground biomass of tree species *j* in sample plots of stratum *i* in year *t*; $tC/tree$
$N_{J,sp,i,t}$	=	Number of trees of species *j* in sample plot sections of stratum *i* in year t
l	=	Stratum row *1,2,3,…*$N_{J,sp,i,t}$

Step 6: Calculate carbon stocks of trees in a stratum from carbon stocks of tree biomass in the sample plots using the following formula:

$$C_{TREE\_BSL,i,t} = \frac{A_i}{ASP_i} \sum_{sp=1}^{P_i} C_{TREE,i,sp,t}$$

Where:

$C_{TREE\_BSL,i,t}$	=	Baseline carbon stocks of tree biomass in stratum *i* in year *t*; tC
$C_{TREE,i,sp,t}$	=	Carbon stock of trees in sample plots of strata *i* in year *t*; tC
ASP_i	=	Area of all sample plots in stratum *i*; ha
A_i	=	Area of stratum *i*; ha
sp	=	Sample plots in project scenario stratum *i* (*1,2,3,...Pi*)
i	=	Project scenario strata (*1,2,3,...i*)
t	=	No. of years since beginning of AR-CDM project (*1,2,3,... t*)

Step 7: Calculate the change in carbon stocks of tree biomass in all strata using the following formula:

$$\Delta C_{TREE\_BSL,t} = \frac{C_{TREE\_BSL,i,t2} - C_{TREE\_BSL,i,t1}}{t_2 - t_1}$$

Where:

$\Delta C_{TREE\_BSL,t}$	=	Average annual change in carbon stock of tree biomass in stratum *i*; $tC/year$

Step 8: Calculate the shrub biomass per unit area using the following formula:

$$b_{SHRUB,i,t} = BDR_{SF,t} \times b_{forest} \times CC_{SHRUB,i,t}$$

Where:

$b_{SHRUB,i,t}$	=	Shrub biomass per unit area in stratum *i*; $t.d.m/ha$
$BDR_{SF,t}$	=	Ratio of shrub biomass per unit area
b_{forest}	=	Above-ground woodland biomass by country; $t.d.m/ha$
$CC_{SHRUB,i,t}$	=	Ratio of canopy coverage in stratum *i*; dimensionless

Step 9: Calculate the carbon stock of shrub biomass in each stratum using the following formula:

$$C_{SHRUB_{BSL},i} = CF_S \times (1 + R_{s,j}) \times \sum_i A_{SHRUB,i} \times b_{SHRUB,i}$$

Where:

$C_{SHRUB,BSL,i}$	=	Carbon stocks of shrubs; tC
CF_S	=	Carbon density of shrubs; $tC/t.d.m$
$R_{s,j}$	=	Ratio of carbon in below-ground shrub biomass; dimensionless
$A_{SHRUB,i}$	=	Area of shrubs in stratum *i*; ha

Step 10: Calculate the change in carbon stocks of shrubs in each stratum using the following formula:

$$\Delta C_{SHRUB\_BSL,t} = \frac{C_{SHRUB\_BSL,i,t2} - C_{SHRUB\_BSL,i,t1}}{t_2 - t_1}$$

Where:

$\Delta C_{SHRUB\_BSL,t}$	=	Average annual change in carbon stocks of shrubs in stratum *i*; $tC/year$

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(1) The parameters applied in the calculations, as well as the default values and contributions extracted from the IPCC Reference Manual, are detailed in Table 3.3.8.

Table 3.3.8 Parameters Applied and Default Values Referenced

Item	Application	Reference
Biomass expansion factor (BEF) for above-ground tree species	*Peltophorum dubium* "1.5" as a general reference tree	Hutchinson, J. 1972
	Acrocomia tonai "1.0" as a representative palm tree	Hutchinson, J. 1972
Volume coefficient by tree species	*Peltophorum dubium* "0.775" as a general reference tree	Hutchinson, J. 1972
	Acrocomia tonai "0.800" as a representative palm tree	Hutchinson, J. 1972
Carbon density by tree species; $tC/t.d.m$	Default value "0.47"	AR-tool 14
Basic wood density (WD) by tree species; $t.d.m/m^3$	*eltophorum pterocarpum* "0.062" was selected as a general reference tree for *Peltophorum dubium*	IPCC-GPG-LULUCF Table 3A.1.9-2
	Cocos nucifera "0.5" was selected as a representative palm tree for *Acrocomia tonai*	IPCC-GPG-LULUCF Table 3A.1.9-2
Root to shoot ratio (R) of above- to below-ground biomass by tree species	If above-ground biomass is less than 50 t/ha, "0.45"; between 50-150 t/ha, "0.35"; more than 150 t/ha, "0.2"	LULUCF Table 3A.1.8
Above-ground woodland biomass by country; $t.d.m/ha$	Paraguay "59"	LULUCF Table 3A.1.4

Note: BEF = Biomass Expansion Factor, WD = Basic Wood Density, R = Root to Shoot Ratio

(2) Comparison of 2013 and 2014 carbon stocks

The results of calculating the carbon stocks of trees in 2013 and 2014 are shown in Table 3.3.9.

The original plan was to compare 2013 and 2014 stocks from all sample plots and to determine the difference to measure the change in tree carbon stocks. However, because the farmers had thinned a portion of trees before planting, results showed the carbon stock of grasslands to have decreased by 15.4 $tCO_{2\text{-}e}$.

Table 3.3.9 Sample Survey Comparison of Baseline GHG Removals in 2013 and 2014

Farmland

NO	Re-gion code	Farmer code	area (ha)	2013 Tree count	2013 Tree volume (m³)	2013 Carbon stocks (tC) Above-ground	2013 Carbon stocks (tC) Below-ground	2013 Carbon stocks (tC) Total	2013 GHG removals (tCO2-e)	2014 Tree count	2014 Tree volume (m³)	2014 Carbon stocks (tC) Above-ground	2014 Carbon stocks (tC) Below-ground	2014 Carbon stocks (tC) Total	2014 GHG Removals (tCO2-e)	2013-2014 Difference in GHG removals (tCO2-e)
1	N-3	CSL01-1	0.5471	23	0.214	0.062	0.016	0.078	0.286	11	0.489	0.036	0.143	0.178	0.654	0.367
2	N-5	PNJ02-1	0.654	17	2.367	0.559	0.140	0.699	2.563	17	3.173	0.188	0.752	0.939	3.445	0.882
3	N-5	PNJ12-1	0.9263	41	9.331	2.719	0.680	3.399	12.462	20	9.742	0.710	2.839	3.549	13.012	0.550
4	N-6	PCR06-2	0.7381	18	1.608	0.469	0.117	0.586	2.148	16	1.954	0.142	0.569	0.712	2.609	0.462
5	N-8	SJB01-1	1.7564	57	5.362	1.287	0.322	1.609	5.900	43	6.319	0.380	1.518	1.898	6.958	1.058
6	N-8	SJB02-1	0.6076	8	1.895	0.552	0.138	0.690	2.532	8	2.029	0.148	0.591	0.739	2.710	0.179
7	N-9	GTP01-1	0.6072	1	0.566	0.133	0.033	0.166	0.609	1	0.487	0.029	0.114	0.143	0.524	-0.085
8	N-11	YSB02-1	0.9382	11	0.728	0.212	0.053	0.265	0.972	12	1.204	0.088	0.351	0.438	1.608	0.636
9	N-11	YSB05-1	0.8027	4	1.672	0.472	0.118	0.590	2.163	3	1.710	0.125	0.498	0.623	2.284	0.122
10	E-1	SA05-1	0.6036	0	0	0	0	0	0	4	1.093	0.078	0.311	0.389	1.427	1.427
11	E-2	SAD06-1	0.5982	0	0	0	0	0	0	0	0	0	0	0	0	0.000
12	E-3	PSM05-1	0.6525	14	0.589	0.172	0.043	0.214	0.786	8	0.020	0.001	0.006	0.007	0.027	-0.759
13	E-3	PSM07-1	1.6058	22	3.152	0.861	0.215	1.076	3.946	22	3.922	0.268	1.073	1.341	4.917	0.971
14	E-4	MOM05-1	0.8083	4	0.960	0.227	0.057	0.283	1.039	4	1.123	0.067	0.269	0.336	1.233	0.194
15	S-2	ANE02-1	2.8512	22	1.232	0.359	0.090	0.449	1.646	17	1.572	0.115	0.458	0.573	2.100	0.454
16	S-2	ANE03-1	0.7151	0	0	0	0	0	0	4	0.327	0.020	0.082	0.102	0.374	0.374
17	S-2	ANE04-1	0.8883	1	0.046	0.013	0.003	0.017	0.061	1	0.113	0.008	0.033	0.041	0.150	0.089
18	S-3	KSR03-1	0.7104	3	1.250	0.294	0.073	0.367	1.346	7	1.227	0.072	0.289	0.361	1.324	-0.022
19	S-3	KSR06-1	0.5722	9	0.631	0.177	0.044	0.221	0.809	18	0.936	0.066	0.265	0.331	1.215	0.406
20	S-3	KSR09-1	0.38	14	0.607	0.160	0.040	0.200	0.732	12	0.572	0.037	0.147	0.184	0.673	-0.059
		Total agric. land	17.963	269	32.21	8.73	2.18	10.91	**39.999**	228	38.01	2.58	10.31	12.89	**47.245**	7.246
		Average	0.8981	13.5	1.61	0.44	0.11	0.55	2.00	11.4	1.90	0.13	0.52	0.64	2.36	
								Per ha	**2.23**					**Per ha**	**2.63**	

Grassland

NO	Re-gion code	Farmer code	Area (ha)	2013 Tree count	2013 Tree volume	2013 Carbon stocks (tC) Above-ground	2013 Carbon stocks (tC) Below-ground	2013 Carbon stocks (tC) Total	2013 GHG Removals	2014 Tree count	2014 Tree volume	2014 Carbon stocks (tC) Above-ground	2014 Carbon stocks (tC) Below-ground	2014 Carbon stocks (tC) Total	2014 GHG removals	2013-2014 Difference in GHG removals
					(m^3)		(tC)		(tCO_2-e)		(m^3)		(tC)		(tCO_2-e)	(tCO_2-e)
1	N-1	YSG09-1	1.4982	22	1.203	0.350	0.088	0.438	1.606	23	0.034	0.002	0.010	0.012	0.046	-1.561
2	N-1	YSG10-1	1.4403	0	0	0	0	0	0	0	0	0	0	0	0	0.000
3	N-2	CTPR05-1	0.5577	12	1.337	0.390	0.097	0.487	1.785	11	1.453	0.106	0.423	0.529	1.940	0.155
4	N-2	CTPR06-1	1.3194	0	0	0	0	0	0	0	0	0	0	0	0	0.000
5	N-3	CTPR08-1	0.727	10	1.169	0.341	0.085	0.426	1.561	5	0.103	0.007	0.030	0.037	0.137	-1.424
6	N-2	CTPR09-1	3.5328	0	0	0	0	0	0	0	0	0	0	0	0	0.000
7	N-5	PNJ04-1	1.1076	6	0.173	0.051	0.013	0.063	0.232	5	0.243	0.018	0.071	0.089	0.325	0.093
8	N-5	PNJ08-1	0.7447	1	0.160	0.038	0.009	0.047	0.172	6	5.277	0.382	1.528	1.911	7.006	6.834
9	N-6	PCR06-1	2.8814	1	0.252	0.059	0.015	0.074	0.272	1	0.395	0.029	0.115	0.144	0.527	0.255
10	N-6	PCR07-1	0.9523	13	0.416	0.111	0.028	0.139	0.509	12	0.547	0.040	0.159	0.199	0.730	0.222
11	N-9	GTP07-1	2.27	72	25.32	7.365	1.841	9.206	33.754	39	8.442	0.611	2.446	3.057	11.209	-22.546
12	N-10	CSB01-1	1.1031	1	0.041	0.012	0.003	0.015	0.055	1	0.047	0.003	0.014	0.017	0.063	0.008
13	N-10	CSB02-1	0.5376	0	0	0	0	0	0	0	0	0	0	0	0	0.000
14	E-3	PSM22-1	0.6201	6	2.118	0.617	0.154	0.771	2.829	6	3.451	0.251	1.006	1.257	4.609	1.780
15	E-3	PSM22-2	0.5688	3	0.822	0.240	0.060	0.300	1.098	3	0.963	0.070	0.281	0.351	1.286	0.188
16	O-1	EE04-1	0.9811	0	0	0	0	0	0	0	0	0	0	0	0	0.000
17	O-1	EE07-1	0.6021	14	0.683	0.199	0.050	0.249	0.913	7	1.446	0.105	0.421	0.527	1.931	1.018
18	O-1	EE12-1	1.6616	0	0	0	0	0	0	0	0	0	0	0	0	0.000
19	S-3	KSR04-2	1.1485	0	0	0	0	0	0	0	0	0	0	0	0	0.000
20	S-3	KSR05-1	0.5106	0	0	0	0	0	0	1	0.001	0.000	0.000	0.000	0.001	0.001
21	S-3	KSR13-1	0.6088	5	0.359	0.093	0.023	0.116	0.424	0	0	0	0	0	0	-0.424
22	A-1	ARP01-1	7.8738	0	0	0	0	0	0	0	0	0	0	0	0	0.000
23	A-1	ARP01-2	9.999	0	0	0	0	0	0	0	0	0	0	0	0	0.000
		Total	43.246	166	34.05	9.864	2.466	12.330	**45.210**	120	22.40	1.626	6.504	8.130	**29.809**	-15.401
		Average	1.8803	7.2	1.481	0.429	0.107	0.536	1.966	5.2	0.974	0.071	0.283	0.353	1.296	
								Per ha	**1.05**					**Per ha**	**0.69**	
		Total	**61.21**	**435**	**66.26**	**18.59**	**4.65**	**23.24**	**85.21**	**348**	**60.41**	**4.20**	**16.81**	**21.01**	**77.05**	**-8.155**

In the baseline scenario, which includes no project activity, the volume of biomass in the target plots without human influence should not decrease. As a result, the method of comparing changes in biomass across all sample plots is not sufficient. Instead, changes in tree carbon stock were calculated from changes in the biomass of individual plots.

(3) Annual baseline GHG removals

Of the trees that were identified in the 2013 and 2014 surveys, 112 were located on farmland (228 total trees) and 61 were on grassland (120 total trees). The changes in carbon stocks of the sample trees on both grassland and farmland are shown in Figures 3.3.4 and 3.3.5.

In addition, changes in annual carbon stocks are shown in Table 3.3.10, with average increases of 0.0163 tC/tree on farmland and 0.0215 tC/tree on grassland. The change in annual GHG removals per hectare is 0.8948 tCO_2/ha/year for farmland and 0.3031 tCO_2/ha/year for grassland.

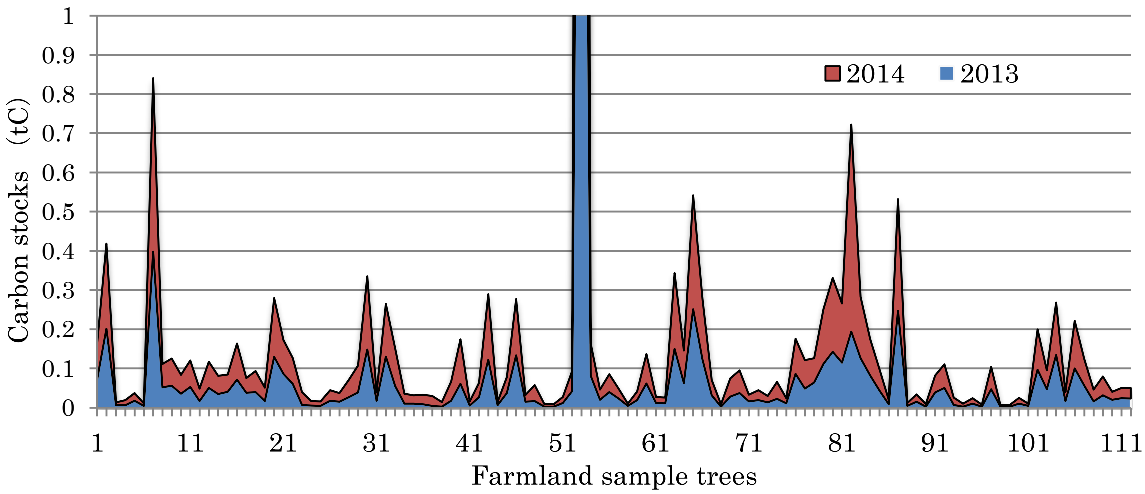

Figure 3.3.4 Change in Carbon Stock of Farmland Sample Trees, 2013-2014

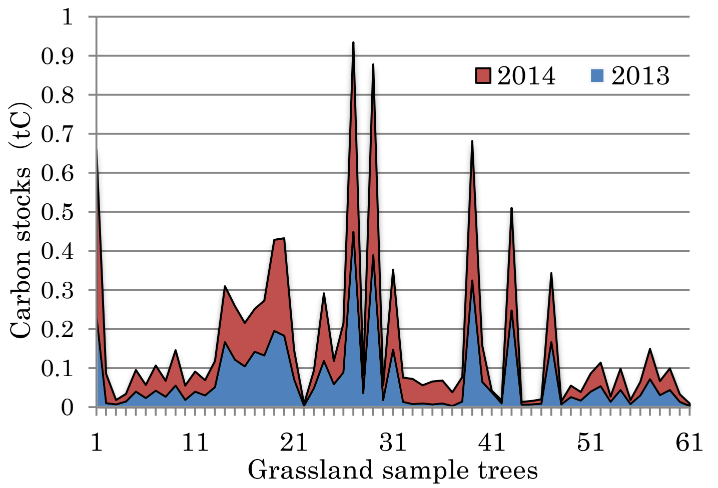

Figure 3.3.5 Change in Carbon Stock of Grassland Sample Trees, 2013-2014

Table 3.3.10　Change in Annual Baseline Carbon Stocks

		Farmland	Grassland
Change in annual baseline carbon stocks			
No. of individual trees identified	(a)	112	61
Average 2013 carbon stock value (tC/tree)	(b)	0.0794	0.0717
Average 2014 carbon stock value (tC/tree)	(c)	0.0957	0.0932
2013-2014 change (tC/tree)	(d)	**0.0163**	**0.0215**
2013 baseline carbon stocks			
No. of specimens (trees)	(e)	269	166
Survey area (ha)	(f)	17.96	43.25
No. of trees per ha (trees/ha)	(g)	14.98	3.84
Annual carbon stock per ha (tC/ha・year)	(h)	**0.2442**	**0.0826**
Change in annual GHG removal per ha (tCO_2/ha・year)	(i)	**0.8948**	**0.3031**

Note:

(a): As shown earlier in (3), the number of trees recognized to be identical from 2013 to 2014

(b): Average values for 2013 carbon stocks of 112 trees on farmland and 61 on grassland

(c): Average values for 2014 carbon stocks of 112 trees on farmland and 61 on grassland

(d): (c)-(d)

(e): Total number of trees on farmland plots and total number of trees on grassland plots, as shown in Table 3.3.9

(f): Total area of farmland plots and total area of grassland plots, as shown in Table 3.3.9

(g): (e)/(f)

(h): (d)×(g)

(i): (h)×44/12

(6) Calculation of baseline net GHG removals

Baseline net GHG removals are calculated by converting the carbon stocks of trees and shrubs in each stratum and the sum total of the change in the accumulated stocks into a volume of carbon dioxide using the following formula:

$$C_{BSL,t} = [C_{TREE\_BSL,t1} + C_{SHRUB\_BSL,t1} + \sum_{i=1}^{l}(\Delta C_{TREE\_BSL,t} + \Delta C_{SRUB\_BSL,t})] \times \frac{44}{12}$$

Where:

$C_{BSL,t}$	=	Baseline net GHG removals in year $t; tCO_{2-e}$

The results of calculating baseline GHG removals are shown in Tables 3.3.11 and 3.3.12.

Table 3.3.11 Baseline Net GHG Removals

Baseline GHG removals (tCO_{2-e})		Farmland	Grassland
Afforestation project area (ha)	(j)	180.05	117.25
2013 baseline GHG removals (tCO_{2-e})	(k)	400.93	122.57
Baseline annual GHG removals after 2014(tCO_{2-e})	(l)	161.22	35.52

Note:

(k): 2013 baseline GHG removals are calculated by multiplying the total 2013 GHG removals per unit area (ha) by the afforestation project area. In other words, the total 2013 GHG removals from Table 3.3.9 (tCO_{2-e})/(f) survey area (ha) × (j) project afforestation area (ha).

(l): Baseline GHG removals after 2014 are calculated by multiplying the change in the total 2014 GHG removals per unit area (ha) by the afforestation project area. In other words, (i) change in annual GHG removals per ha (tCO_{2-e}/ha・year) × (j) project afforestation area (ha).

Table 3.3.12 Baseline Net GHG Removals

Year	Farmland + grassland	Farmland		Grassland	
	$C_{BSL,t}$	(1)	(2)	(1)	(2)
	(tCO_2-e)	(tCO_2-e)	(tCO_2-e)	(tCO_2-e)	(tCO_2-e)
1	523.5	400.9		122.6	
2	196.7		161.2		35.5
3	196.7		161.2		35.5
4	196.7		161.2		35.5
5	196.7		161.2		35.5
6	196.7		161.2		35.5
7	196.7		161.2		35.5
8	196.7		161.2		35.5
9	196.7		161.2		35.5
10	196.7		161.2		35.5
11	196.7		161.2		35.5
12	196.7		161.2		35.5
13	196.7		161.2		35.5
14	196.7		161.2		35.5
15	196.7		161.2		35.5
16	196.7		161.2		35.5
17	196.7		161.2		35.5
18	196.7		161.2		35.5
19	196.7		161.2		35.5
20	196.7		161.2		35.5
Total	**4,260.8**	**400.9**	**3,062.8**	**122.6**	**674.5**

Note: (1) 2013 baseline GHG removals; (2) baseline GHG removals after 2014

3.3.2 Calculating Leakage

(1) Methodology and tools

Leakage is the increase in CO_2 emissions from outside the project boundaries that is caused by project activities. It is necessary to subtract this amount from the carbon sinks created by the project activities. For example, if, due to project implementation, an individual using the proposed project site for agriculture decides to move to and partake in agricultural activities at a site outside the project boundaries, the emissions created must be recognized as CO_2 leakage and subtracted from the total carbon sinks created through project activities.

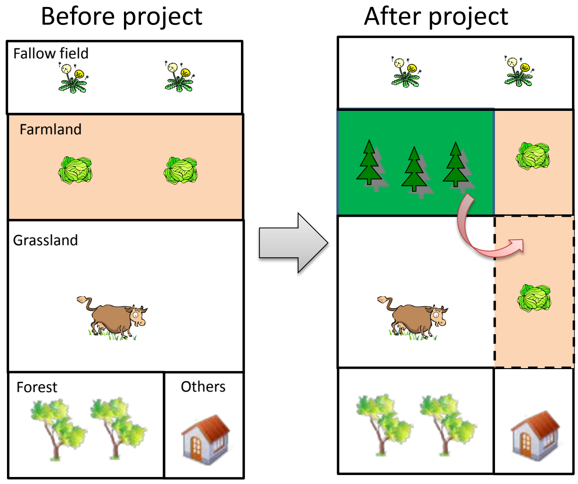

Figure 3.3.6 Changes in Land Use Caused by the Project

According to methodology AR-AMS0007 v.3.1, leakage should be calculated with the following formula:

$$LK_{AGRIC,t} = LK_{AGRIC,t}$$

Where:

$LK_{AGRIC,t}$ = Leakage due to the displacement of agricultural activities in year t

According to AR-Tool 15, "*Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 02.0,*" $LK_{AGRIC,t}$ should be calculated with the following formula:

$$LK_{AGRIC,t} = \left(\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t}\right) \times 44/12$$

Where:

$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + b_{TREE}) + b_{SHRUUB} \times (1 + R_s)] \times CF$$

$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{MGD} \times f_{IND}) \times A_{DISP,t}$$

However, when the target carbon pools include both above- and below-ground biomass, the following formula should be used:

$$LK_{AGRIC,t} = \Delta C_{BIOMASS,t} \times 44/12$$

Where:

$\Delta C_{BIOMASS,t}$	=	Decrease in carbon stock in the carbon pools of the land receiving the activity displaced in year t; tC
$\Delta SOC_{LUC,t}$	=	Change in soil organic carbon (SOC) stock due to land-use change in the land receiving the displaced activity in year t; tC
CF	=	Carbon factor of woody biomass; $tC/t.d.m$ * "0.47" according to AR-Tool 15 paragraph 11
b_{TREE}	=	Mean above-ground tree biomass in land receiving the displaced activity; $t.d.m/ha$
$A_{DISP,t}$	=	Area of land from which agricultural activity is being displaced by planting in year t (ha)
R_S	=	Root-shoot ratio for shrubs in the land receiving the displaced activity * "0.4" according to AR-Tool 15 paragraph 11
SOC_{REF}	=	Reference SOC stock corresponding to the reference condition in native lands by climate and soil type applicable to the land receiving the displaced activity; tC
f_{LUP}, f_{MGP}, f_{INP}	=	Relative SOC stock change factors for land-use (LUP), management practices (MGP), and inputs (INP), respectively, applicable to the receiving land before the displaced activity is received; dimensionless
f_{LUD}, f_{MGD}, f_{IND}	=	Relative SOC stock change factors for land-use (LUD), MGP, and INP, respectively, applicable to the receiving land after the displaced activity has been received; dimensionless

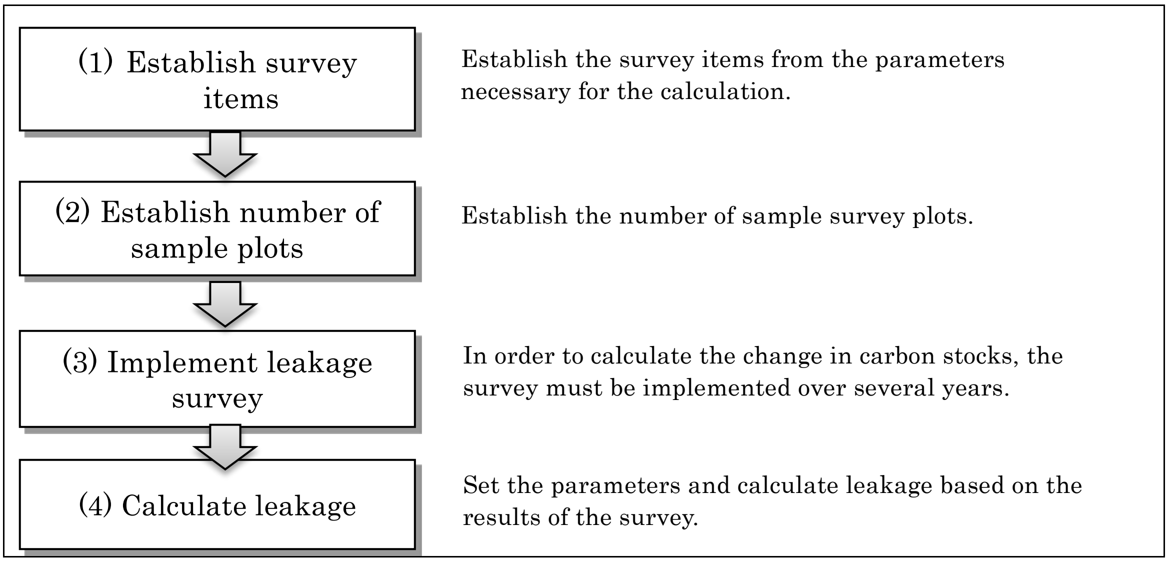

Figure 3.3.7 Flowchart for Leakage Calculation

(1) Leakage survey items

If the conditions in AR-Tool 15 paragraph 10 are met (see below), leakage can be counted as zero, but a survey is still necessary to determine the cause. Calculating leakage with the formulas in this tool requires information on any displaced activities, the displaced area, and the amount of tree and shrub biomass in the new location.

10. Leakage emission attributable to the displacement of grazing activities under the following conditions is considered insignificant and hence accounted as zero:

(a) Animals are displaced to existing grazing land and the total number of animals in the receiving grazing land (displaced and existing) does not exceed the carrying capacity of the grazing land;

(b) Animals are displaced to existing non-grazing grassland and the total number of animals displaced does not exceed the carrying capacity of the receiving grassland;

(c) Animals are displaced to cropland that has been abandoned within the last five years;

(d) Animals are displaced to forested lands, and no clearance of trees, or decrease in crown cover of trees and shrubs, occurs due to the displaced animals;

(e) Animals are displaced to zero-grazing system.

In the previous methodology tool AR-AMS0001, leakage was thought to account for 15% of actual net GHG removals prior to the project, and leakage was therefore simply calculated as 15% of carbon stocks annually after the 2nd year of the project. However, the current methodology tool makes no reference to this practice.

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As it was necessary to confirm whether project activities had caused any displacement of activity, a survey of changes in land use was conducted before and after the project activities. Where displacement activity was found, the biomass of the displaced land (trees and shrubs) was calculated.

Table 3.3.13 Leakage Survey Items

Land classification	Survey contents
Farmland	・ Whether agricultural activities have been displaced ・ Above-ground biomass (trees and shrubs) of land receiving displaced activity *land use conditions of land receiving displaced activity include land use classification, number of years of cultivation, crops planted, ratio of area plowed, and presence/absence of fertilizer
Grassland	・ Whether grazing activities have been displaced ・ If the trees on land receiving displaced activity are felled, the above-ground biomass (tree and shrubs) * land use conditions of land receiving displaced activity include number of animals pastured, presence/absence of grass, ratio of area plowed, and presence/absence of fertilizer

(2) Establishment of the number of sample plots

The number of sample plots is established in the same manner as the baseline.

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Initially the number of farmers to be included in the baseline survey of sample plots was set at 42; however, after considering that some farmers might quit the project, the estimate was revised to 46.

Table 3.3.14 Number of Sample Plots for Leakage Survey

Area of land owned (ha)	No. of farmers surveyed(households)
0-5	11
5-10	13
10-20	10
20-50	4
50-200	5
200-1000	0
1000-2000	1
2000-5500	2
Total	46

(3) Implementation of the leakage survey

To determine whether pre-project agricultural activity was being displaced to areas outside the project boundaries, a survey was conducted of the changes in farmers' land use and pasturage before and after the project, using the established survey items and the number of sample survey plots.

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CPA Coronel Oviedo was unable to confirm the displacement of grazing or agricultural activities by the project. The area of farmland (plowed and fallow fields) afforested was 14.8 ha (Table 3.3.15), and the reduction of area used as farmland (plowed and fallow fields) was 14.8 ha (Table 3.3.16). In other words, after the farmland was planted with trees, the farmers did not continue their agricultural practices elsewhere; thus, a displacement of activities was not observed. Identical results were also obtained for grassland.

Table 3.3.15 Area of Afforestation by Land Use

Afforested land	Afforestation area (ha)
Plowed fields・fallow fields	14.80
Area of grassland afforestation	132.50
Total	147.30

Table 3.3.16 Changes in Area of Land Use Due to Project Activities

Land use classification	Before afforestation (ha)	After afforestation (ha)	Change (ha)
Farmland	96.35	89.05	-7.30
Fallow land	57.75	50.25	-7.50
Natural grassland	8,568.75	8,438.15	-130.60
Artificial grassland	902.00	900.10	-1.90
Natural forest	382.00	382.00	0
Artificial forest	4.25	151.55	147.30
Other	24.60	24.60	0

The grazing density, or pasture allowance, exhibited little change after the afforestation (Table 3.3.17), suggesting the impact of the project on grazing density was minimal. The 132 ha of afforestation on grasslands decreased pasturage by 132 ha, and the livestock count was reduced by 70 animals. As a result, the grazing density increased only slightly, from 1.211 cattle/ha pre-afforestation to 1.220 cattle/ha post-afforestation.

Table 3.3.17 Changes in Pasture Density Due to the Project

	Before afforestation	After afforestation	Change
No. of beef cattle	5,302	5,244	-58
No. of dairy cattle	6,163	6,151	-12
Pasture area (ha)	9,471	9,338	-132
Pasture density (cattle/ha)	1.211	1.220	0.010

(4) Calculating leakage

The procedure for calculating leakage when agricultural activities are displaced outside the project area due to project activities is as follows:

Step 1: In case of displacement, attempt to measure the biomass of trees in the area receiving the displaced activity and obtain the carbon stock figure using the following formula:

$$b_{TREE} = SV_j \times BEF_j \times WD_j$$

Where:

b_{TREE}	=	Mean above-ground tree biomass in land receiving the displaced activity; $t.d.m/ha$
SV_j	=	Trunk volume of tree species *j*; m^3/ha
BEF_j	=	Above-ground biomass expansion factor for tree species *j*; dimensionless * From Hutchinson, J. 1972. *Peltophorum dubium* "1.5" to represent general tree species *Acrocomia tonai* "1.0" to represent a general palm tree species
WD_j	=	Basic wood density of tree species *j*; $t.d.m/m^3$

		* IPCC-GPG-LULUCF Table 3A.1.9-2 *Peltophorum pterocarpum* "0.62" was selected as a general representative species for *Peltophorum dubium* *Cocos nucifera* "0.5" was selected as a representative palm tree species for *Acrocomia tonai*

Step 2: Calculate carbon stocks of tree biomass in areas receiving displaced agricultural activity using the following formula:

$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + b_{TREE}) + b_{SHURUB} \times (1 + R_s)] \times CF \times A_{DISP,t}$$

Where:

$\Delta C_{BIOMASS,t}$	=	Decrease in carbon stock in the carbon pools of the land receiving the displaced activity in year t; tC
b_{TREE}	=	Mean above-ground tree biomass in land receiving the displaced activity; $t.d.m/ha$
R_s	=	Root-shoot ratio of above-ground portions to below-ground portions
CF	=	Carbon factor of woody biomass; $tC/t.d.m$
$A_{DISP,t}$	=	Area of land from which agricultural activity is being displaced in (planting) year t; ha

Step 3: Calculate the leakage using the following formula:

$$LK_{AGRIC,t} = \Delta C_{BIOMASS,t} \times \frac{44}{12}$$

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As the displacement of agricultural and grazing activities by the project could not be confirmed, and because there was almost no change in the grazing density as a result of afforestation, it was determined that CPA Coronel Oviedo had zero leakage emissions.

Still, calculations of the standard grazing density based on the old methodology AR-AMS0001 v0.6 Appendix D resulted in 0.88 cattle/ha, as noted below. Yet according to the old methodology, the nutritive capacity of the pasture is insufficient, regardless of the project, because the current grazing density is 1.22 cattle/ha. Moreover, the farmers currently graze their herds on fallow fields in addition to the pastures, feed them residue of sugarcane and corn, and carry on other supplementary feeding activities, suggesting that the grasslands are indeed nutrient-poor.

GC = $ANPP \times 1000 \div (DMI \times 365)$

Where:

GC = Grazing density (cattle/ha)

$ANPP$ = Dry weight of above-ground primary production goods (t.d.m/ha/year)

(8.2 is the default value according to IPCC Good Practice Guidance for LULUCF, P3.109, humid tropical climate)

DMI = Daily intake of dried foodstuffs per livestock animal (kg.d.m./animal/days) (25.5 is the default value according to Table 3, AR-AMS0001 v.0.6)

Therefore, the standard grazing density equation is worked as follows:

GC = 8.2 ×1000 ÷ (25.5 × 365) = 0.881 cattle/ha

3.3.3 Calculating Actual Net GHG Removals

(1) Methodology and tools

Actual net GHG removals can be calculated using the following formula provided by methodology AR-AMS0007 v.3.1:

$$\Delta C_{ACTUAL,t} = \Delta C_{p,t} - GHG_{E,t}$$

$$\Delta C_{p,t} = \Delta C_{TREE_{PROJ},t} + \Delta C_{SHRURB_{PROJ},t} + \Delta C_{DW_{PROJ},t} + \Delta C_{LI_{PROJ},t} + \Delta SOC_{ALI,t}$$

Where:

$\Delta C_{p,t}$	=	Change in the carbon stocks in the project, occurring in the selected carbon pools, in year t; tCO_{2e}
$GHG_{E,t}$	=	Increase in non-CO_2 GHG emissions within the project boundary as a result of the implementation of the A/R CDM project activity, in year t, as calculated in AR-Tool 8; tCO_{2e}
$\Delta C_{TREE_{PROJ},t}$	=	Change in carbon stock in tree biomass in project in year t, as estimated in AR-Tool 14; tCO_{2e}
$\Delta C_{SHRUB_{PROJ},t}$	=	Change in carbon stock in shrub biomass in project in year t, as estimated in AR-Tool 14; tCO_{2e}
$\Delta C_{DW_{PROJ},t}$	=	Change in carbon stock in dead-wood biomass in project in year t, as estimated in AR-Tool 12; tCO_{2e}
$\Delta C_{LI_{PROJ},t}$	=	Change in carbon stock in litter biomass in project in year t, as estimated in AR-Tool 12; tCO_{2e}
$\Delta SOC_{ALI,t}$	=	Change in carbon stock in SOC in project in year t, as estimated in AR-Tool 16; tCO_{2e}

(1) Stratification of carbon pool	Stratification of carbon pools in the project scenario.
(2) Establishment of tree growth scenario	Establishment of tree growth scenarios for each species afforested in order to calculate tree growth volume over several years.
(3) Establishment of management plans	Establishment of management plans for periodic thinning and rotation, which will influence carbon stocks.
(4) Calculation of actual net GHG emissions	Calculation of GHG emissions removals by strata.

Table 3.3.8 Calculation Workflow for Actual Net GHG Removals

(1) Carbon pool stratification

As with the baseline, the target carbon pools include above-ground and below-ground biomass, but do not include soil fertility or dead wood and leaf litter. Also, shrubs are not a target carbon pool, and are not included in the sample plots.

AR-Tool 8 paragraph 3 contains the calculation requirements for $GHG_{E,t}$. However, calculations do not include biomass conflagrations (fires) because the formulation of the project design specifications was unclear.

3. Non-CO_2 GHG emissions resulting from any occurrence of fire within the project boundary shall be accounted for each incidence of fire which affects an area greater than the minimum threshold area reported by the host Party for the purpose of defining forest, provided that the accumulated area affected by such fires in a given year is ≥5% of the project area.

The following formula establishes the classification of trees by strata, as derived from the passage above:

$$\Delta C_{ACTUAL,t} = \Delta C_{p,t} = \Delta C_{TREE_{PROJ},t}$$

Derived from tree species and planting year, the six strata in the classification used to calculate actual net GHG removals (project scenario) are listed in Table 3.3.18.

Table 3.3.18 Strata Classification for Actual Net GHG Removals (Project Scenario)

Stratum	Tree species	Year planted	Planting interval
S1	*E. grandis*	2013	4 m × 2.5 m
S2	*E. grandis*	2014	4 m× 2.5 m
S3	*E. camaldulensis*	2013	4 m× 2.5 m
S4	*E. camaldulensis*	2014	4 m× 2.5 m
S5	*E. grandis var. E. camaldulensis*	2013	4 m× 2.5 m
S6	*E. grandis var. E. camaldulensis*	2014	4 m× 2.5 m

(2) Establishment of tree growth scenarios

An allometry equation is configured to calculate the growth volumes of afforested tree species over multiple years. Since the actual carbon stocks will be calculated and reviewed during the verification process, a highly accurate allometry equation is unnecessary for the formulation of the project design specifications (or during validation review). However, the basis for the allometry equation adopted should be clearly defined.

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(1) Allometry formula

Tree growth volume was estimated using the *E. grandis* in the Japan International Research Center for Agricultural Sciences (JIRCAS) exhibition field in San Roque González in the department of Paraguarí. Figures 3.3.9 and 3.3.10 show the growth curves by tree age for the height and DBH, respectively. 1) mean value, 2) mean value – standard deviation (SD) (values include approximately 68% of observed data)

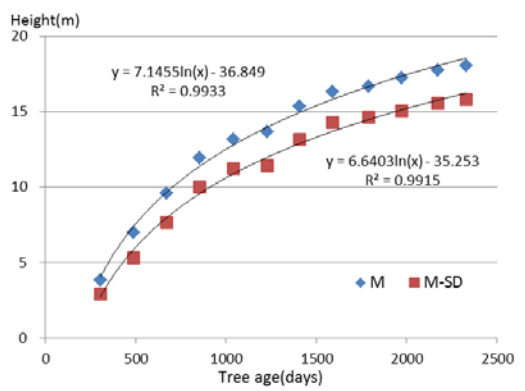

Figure 3.3.9 Yearly Growth of Tree Height (m)

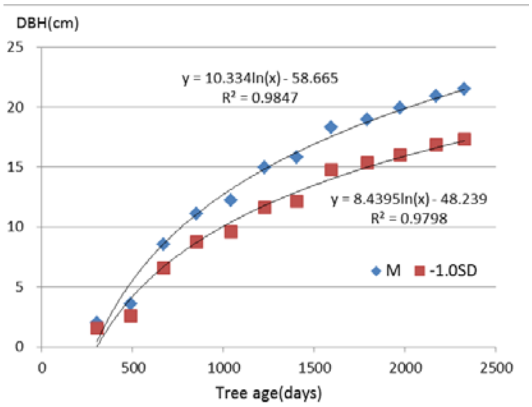

Figure 3.3.10 Yearly Growth of DBH (cm)

Note: 1. 130 trees planted and raised.
2. Height and DBH were measured once every six months from July 2007 to December 2014.

3. After June 2011, tree height could no longer be measured with the measuring pole, so only DBH measurements were taken.

Table 3.3.19 Growth Equation for Height and DBH (Approximate Curve and Coefficient of Determination R^2)

Growth division	DBH (cm)		Height (m)	
	Regression curve	R^2	Regression curve	R^2
M	Y1 = 10.334ln (days) - 58.665	0.9847	Y2 = 7.1455ln (x) - 36.849	0.9933
-1.0SD	Y1 = 8.4395ln (days) - 48.239	0.9798	Y2 = 6.6403ln (x) - 35.253	0.9915

The tree trunk volume, calculated with the height and DBH obtained from the growth equation, is shown in Figure 3.3.11 plotted against tree age.

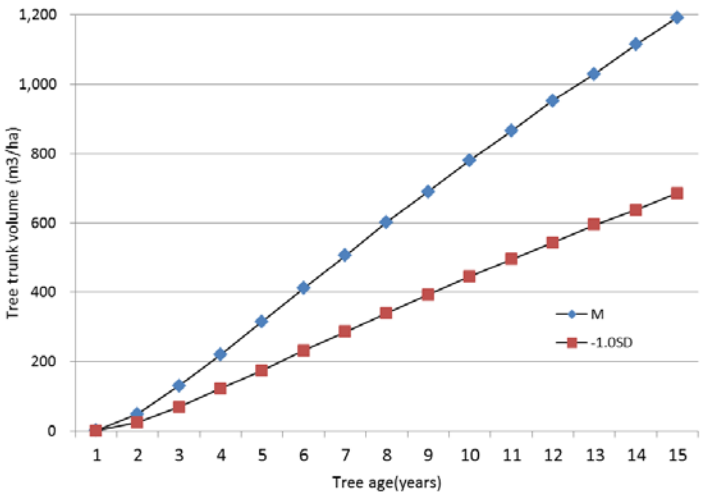

Figure 3.3.11 Tree Trunk Volume m^3 (1000 trees/ha) Continuous Annual Change

The CPA Coronel Oviedo growth scenario adopted an average value SD and used the following *E. grandis* allometry equation to produce a conservative calculation:

$$DBH_{,t} = 8.4395 \times \ln(t) - 48.239,$$

$$Height_{,t} = 6.6403 \times \ln(t) - 35.253$$

t = Number of days of growth since planting

(2) *E. grandis* and *E. camaldulensis* growth comparison

It is necessary to calculate the growth volume by tree species. The growth of *E. camaldulensis* was calculated through a comparison with the growth in trunk volume of *E. grandis*.

The DBH and height of the two species (*E. grandis* and *E. camaldulensis*) were measured in Paraguarí Department's farmers' eucalyptus plantations and the volume of their growth compared to determine a growth ratio. There was no significant difference between the species. Accordingly, the two species' growth ratio is considered identical.

Table 3.3.20 Number of Trees in Survey Sample of Farmers' Plantations

Afforested land	Farmer afforested land	
Tree species	*E. grandis*	*E. camaldulensis*
Height	873	783
DBH	1,156	1,000

Note: the measuring pole was insufficient for trees higher than 14 m; thus only DBH was measured.

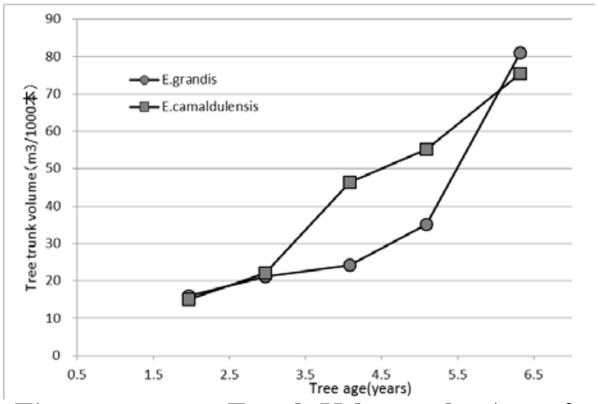

Figure 3.3.12 Trunk Volumes by Age of Two Eucalyptus Species

(3) Establishment of management plans

Periodic thinning and other forest management practices impact the carbon stock of tree biomass. Thus, clearly specifying management practices prior to project implementation will increase the accuracy of calculations. At this point, the management plan must be consistent with the unit strata. When consistency cannot be achieved, it is necessary to further subdivide the strata in order to fit the management plan.

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Management plans for the calculation of actual net GHG removals are based on a 12-year harvest period (*E. grandis* and the hybrid are thinned 30% every fourth years), which allows reforestation to continue due to coppice regeneration after harvesting.

The survival rate of sprouts (0.88) and the germination rate (0.78) were adopted from the "Brazil" entry in "coppice regeneration of *E. globulus* production plantations in Brazil and Portugal" (March 2006) by the Japan Paper Association (under the auspices of the Japan Overseas Plantation Center for Pulpwood).

As an example, the trunk volume of an *E. grandis* coppice regenerating by sprout can be calculated with the following equation:

SV = trunk volume/ha × survival rate × germination rate

(4) Calculating actual net GHG removals

The calculation method for actual net GHG removals is the same as for baseline net GHG removals, yet the calculation of the baseline is based on actual measurements and the actual net GHG is calculated by determining tree growth volumes using an allometry formula.

(1) The values applied in the calculations, as well as default values and contributions extracted from the IPCC Reference Manual, are detailed in Table 3.3.21.

Table 3.3.21 Applied Values and Default Values from IPCC

Item	Application	Reference
Biomass expansion factor for above-ground biomass of tree species	Tropical/broadleaf/average "1.5"	IPCC Table 3A.1.10
Trunk volume coefficient for tree species	*E. grandis* "0.5023"	JIRCAS, UNA, 2013
	E. camaldulensis "0.5343"	JIRCAS, UNA, 2013
Carbon density of tree species; $tC/t.d.m$	Default value "0.47"	AR-tool 14
Basic wood density for tree species (WD); $t.d.m/m^3$	*E. grandis* "0.528181"	UNA, 2007
	E. camaldulensis "0.650174"	UNA, 2007
Ratio of above- to below-ground biomass for tree species (R)	If above-ground biomass weight is less than 50 t/ha, "0.45"; between 50 and 150 t/ha, "0.35"; greater than 150 t/ha, "0.2"	LULUCF Table 3A.1.8

Note:

- JIRCAS, UNA, 2013: JIRCAS, UNA, DETERMINACION DE FACTOR DE FORMA DE *Grevillea robusta*, *Eucalyptus camaldulensis* y *Eucalyptus grandees.*
- UNA, 2007: Determinación de la Densidad Específica de la Madera de *Eucalyptus camaldulensis*, *E. grandis* y *Grevillea robusta* A. Cunn.

Table 3.3.22 Calculation of Actual GHG Removals by Stratum (Stratum 1)

[Stratum 1] Tree species *E. grandis*, afforestation density 1000/ha (4.0 × 2.5), planted in 2013													
Starting date of the project September 2013	Forest age (year)	Days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} ($tCO_{2\text{-}e}$)
2013-2014	1	0	0	0	0		0	0	0	0	0	0	0
2014-2015	2	365	1.6	3.9	0.39		0.394	0.31	0.14	0.45	45.3	21.27	78.0
2015-2016	3	730	7.4	8.5	18.36		18.363	14.55	6.55	21.09	2,110.1	991.76	3,636.4
2016-2017	4	1095	10.8	11.2	51.54	15.46*	36.076	28.58	12.86	41.44	4,145.6	1,948.44	7,144.3
2017-2018	5	1460	13.3	13.1	63.99		63.992	50.70	17.74	68.44	6,846.4	3,217.82	11,798.7
2018-2019	6	1825	15.1	14.6	91.93		91.930	72.83	25.49	98.33	9,835.5	4,622.68	16,949.8
2019-2020	7	2190	16.7	15.8	121.69		121.686	96.41	33.74	130.15	13,019.0	6,118.95	22,436.2
2020-2021	8	2555	18	16.8	150.32	45.09*	105.221	83.36	29.18	112.54	11,257.5	5,291.02	19,400.4
2021-2022	9	2920	19.1	17.7	124.82		124.821	98.89	34.61	133.50	13,354.5	6,276.61	23,014.2
2022-2023	10	3285	20.1	18.5	144.48		144.482	114.47	40.06	154.53	15,457.9	7,265.22	26,639.1
2023-2024	11	3650	21	19.2	163.68		163.677	129.68	45.39	175.06	17,511.6	8,230.47	30,178.4
2024-2025	12	4015	21.8	19.8	181.90	181.90	0	0.00	0.00	0.00	0.0	0.00	0.0
2025-2026	1	0	0	0	0		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2026-2027	2	365	1.6	3.9	0.27		0.272	0.22	0.10	0.31	31.2	14.68	53.8
2027-2028	3	730	7.4	8.5	12.67		12.670	10.04	4.52	14.56	1,456.0	684.31	2,509.1
2028-2029	4	1095	10.8	11.2	35.56	10.67*	24.892	19.72	8.87	28.60	2,860.5	1,344.42	4,929.6
2029-2030	5	1460	13.3	13.1	44.15		44.154	34.98	15.74	50.72	5,074.0	2,384.76	8,744.1
2030-2031	6	1825	15.1	14.6	63.43		63.432	50.26	17.59	67.84	6,786.5	3,189.65	11,695.4
2031-2032	7	2190	16.7	15.8	83.96		83.963	66.52	23.28	89.80	8,983.1	4,222.08	15,480.9
2032-2033	8	2555	18	16.8	103.72	31.12*	72.603	57.52	20.13	77.65	7,767.7	3,650.80	13,386.3

Note: the asterisk in harvesting volume indicates thinning volume.

Table 3.3.23 Calculation of Actual Net GHG Removals by Stratum (Stratum 2)

[Stratum 2] Tree species *E. grandis,* afforestation density 1000/ha (4.0 × 2.5), planted in 2014													
Starting date of the project September 2013	Forest Age (year)	days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} ($tCO_{2\text{-}e}$)
2013-2014							0	0	0	0	0	0	0
2014-2015	1	0	0	0	0		0	0	0	0	0	0	0
2015-2016	2	365	1.6	3.9	0.39		0.394	0.31	0.14	0.45	29.8	13.98	51.3
2016-2017	3	730	7.4	8.5	18.36		18.363	14.55	6.55	21.09	1,387.0	651.89	2,390.2
2017-2018	4	1095	10.8	11.2	51.54	15.46*	36.076	28.58	12.86	41.44	2,724.9	1,280.71	4,696.0
2018-2019	5	1460	13.3	13.1	63.99		63.992	50.70	17.74	68.44	4,500.2	2,115.08	7,755.3
2019-2020	6	1825	15.1	14.6	91.93		91.930	72.83	25.49	98.33	6,464.9	3,038.50	11,141.2
2020-2021	7	2190	16.7	15.8	121.69		121.686	96.41	33.74	130.15	8,557.5	4,022.00	14,747.3
2021-2022	8	2555	18	16.8	150.32	45.09*	105.221	83.36	29.18	112.54	7,399.6	3,477.80	12,751.9
2022-2023	9	2920	19.1	17.7	124.82		124.821	98.89	34.61	133.50	8,777.9	4,125.63	15,127.3
2023-2024	10	3285	20.1	18.5	144.48		144.482	114.47	40.06	154.53	10,160.5	4,775.45	17,510.0
2024-2025	11	3650	21	19.2	163.68		164	129.68	45.39	175.06	11,510.5	5,409.91	19,836.4
2025-2026	12	4015	21.8	19.8	181.90	181.90	0.000	0.00	0.00	0.00	0.0	0.00	0.0
2026-2027	1	0	0	0	0		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2027-2028	2	365	1.6	3.9	0.27		0.272	0.22	0.10	0.31	20.5	9.65	35.4
2028-2029	3	730	7.4	8.5	12.67		12.670	10.04	4.52	14.56	957.0	449.80	1,649.3
2029-2030	4	1095	10.8	11.2	35.56	10.67*	24.892	19.72	8.87	28.60	1,880.2	883.69	3,240.2
2030-2031	5	1460	13.3	13.1	44.15		44.154	34.98	15.74	50.72	3,335.1	1,567.51	5,747.5
2031-2032	6	1825	15.1	14.6	63.43		63.432	50.26	17.59	67.84	4,460.8	2,096.57	7,687.4
2032-2033	7	2190	16.7	15.8	83.96		83.963	66.52	23.28	89.80	5,904.6	2,775.18	10,175.7

Note: the asterisk in harvesting volume indicates thinning volume.

Table 3.3.24 Calculation of Actual Net GHG Removals by Stratum (Stratum 3)

[Stratum 3] Tree species *E. camaldulensis,* afforestation density 1000/ha (4.0 × 2.5), planted in 2013													
Starting date of the project September 2013	Forest age (year)	Days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} ($tCO_{2\text{-}e}$)
2013-2014	1	0			0		0	0	0	0	0	0	0
2014-2015	2	365			0.39		0.394	0.38	0.17	0.56	4.1	1.93	7.1
2015-2016	3	730			18.36		18.363	17.91	8.06	25.97	191.1	89.83	329.4
2016-2017	4	1095			51.54		51.537	50.26	17.59	67.85	499.4	234.72	860.6
2017-2018	5	1460			91.42		91.417	89.16	31.20	120.36	885.8	416.35	1,526.6
2018-2019	6	1825			131.33		131.329	128.08	44.83	172.91	1,272.6	598.12	2,193.1
2019-2020	7	2190			173.84		173.837	169.54	33.91	203.44	1,497.3	703.75	2,580.4
2020-2021	8	2555			214.74		214.737	209.42	41.88	251.31	1,849.6	869.33	3,187.5
2021-2022	9	2920			254.74		254.738	248.44	49.69	298.12	2,194.2	1,031.27	3,781.3
2022-2023	10	3285			294.86		294.861	287.57	57.51	345.08	2,539.8	1,193.70	4,376.9
2023-2024	11	3650			334.04		334.036	325.77	65.15	390.93	2,877.2	1,352.29	4,958.4
2024-2025	12	4015			371.22	371.22	0	0.00	0.00	0.00	0.0	0.00	0.0
2025-2026	1	0			0		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2026-2027	2	365			0.27		0.272	0.27	0.12	0.38	2.8	1.33	4.9
2027-2028	3	730			12.67		12.670	12.36	5.56	17.92	131.9	61.98	227.3
2028-2029	4	1095			35.56		35.560	34.68	15.61	50.29	370.1	173.95	637.8
2029-2030	5	1460			63.08		63.078	61.52	21.53	83.05	611.2	287.28	1,053.4
2030-2031	6	1825			90.62		90.617	88.38	30.93	119.31	878.1	412.70	1,513.2
2031-2032	7	2190			119.95		119.948	116.98	40.94	157.92	1,162.3	546.29	2,003.1
2032-2033	8	2555			148.17		148.169	144.50	50.58	195.08	1,435.8	674.82	2,474.3

Table 3.3.25 Calculation of Actual Net GHG Removals by Stratum (Stratum 4)

[Stratum 4] Tree species *E. camaldulensis,* afforestation density 1000/ha (4.0 × 2.5), planted in 2014													
Starting date of the project September 2013	Forest age (year)	Days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} (tCO_{2-e})
2013-2014					0		0	0	0	0	0	0	0
2014-2015	1	0			0		0	0	0	0	0	0	0
2015-2016	2	365			0.39		0.39	0.38	0.17	0.56	61.2	28.77	105.5
2016-2017	3	730			18.36		18.36	17.91	8.06	25.97	2,853.5	1,341.16	4,917.6
2017-2018	4	1095			51.54		51.54	50.26	17.59	67.85	7,456.4	3,504.53	12,849.9
2018-2019	5	1460			91.42		91.42	89.16	31.20	120.36	13,226.4	6,216.39	22,793.4
2019-2020	6	1825			131.33		131.33	128.08	44.83	172.91	19,000.8	8,930.39	32,744.8
2020-2021	7	2190			173.84		173.84	169.54	33.91	203.44	22,356.5	10,507.54	38,527.7
2021-2022	8	2555			214.74		214.74	209.42	41.88	251.31	27,616.4	12,979.72	47,592.3
2022-2023	9	2920			254.74		254.74	248.44	49.69	298.12	32,760.7	15,397.53	56,457.6
2023-2024	10	3285			294.86		294.86	287.57	57.51	345.08	37,920.8	17,822.76	65,350.1
2024-2025	11	3650			334.04		334.04	325.77	65.15	390.93	42,958.9	20,190.68	74,032.5
2025-2026	12	4015			371.22	371.22	0	0	0	0	0	0.00	0
2026-2027	1	0			0		0.00	0.00	0.00	0.00	0.0	0.00	0.0
2027-2028	2	365			0.27		0.27	0.27	0.12	0.38	42.2	19.85	72.8
2028-2029	3	730			12.67		12.67	12.36	5.56	17.92	1,968.9	925.40	3,393.1
2029-2030	4	1095			35.56		35.56	34.68	15.61	50.29	5,526.0	2,597.24	9,523.2
2030-2031	5	1460			63.08		63.08	61.52	21.53	83.05	9,126.2	4,289.31	15,727.5
2031-2032	6	1825			90.62		90.62	88.38	30.93	119.31	13,110.6	6,161.97	22,593.9
2032-2033	7	2190			119.95		119.95	116.98	40.94	157.92	17,354	8,156.48	29,907

Table 3.3.26 Calculation of Actual Net GHG Removals by Stratum (Stratum 5)

[Stratum 5] Tree species *E. grandis* x *E. camaldulensis*, afforestation density 1000/ha (4.0 × 2.5), planted in 2013													
Starting date of the project September 2013	Forest age (year)	Days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} ($tCO_{2\text{-}e}$)
2013-2014	1	0			0		0	0	0	0	0	0	0
2014-2015	2	365			0.39		0.394	0.38	0.17	0.56	5.2	2.46	9.0
2015-2016	3	730			18.36		18.363	17.91	8.06	25.97	243.8	114.60	420.2
2016-2017	4	1095			51.54	15.46*	36.076	35.18	15.83	51.02	479.0	225.15	825.5
2017-2018	5	1460			63.99		63.992	62.41	21.84	84.25	791.1	371.83	1,363.4
2018-2019	6	1825			91.93		91.930	89.66	31.38	121.04	1,136.5	534.17	1,958.6
2019-2020	7	2190			121.69		121.686	118.68	41.54	160.21	1,504.4	707.06	2,592.6
2020-2021	8	2555			150.32	45.09*	105.221	102.62	35.92	138.53	1,300.8	611.39	2,241.8
2021-2022	9	2920			124.82		124.821	121.73	42.61	164.34	1,543.2	725.28	2,659.4
2022-2023	10	3285			144.48		144.482	140.91	49.32	190.23	1,786.2	839.52	3,078.2
2023-2024	11	3650			163.68		163.677	159.63	31.93	191.55	1,798.7	845.38	3,099.7
2024-2025	12	4015			181.90	181.90	0	0	0	0	0	0.00	0
2025-2026	1	0			0.00		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2026-2027	2	365			0.27		0.272	0.27	0.12	0.38	3.6	1.70	6.2
2027-2028	3	730			12.67		12.670	12.36	5.56	17.92	168.2	79.07	289.9
2028-2029	4	1095			35.56	10.67*	24.892	24.28	10.92	35.20	330.5	155.35	569.6
2029-2030	5	1460			44.15		44.154	43.06	19.38	62.44	586.3	275.57	1,010.4
2030-2031	6	1825			63.43		63.432	61.86	21.65	83.51	784.2	368.57	1,351.4
2031-2032	7	2190			83.96		83.963	81.89	28.66	110.55	1,038.0	487.87	1,788.9
2032-2033	8	2555			103.72	31.12*	72.603	70.807	24.782	95.589	898	421.86	1,547

Note: the asterisk in harvesting volume indicates thinning volume.

Table 3.3.27 Calculation of Actual Net GHG Removals by Stratum (Stratum 6)

[Stratum 6] Tree species *E. grandis* x *E. camaldulensis,* afforestation density 1000/ha (4.0 × 2.5), planted in 2014

Starting date of the project September 2013	Forest age (year)	Days	DBH (cm)	Height (m)	Stem volume (m^3/ha)	Harvesting volume (m^3)	Remaining stem volume (m^3)	$b_{TREE\_AG,i}$ (t.d.m/ha)	$b_{TREE\_BG,i}$ (t.d.m/ha)	$b_{TREE,i}$ (t.d.m/ha)	$b_{TREE,i} \cdot A_i$ (t.d.m)	B_{TREE} (tC)	C_{TREE} (tCO_{2-e})
2013-2014					0		0	0	0	0	0	0	0
2014-2015	1	0			0.00		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2015-2016	2	365			0.39		0.394	0.38	0.17	0.56	5.2	2.46	9.0
2016-2017	3	730			18.36		18.363	17.91	8.06	25.97	243.8	114.60	420.2
2017-2018	4	1095			51.54	15.46*	36.076	35.18	15.83	51.02	479.0	225.15	825.5
2018-2019	5	1460			63.99		63.992	62.41	21.84	84.25	791.1	371.83	1,363.4
2019-2020	6	1825			91.93		91.930	89.66	31.38	121.04	1,136.5	534.17	1,958.6
2020-2021	7	2190			121.69		121.686	118.68	41.54	160.21	1,504.4	707.06	2,592.6
2021-2022	8	2555			150.32	45.09*	105.221	102.62	35.92	138.53	1,300.8	611.39	2,241.8
2022-2023	9	2920			124.82		124.821	121.73	42.61	164.34	1,543.2	725.28	2,659.4
2023-2024	10	3285			144.48		144.482	140.91	49.32	190.23	1,786.2	839.52	3,078.2
2024-2025	11	3650			163.68		164	160	32	192	1,799	845.38	3,100
2025-2026	12	4015			181.90	181.90	0.000	0.00	0.00	0.00	0.0	0.00	0.0
2026-2027	1	0			0.00		0.000	0.00	0.00	0.00	0.0	0.00	0.0
2027-2028	2	365			0.27		0.272	0.27	0.12	0.38	3.6	1.70	6.2
2028-2029	3	730			12.67		12.670	12.36	5.56	17.92	168.2	79.07	289.9
2029-2030	4	1095			35.56	10.67*	24.892	24.28	10.92	35.20	330.5	155.35	569.6
2030-2031	5	1460			44.15		44.154	43.06	19.38	62.44	586.3	275.57	1,010.4
2031-2032	6	1825			63.43		63.432	61.86	21.65	83.51	784.2	368.57	1,351.4
2032-2033	7	2190			83.96		83.963	81.886	28.660	110.546	1,038	487.87	1,789

Note: the asterisk in harvesting volume indicates thinning volume.

3.3.4 Anthropogenic GHG Removals and tCER Calculation

The formula for calculating net anthropogenic GHG removals from the results of the above calculations is as follows:

$$\Delta C_{AR-CDM,t} = \Delta C_{ACTUAL,t} - \Delta C_{BSL,t} - \Delta LK_t$$

Credits are issued on the basis of the total volume of carbon stocks during verification. However, there are no regulations to refer to during verification, so to avoid peak carbon stocks, the process is generally delayed for one year. In addition to the portion earmarked for aid to developing countries (2%) and the share of proceeds (SOP), a total of US$0.10 of each 1 tCO_2 goes to CDM operation costs.

CPA Coronel Oviedo Case Study

Short-term, fixed-deadline credits (tCER) are issued for net anthropogenic GHG removals.

The results of the tCER calculations for CPA Coronel Oviedo are shown in Table 3.3.28. Further, the total tCER issuance (the blue rows indicate total figures) was 192,685 tCO_2-e with a 20-year average of 9,634 tCO_2-e.

Table 3.3.28 Results of tCER Calculations for CPA Coronel Oviedo tCER

Year	Actual GHG removals (tCO_2-e)	Net GHG removals (tCO_2-e)	$\Delta C_{BSL,t}$ (tCO_2-e)	$LK_{,t}$ (tCO_2-e)	Net anthropogenic GHG removals (tCO_2-e)	tCER (tCO_2-e)
2013	0.00	0	524	0	-524	-524
2014	94.08	94	197	0	-103	-626
2015	4,551.77	4,458	197	0	4,261	3,635
2016	16,558.49	12,007	197	0	11,810	15,445
2017	33,060.08	16,502	197	0	16,305	31,751
2018	53,013.65	19,954	197	0	19,757	51,508
2019	73,453.70	20,440	197	0	20,243	71,751
2020	80,697.31	7,244	197	0	7,047	78,799
2021	92,040.96	11,344	197	0	11,147	89,946
2022	108,338.60	16,298	197	0	16,101	106,047
2023	124,174.92	15,836	197	0	15,639	121,687
2024	96,968.60	-27,206	197	0	-27,403	94,284
2025	0.00	-96,969	197	0	-97,166	-2,882
2026	64.91	65	197	0	-132	-3,014
2027	3,140.72	3,076	197	0	2,879	-134
2028	11,469.35	8,329	197	0	8,132	7,998
2029	24,140.96	12,672	197	0	12,475	20,473
2030	37,045.49	12,905	197	0	12,708	33,182
2031	50,905.62	13,860	197	0	13,663	46,845
2032	59,279.08	8,373	197	0	8,176	55,021
Total		59,282	4,261	0	55,021	821,192

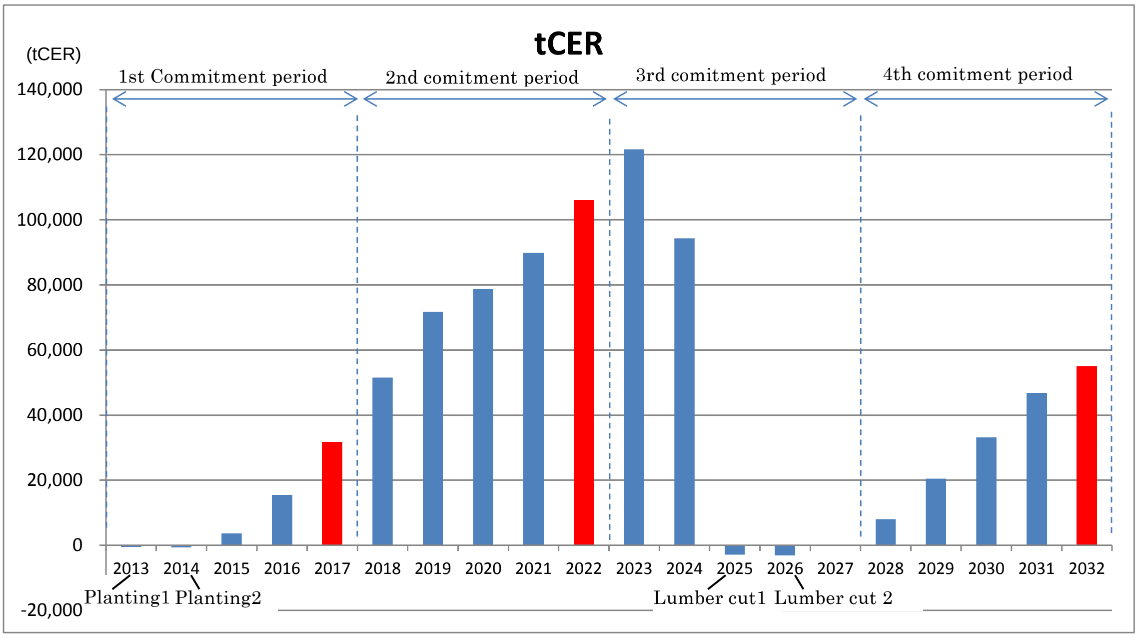


Figure 3.3.13　Planned Issuance of tCERs During Project Period

Chapter 4 Profitability Analysis of Forest Management by Farmers

4.1 Objective

If it can be shown that forest management by farmers has guaranteed a certain level of profitability after the afforestation of a wide area, then in addition to restoring forest resources, the project can be said to have improved the farmers' standard of living. However, many studies on forest resources are being conducted by a variety of institutions, and results are unclear regarding the economy of farmer-based forestry and the circulation of lumber.

Therefore, the goal of this chapter is to build upon the results of regional natural resource project surveys by outlining methods and procedures for conducting a profitability analysis of forest management by farmers, as well as highlighting indications that afforestation can guarantee profitability.

4.2 Profitability Analysis

(1) What is a profitability analysis?

Profitability can be described simply as the condition of yielding financial gains, demonstrating a positive overall ratio of expenses (investments) to income (profit). A profitability analysis of forest management by farmers was conducted using data on the pace of tree growth, forestry expenses, and the cost of selling lumber to determine whether the project was profitable. The profitability analysis makes possible a quantitative understanding of the relationship between profit and the size of the timber harvest.

(2) Method of analysis

The internal rate of return (IRR) and Net Present value method (NPV) was the method used to analyze the profitability of forest management by farmers. The IRR is the income ratio of fixed expenditures to earnings. As an example, imagine an initial investment of $100,000 in a bank account with compound interest, with successive withdrawals of $50,000, $50,000, and $30,000 over the first three years of the account. The IRR on this account is the rate of return that makes the net present value of all monetary flows from the initial investment equal zero. And net present value method is used in capital budgeting to analyze the profitability of project converting the present value of a common time in the sum of incoming and outgoing cash flows over a period of time. It is a convenient indicator to determine how effectively capital investments are being used, and it can be calculated easily with programmable spreadsheet software such as MS Excel.

In this chapter, the valuation basis of the IRR was set at a 10% interest rate for bank deposits (Central Bank 2014). The rate for bank deposits rather than loans was used because it was assumed that since forestry activities are complementary to agricultural activities for the farmers, they would invest their own money and extra time into forest management. And the discount rate calculated by net present value is defined as 10 percent.

(3) Information and data for the analysis

The following information was required for the profitability analysis:

- Information necessary to calculate expenditures (preparation, planting, and silviculture costs)
- Information necessary to calculate income (selling price of eucalyptus firewood, lumber, and saw logs)
- Size of timber harvest (amount of tree growth)

(4) Steps in a profitability analysis

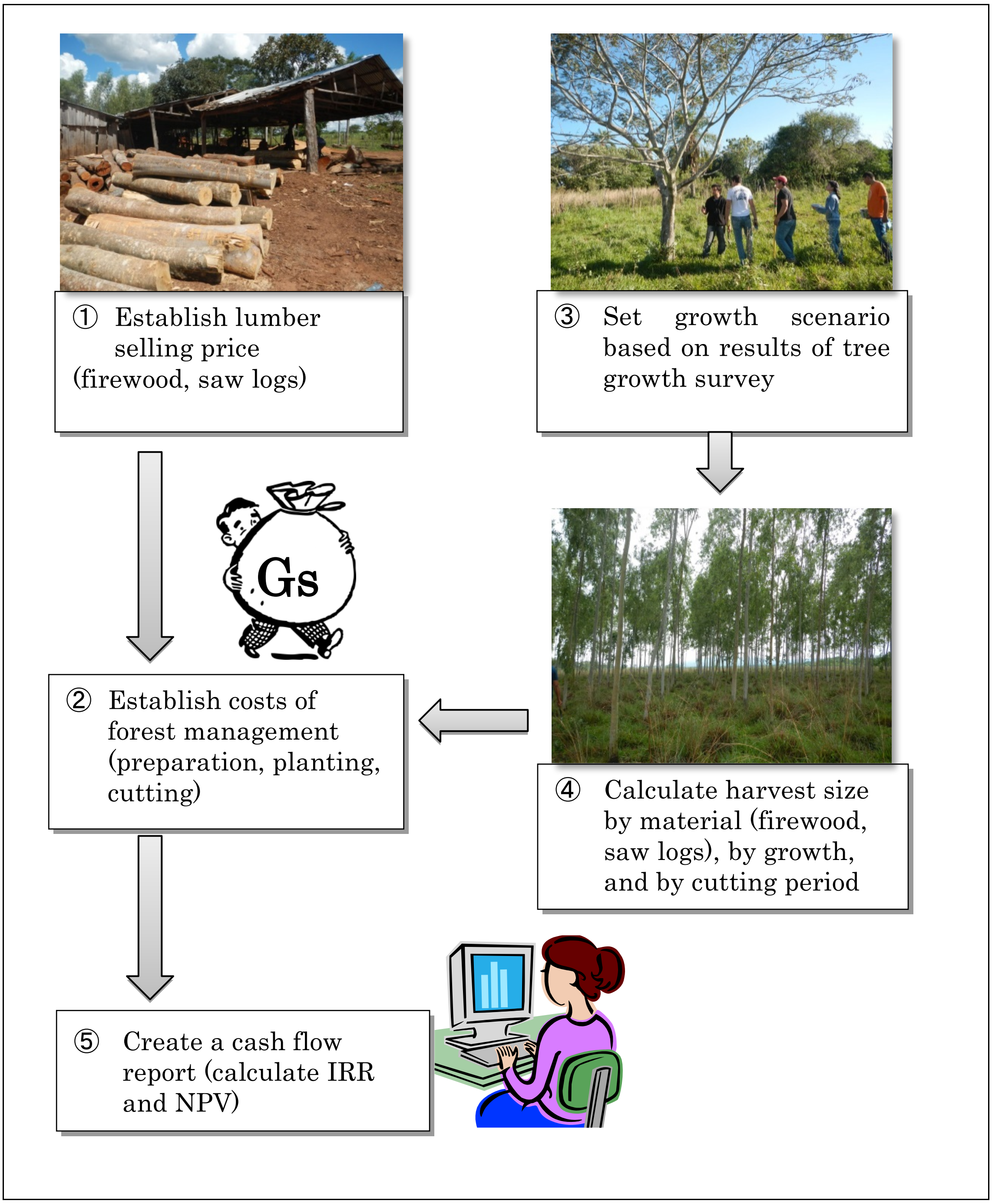


Figure 4.2.1 Steps in a Profitability Analysis

4.3 Procedure for Profitability Analysis and a Case Study

① Establishing a lumber selling price with the producers (farmers)

- To guarantee accurate price setting, we interviewed not only the producers but also those involved in distribution and consumption to verify the validity of the prices.
- The selling price of eucalyptus saw logs varies considerably depending on the species, the diameter, the condition, and so on.
- Sawmill purchasing policies reflect their equipment capacity and cover everything from the smallest diameter to the longest log.

[CPA Coronel Oviedo case survey]

The results of the lumber selling price interviews conducted as part of this survey are displayed in Table 4.3.1 and in Figure 4.3.1.

Table 4.3.1 Lumber Selling Prices by Producer

Tree species	Unit price (Gs/m^3)	Supplement
Firewood	37,100	Artificial and natural forests
Eucalyptus saw log (small dia.)	88,300	Ends between 18 cm-22cm,length 5.5 m
Eucalyptus saw log (medium dia.)	136,000	Ends greater than 22 cm, length 5.5 m

Note: prices of materials in producers' area (felling and gathering performed by farmers)

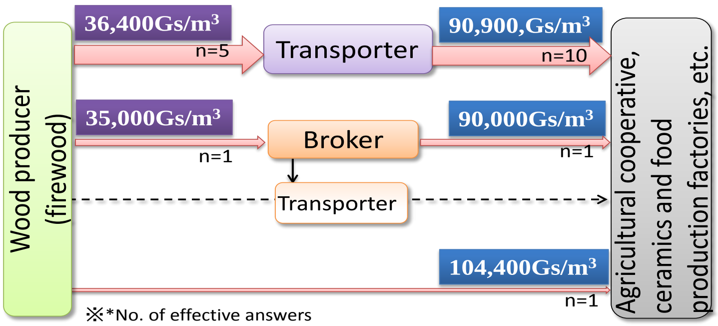


Figure 4.3.1 Production and pricing of firewood

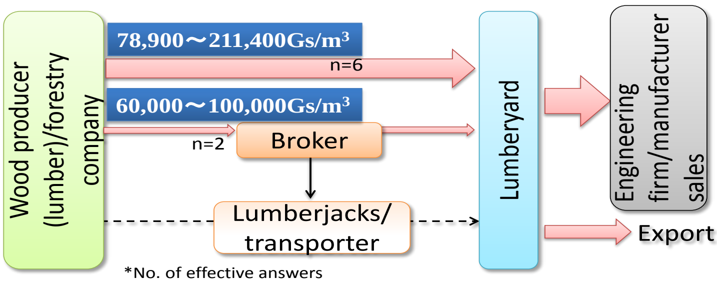


Figure 4.3.1 Production and Pricing of Eucalyptus Saw Logs

② Establishing costs of forest management by farmers

- Forestry methods (weeding, pruning, and periodic thinning) are performed differently by different producers, so conservative values were used in the following calculations to avoid overestimates.

[CPA Coronel Oviedo case survey]

Table 4.3.2 Eucalyptus Afforestation Costs (1000 trees/ha)

Expense item	Unit	Average cost (Gs)	Note
Fencing	Gs/ha	510,000	n = 20
Plowing	Gs/ha	401,000	n = 60
Seedlings	Gs/tree	760	*E. grandis* 760 Gs/tree (P Co., 2013 price)
Planting	Gs/ha	229,000	n = 35
Planting materials	Gs/ha	127,000	n = 19
Weeding	Gs/ha	180,000	3 people/day × 60,000 Gs
Pruning	Gs/ha	180,000-300,000	3 second-graders/day × 60,000 Gs 5 fourth-graders/day × 60,000 Gs

Note: n is the number of effective answers received in the interview surveys

Table 4.3.3 Eucalyptus Lumbering Costs (1000 tree/ha)

Expense item	No./unit		Unit price (Gs)	Expenses (Gs)
Felling				
Laborers	6	Person/day	50,000	300,000
Chainsaw rental fee	3	Number/day	40,000	120,000
Fuel	50.7	Liter/day	6,000	304,200
Hauling lumber	43	Person/day	60,000	2,580,000
Cart rental fee	1	Flat rate	10,000	10,000
Sundry items (food & drink, etc.)	5	%		166,250
Per hectare				3,480,450

Note:

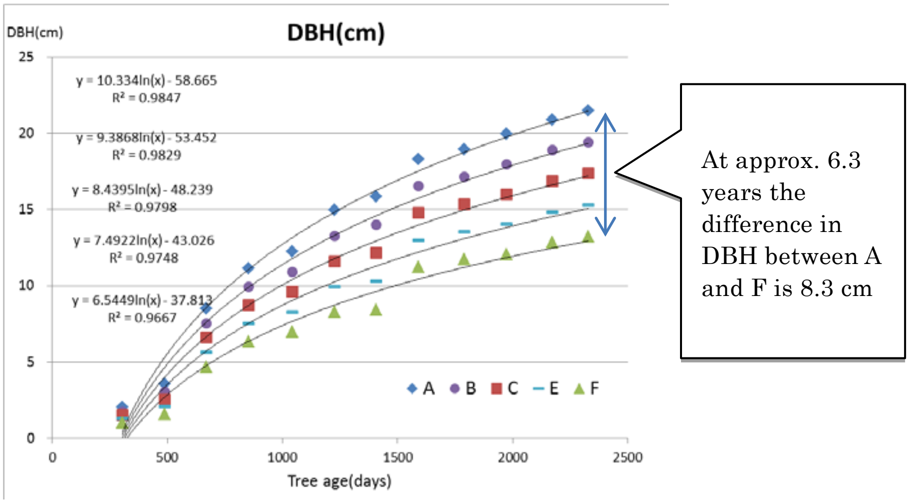
・Interviews with farmers of Oviedo (June 2013)
・Tree species: *E. grandis*: tree age: 12 years; yield of 422 m^3 at 1000 trees/ha
・Fuel tank for a 70 cc class chainsaw included in the rental fee
・Cart rental fee and cost of sundry items is approximate

③ Eucalyptus (*E. grandis*) plantation growth scenario

- Required survey items are height and diameter at breast height (DBH).
- Because growth rates differ by area, multiple growth scenarios were established.
- However, in order to avoid overestimating the growth, a conservative growth scenario was established.

[CPA Coronel Oviedo case survey]

Growth data (*E. grandis*) was used from the Japan International Research Center for Agricultural Sciences (JIRCAS) exhibition field in San Roque González in the department of Paraguarí. In Figure 4.3.2, "M" is the average value, and using the standard deviation (SD), five patterns of growth curves, A-E (A = M, B = M-0.5 SD, C = M-1.0 SD, D = M-1.5 SD, and E = M-2.0 SD) were established according to the age of the stand.



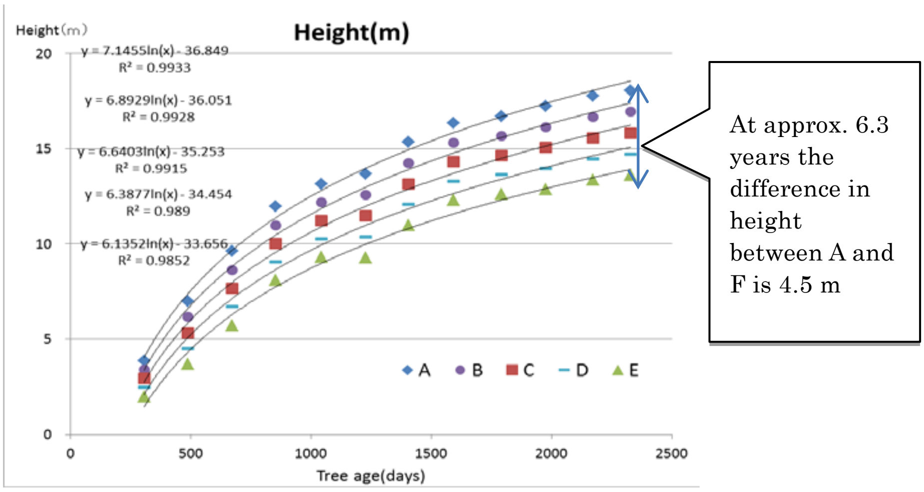


Figure 4.3.2 Changes in Height and DBH of *E. grandis* Over Multiple Years of Growth

Note: the measurement period was from August 2007 to September 2014; the survey frequency was once every six months; the afforestation interval was 4 m × 3 m, with 130 trees planted and raised; and the measurement sample size was 1417 trees for DBH and 889 for height.

Table 4.3.4　Growth Formulas for DBH and Height

Growth pattern	DBH (cm)		Height (m)	
	Growth formula	R^2	Growth formula	R^2
A	Y1 = 10.334ln (days) - 58.665	0.9847	Y2 = 7.1455ln (x) - 36.849	0.9933
B	Y1 = 9.3868ln (days) – 53.452	0.9829	Y2 = 6.8929ln (x) - 36.051	0.9928
C	Y1 = 8.4395ln (days) - 48.239	0.9798	Y2 = 6.6403ln (x) - 35.253	0.9915
D	Y1 =7.4922ln (days) – 43.026	0.9748	Y2 = 6.3877ln (x) - 34.454	0.9890
E	Y1 = 6.5449ln (days) - 37.813	0.9667	Y2 = 6.1352ln (x) - 33.656	0.9852

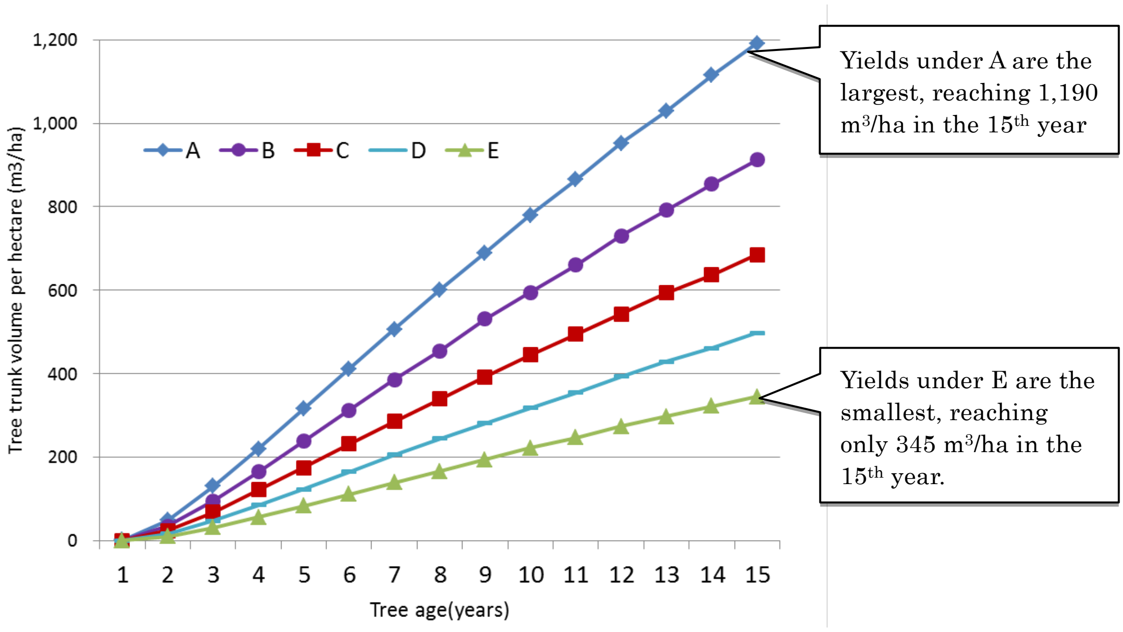


Figure 4.3.3 Changes in *E. grandis* Trunk Volume by Felling Date and Growth Volume

Note

Calculation of trunk volume by tree age

Trunk volumes by tree age were calculated for the five growth patterns, as follows:

Trunk volume = DBH x height x tree trunk volume coefficient

Tree trunk volume coefficient	=	*E. grandis* trunk volume coefficient (dimensionless) 0.502 "Determinación de la Densidad Específica de la Madera de *Eucalyptus camaldulensis*, *E. grandis* y *Grevillea robusta* A. Cunn," Asuncion University, 2007.4

④ Calculating yields (firewood, saw logs) by felling date, growth, and lumber type

- Calculate yield size by lumber type (firewood and saw logs) for each growth pattern.
- Saw log standards (diameter of ends and length) were confirmed during the lumber price survey.

[CPA Coronel Oviedo case survey]

The diameter of saw log ends by growth pattern is displayed in Table 4.3.5. The criterion is to sell logs with ends greater than 18 cm in diameter. According to pattern A, saw logs can be harvested in the 8th year, but in patterns D and E the harvest cannot occur within 15 years.

Table 4.3.5 End Diameter (cm) of Saw Logs Greater Than 5.5 m by Tree Age and Growth Pattern

irowth patter	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th
A	4.5	8.6	11.5	13.8	15.6	17.1	18.5	19.6	20.7	21.6	22.5	23.2	24.0	24.6
B	3.4	7.1	9.8	11.9	13.5	14.9	16.1	17.2	18.1	18.9	19.8	20.4	21.1	21.6
C	2.4	5.7	8.2	10.0	11.5	12.7	13.8	14.7	15.6	16.3	17.0	17.6	18.2	18.7
D	1.4	4.3	6.5	8.1	9.4	10.5	11.5	12.2	13.0	13.6	14.3	14.8	15.3	15.8
E	0.3	2.9	4.8	6.2	7.3	8.2	9.1	9.8	10.5	11.0	11.6	12.0	12.5	12.8

Note:

Green: firewood (diameter less than 18 cm) , Orange: small saw logs (diameter between 18 cm and 22 cm),Red: medium saw logs (diameter between 22 cm and 26 cm)

Figure 4.3.4, which shows lumber volumes (harvest yield), was created from Table 4.3.5 data.

As an example, in the 15th year, pattern A will yield 316 m^3/ha of medium saw logs, 198 m^3/ha of small saw logs, and 305 m^3/ha of firewood.

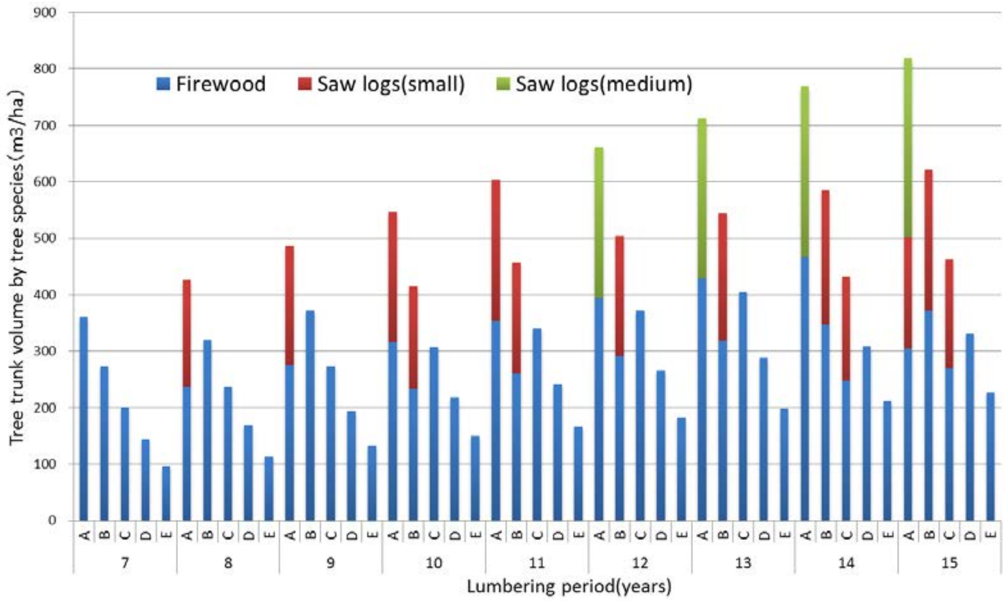


Figure 4.3.4 Trunk Volume by Lumber Type, Tree Age, and Growth Pattern

⑤ Creating a cash flow report

➢ Create a cash flow report using spreadsheet software and calculate the IRR(%) and Net Present value(Gs).

[CPA Coronel Oviedo case survey]

As an example, the cash flow of growth pattern C is shown in Figure 4.3.5. The highest IRR, 17.6%, is obtained by harvesting in the 14th year.

No periodic thinning,15-year clear cut			1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	IRR	NPV
	Expenses	Field fence	510,000																
		Plowing	401,000																
		Planting(seedling)	760,000	76,000															
M-SD		Planting	229,000	22,900															
4.0*2.5		Misc.raw materials	127,000																
1000		Weeding		180,000		180,000													
		Pruning		120,000		300,000													
		Felling					1,013,000	1,332,000	1,639,000	1,934,000	2,222,000	2,506,000	2,770,000	3,022,000	3,292,000	3,508,000	3,754,000		
		Subtotal	2,027,000	398,900	0	480,000	1,013,000	1,332,000	1,639,000	1,934,000	2,222,000	2,506,000	2,770,000	3,022,000	3,292,000	3,508,000	3,754,000		
		Felling percentage					100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%		
	Yield	Firewood					124.3	163.7	201.1	237.3	273.2	307.9	340.4	371.7	404.8	248.8	269.4		
		Saw logs≧18														183.1	193.0		
	Incon	Subtotal	0	0	0	0	4,611,596	6,072,132	7,460,154	8,802,240	10,135,551	11,423,017	12,628,976	13,789,879	15,019,790	25,401,000	27,033,620		
																		IRR	NPV
Cash flow		5 yr full cut	-2,027,000	-398,900	0	0	3,598,596											10.8%	68,201
		6 yr full cut	-2,027,000	-398,900	0	-480,000	0	4,740,132										11.7%	192,884
		7 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	5,821,154									13.6%	535,777
		8 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	6,868,240								14.3%	774,517
		9 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	7,913,551							14.4%	941,408
		10 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	8,917,017						14.2%	1,031,443
		11 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	0	9,858,976					13.8%	1,050,371
		12 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	0	0	10,767,879				13.4%	1,023,877
		13 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	0	0	0	11,727,790			13.0%	986,210
		14 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	0	0	0	0	21,893,000		17.6%	3,592,138
		15 yr full cut	-2,027,000	-398,900	0	-480,000	0	0	0	0	0	0	0	0	0	0	23,279,620	16.7%	3,379,260

Highest IRR

Figure 4.3.5 IRR and Cash Flow for Growth Pattern C

The change in IRR by harvest time for the five growth patterns is shown in Figure 4.3.6.

When saw logs are ready for harvest, the IRR is increasing. To increase profitability, it is important to cut lumber when the price is on the rise.

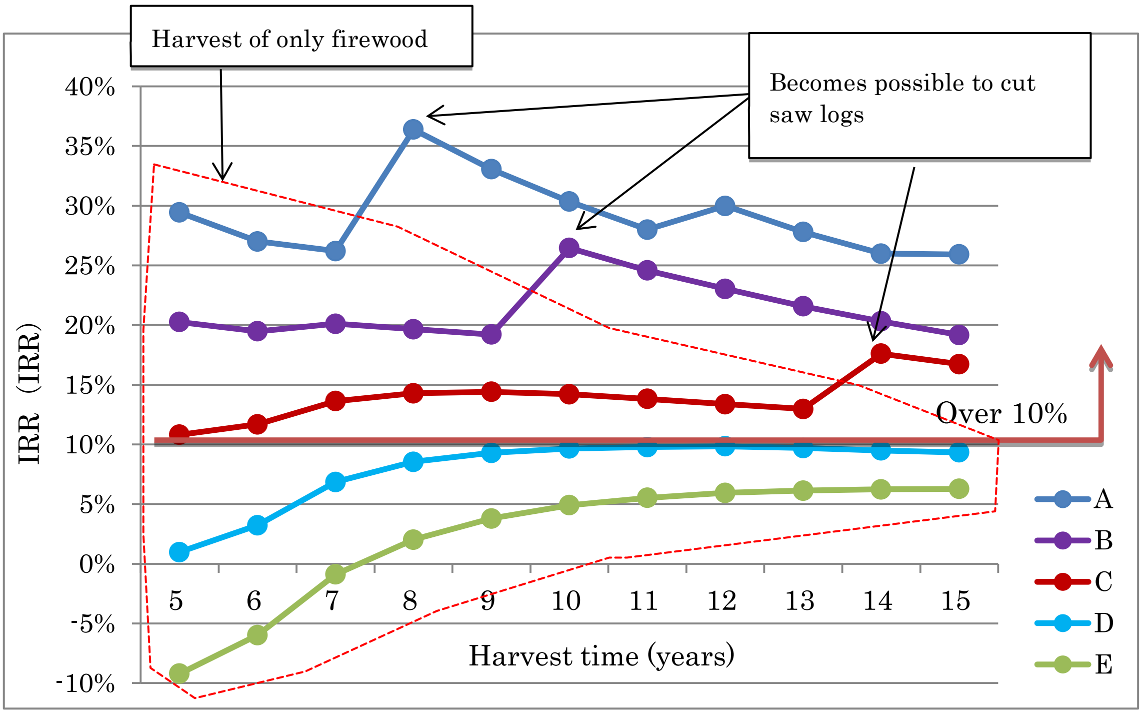


Figure 4.3.6 Changes in IRR by Harvest Time and Growth Pattern

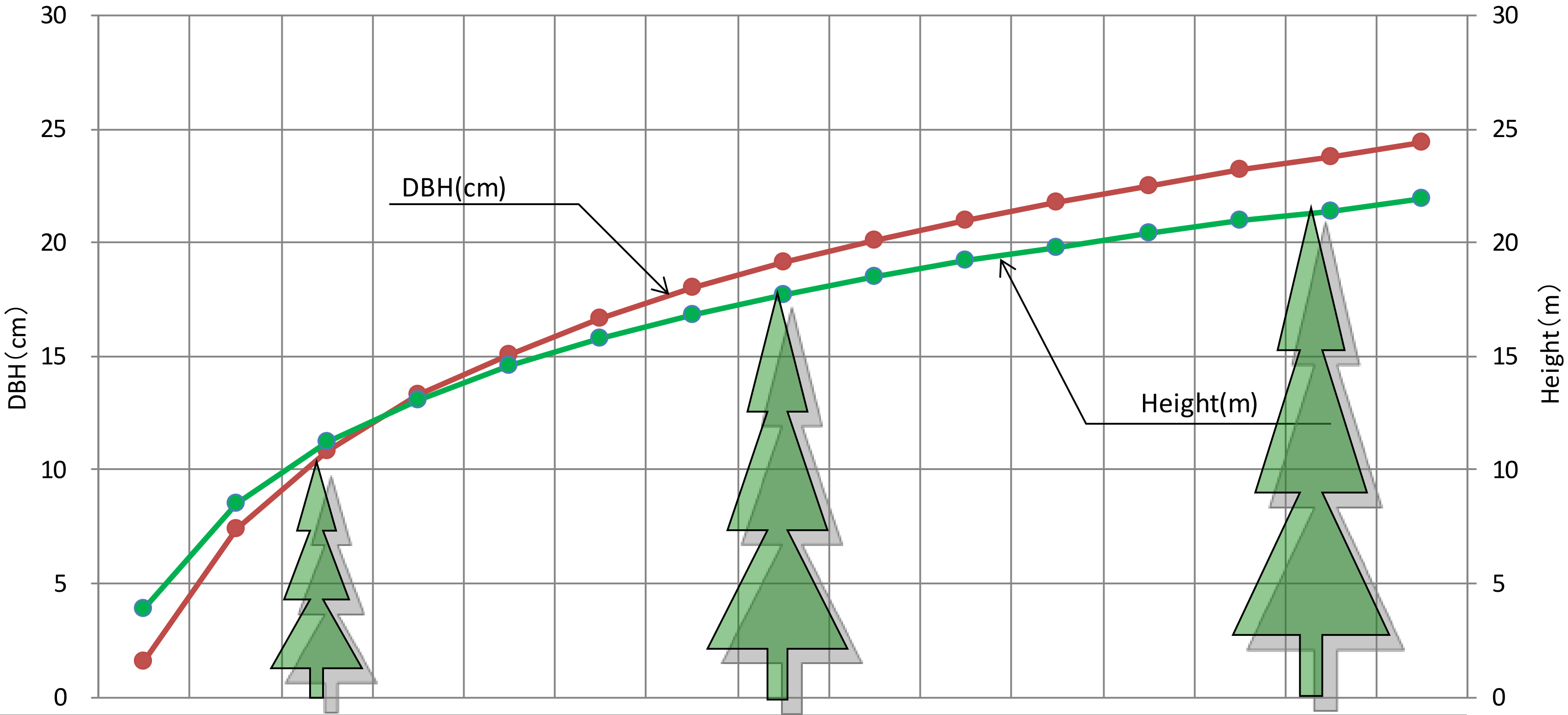
If the valuation basis values ensuring profitability are set with an IRR of 10%, then when growth volumes are at or above C (except a harvest at year 5) can be achieved, the profitability of forest management by farmers can be guaranteed. And NPV in table shows the case of A,B, C only which can ensure the profitability.

Table 4.3.6 Results of IRR and NPV Calculation

Harvest	A		B		C		D	E
years	IRR	NPV	IRR	NPV	IRR	NPV	IRR	IRR
5	29%	2,087	20%	980	11%	68	1%	-9%
6	27%	2,534	19%	1,245	12%	193	3%	-6%
7	26%	3,138	20%	1,717	14%	536	7%	-1%
8	36%	8,547	20%	2,009	14%	775	9%	2%
9	33%	8,846	19%	2,282	14%	941	9%	4%
10	30%	8,991	26%	6,295	14%	1,031	10%	5%
11	28%	8,931	25%	6,256	14%	1,050	10%	6%
12	30%	13,259	23%	6,193	13%	1,024	10%	6%
13	28%	12,784	22%	5,959	13%	986	10%	6%
14	26%	5,694	20%	5,694	18%	3,592	9%	6%
15	26%	14,396	19%	5,361	17%	3,379	9%	6%

Afforestation index for guaranteeing profitability

Tree growth curves that can guarantee an IRR of 10% or more are shown in an afforestation index in Figure 4.3.7.



Tree age (years)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
IRR					10.8%	11.7%	13.6%	14.3%	14.4%	14.2%	13.8%	13.4%	13.0%	17.6%	16.7%
NVP (1000Gs)					68	193	536	775	941	1,031	1,050	1,024	986	3,592	3,379

Figure 4.3.7　Tree growth curves that can guarantee an IRR of 10% or more are shown in an afforestation index

Reference Material: Investigation of the impact of eucalyptus afforestation on soil environment

1. Abstract

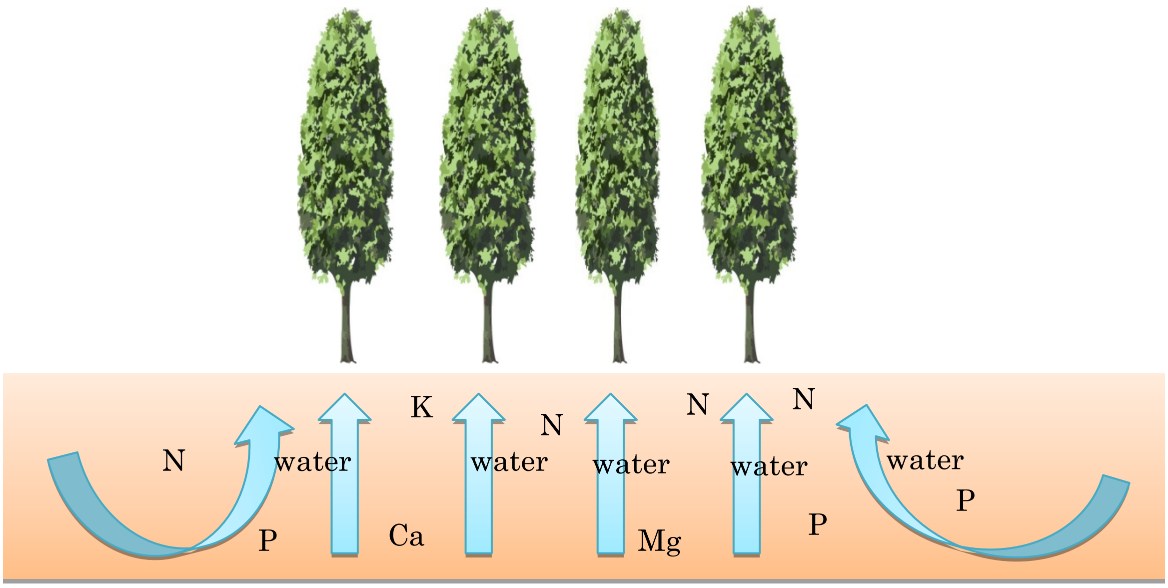
Eucalyptus is an extremely useful timber resource and eucalyptus afforestation is conducted throughout the world. Some environmental protection organizations, including NGOs, criticize eucalyptus afforestation. Criticisms include [1] eucalyptus consumes a large quantity of nutrients from the soil, which deteriorates if the trees are repeatedly cut down quickly, and [2] eucalyptus consumes a great deal of the soil's moisture, harming its water source function.

In Paraguay, the potential for eucalyptus afforestation is high thanks to the broad areas of grasslands that remain in the country, but there is concern that it harms the natural environment. The reasons for this fear are that few past efforts have been made to carry out eucalyptus afforestation, and there is both a shortage of knowledge and low awareness of its impacts on the soil environment. Therefore, in order to promote eucalyptus afforestation over a wide area through regional resource projects, the impacts of eucalyptus afforestation on ground water levels and on soil nutrient content were studied.

The Rural Association of Paraguay (Asociación Rural del Paraguay [ARP]) of Coronel Oviedo City in the Caaguazú Department designated a portion of test land among the natural grasslands it manages, carried out eucalyptus afforestation (*E. camaldulensis, E. grandis, and var. E. camaldulensis*) of the land, and observed the changes over time of the ground water level and soil nutrient content.

The investigation results showed that the average ground water level of the afforested section was 0.85 m, while that of the comparison section was almost equal at 0.84 m. Regarding the soil nutrient content, no conspicuous decline was found to be caused by the eucalyptus afforestation.

Eucalyptus afforestation

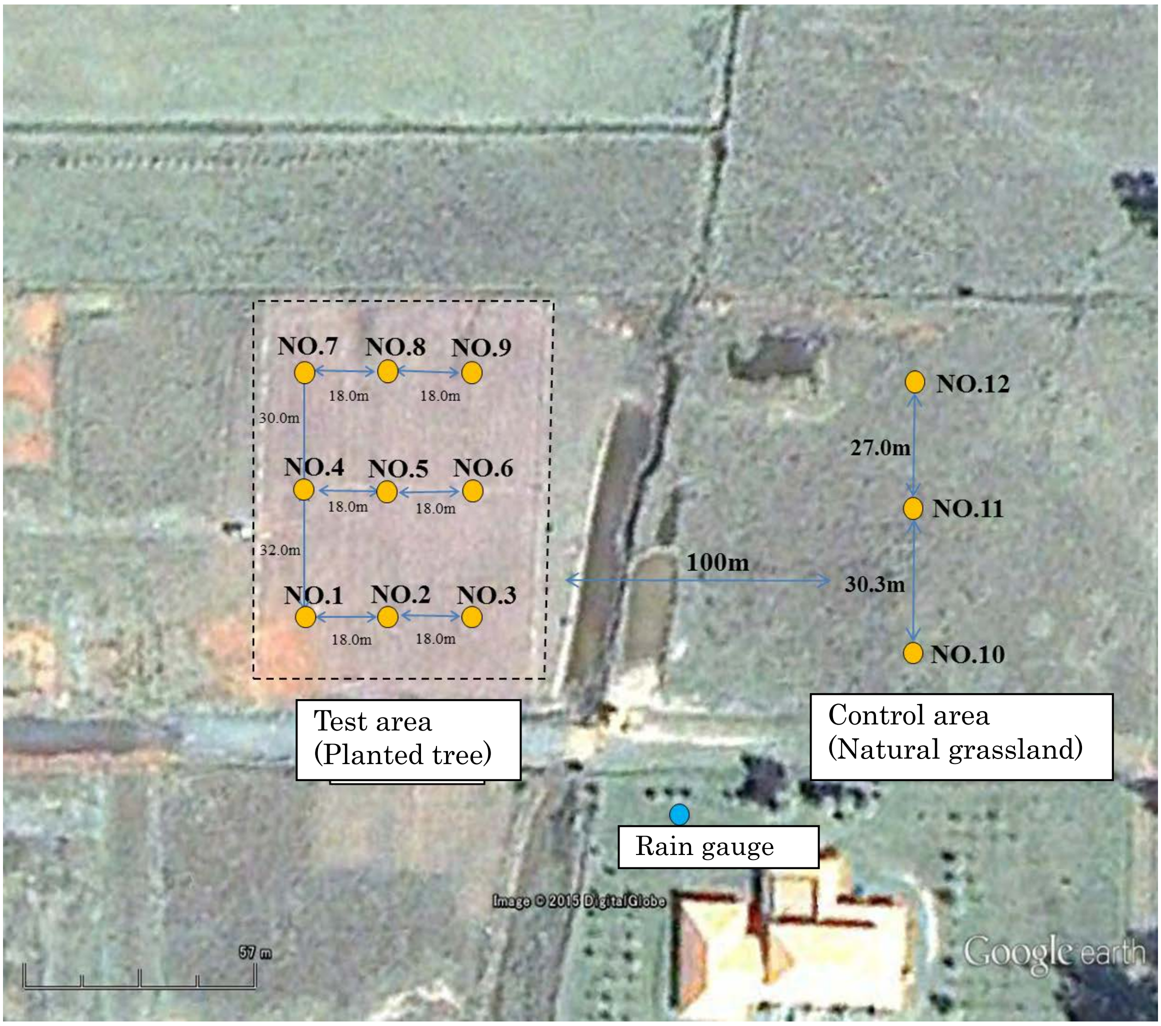


Reference Diagram 1. Impact of eucalyptus afforestation on soil environment (image)

2. Outline of the ARP test fields

The test fields were located on natural grassland adjoining the ARP Caaguazú branch. The afforested section occupied about 0.67 ha (94 m × 71 m), was encircled by a pasture fence, and the comparison section was located on natural grassland about 100 m from the new forest. In addition, a tipping-bucket rain gauge was installed on the ARP facility's site.

Ground water level pipes (12 pipes) were installed, and eucalyptus afforestation (512 trees) was done in July 2013 when testing started.



Reference Diagram 2. ARP test field location map
(● Ground water level measurement pipe ● Rain gauge)

3. Groundwater level investigation

(1) Preparation for the investigation

[1] Installing the tipping-bucket rain gauge

[2] Manufacturing ground water level measurement pipes and installing them in the test district (afforested section [9 pipes], comparison section [3 pipes])

- The groundwater level measurement pipes used were PVC (φ50 mm, t = 1.4 mm, L = 1.8 m).
- Slits (1 mm) were formed every 5 cm on the buried part (L = 1.5 m).
- Covers were installed on the tops and bottoms of the pipes. Slits were formed on the bottom cover.
- After the groundwater measurement pipes were inserted, the gaps between the borehole (80 mm) and the PVC pipes were filled with sand.

[3] The standard height of the tops of the pipes were measured and set above ground level.

- The standard heights of the other pipes were set using the standard height of the groundwater level pipe with the highest elevation assumed to be zero.

Reference Photo 1. Groundwater level measurement pipes

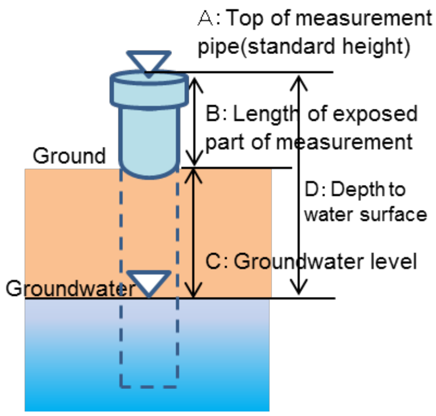
Reference Photo 2. State of excavation to install groundwater level pipes

(2) Measuring groundwater level

[1] Measurements were performed once a week

[2] The depth to groundwater surface in each pipe was measured (D in the figure), and the groundwater level was calculated.

[3] Regarding method, direct measurements were made when the groundwater surface could be directly observed. When it could not be seen, a measuring rod, tester, etc. was used to perform the measurements.



Reference Figure 3. Installation of groundwater level measurement pipes

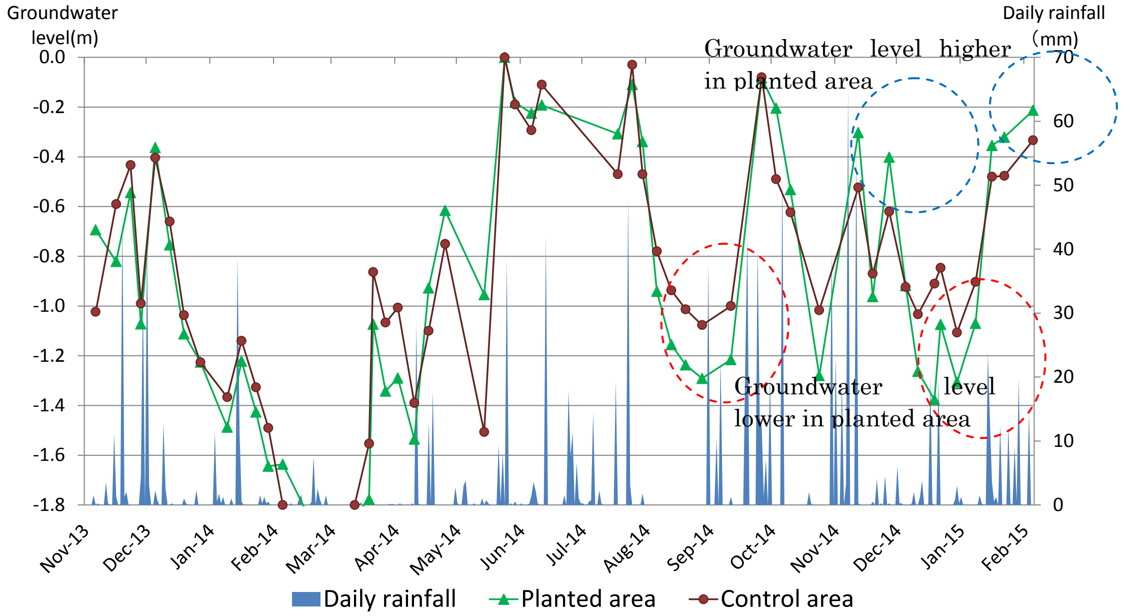

Reference Figure 4. View of groundwater level measurement

(3) Measurement results

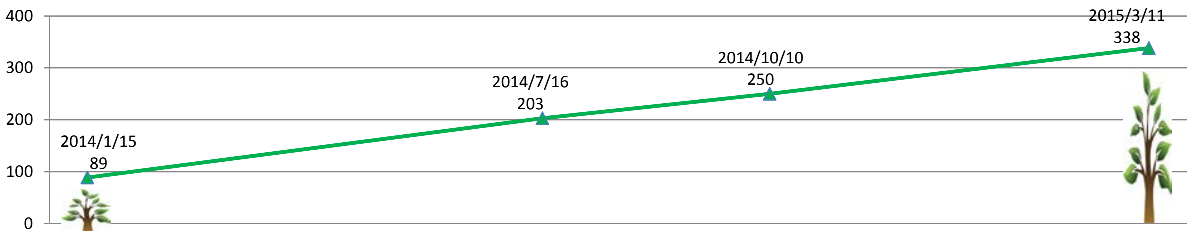
Changes in the average value of groundwater levels in the afforested section and comparison section are shown on a zigzag line graph, and the rainfall is shown on a bar graph (Reference Diagram 5); the change over time of the height of the eucalyptus in the afforested district are also shown (Reference Diagram 6).

These show that the groundwater level varied greatly according to rainfall. The change in growth of the eucalyptus increased from an average height of 0.89 m in January 2014 to 3.38 m in March 2015.

Regarding the groundwater level, while there were periods when it was lower in the afforested section than in the comparison section (broken red line), periods when the groundwater level was higher (dotted green line) were also confirmed. Accordingly, based on a statistical study, the impact of the presence/absence of eucalyptus afforestation on the groundwater level was analyzed.



Reference Diagram 5. Change of ground water level in afforested and comparison sections



Reference Diagram 6. Change over time of eucalyptus height in the afforested section (cm)

(4) Inspection results

An inspection was done to learn if there were differences in the average values between the two groups in the afforested section and comparison section (Table 1). The inspection results found no significant impact from the presence/absence of afforestation on the groundwater level ($F [1,129] = 3.9151$, $p = 0.828 > 0.05$), and no decline in the groundwater level caused by the eucalyptus afforestation was found.

Reference Table 1. Groundwater level measurement and inspection results (cm)

District	NO	Average value	Standard differential	Average value	P value
Planted area	NO.1	-0.69	0.56	-0.853	0.828
	NO.2	-0.54	0.56		
	NO.3	-0.54	0.52		
	NO.4	-0.79	0.54		
	NO.5	-0.77	0.52		
	NO.6	-0.63	0.54		
	NO.7	-1.06	0.60		
	NO.8	-0.98	0.58		
	NO.9	-1.08	0.75		
Control area (grassland)	NO.10	-0.81	0.39	-0.835	
	NO.11	-0.80	0.47		
	NO.12	-0.74	0.58		

(4) Considerations and summary

The impact of eucalyptus afforestation on the groundwater level under natural conditions was confirmed, but this test did not find any significant differences between the afforested and comparison sections.

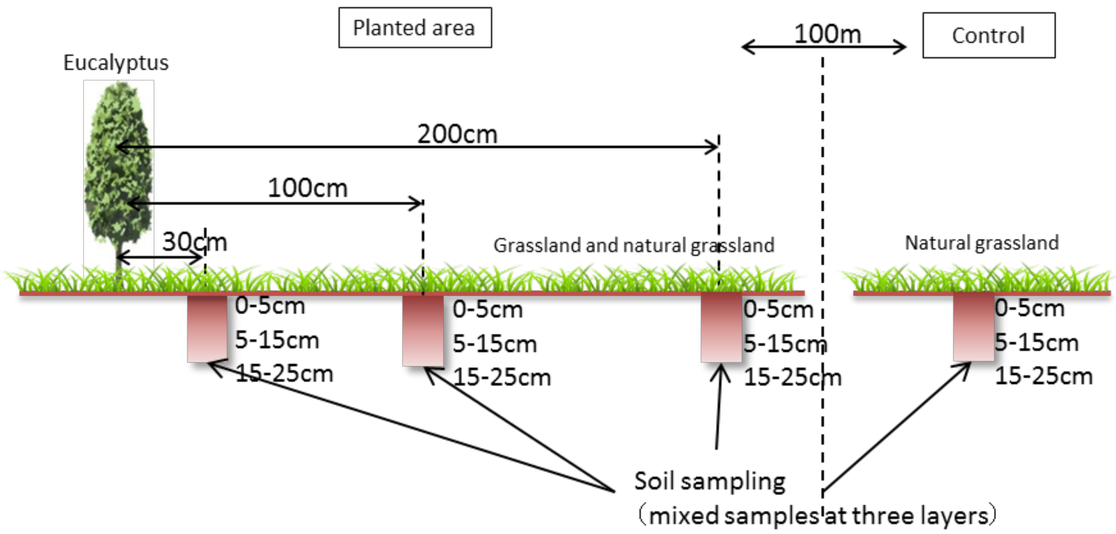
At the test site, the groundwater level was high at an average of 0.85 m, and if intensive rainfall occurred, it increased easily to the ground surface in a short period of time. It was revealed that under such conditions, eucalyptus afforestation has no impact on groundwater.

4. Soil nutrient investigation

(1) Investigation method

Soil was sampled from the area with eucalyptus afforestation and the area without, and the soil nutrient contents of the samples were compared.

- State of afforestation: species is *E. camaldulensis*, tree interval is 4 m × 2.5 m, tree age is 2 years, there are 255 trees, and the average tree height 3.4 m (in March 2015).
- Soil sampling: sampled using a soil auger in the planted area (grassland and natural grassland) and control area (natural grassland about 100 m from the afforested district).
- Number of sampling points: in planted area, there were 12 points, each sampled at three locations at a radius of 30 cm, 100 cm, and 200 cm from the tree base, and one sample depth with mixed samples of soil taken from 0–5 cm, 5–15 cm, and 15–25 cm (12 eucalyptus parts × 3 locations = 36 samples).
- Items analyzed: pH, organic substances, phosphorus, sulphur, potassium, calcium, magnesium, iron, copper, zinc, manganese, aluminum, Cation exchange capacity, and base saturation. The nitrogen analysis could not be done because of the capabilities of the local research institutes and the cost.

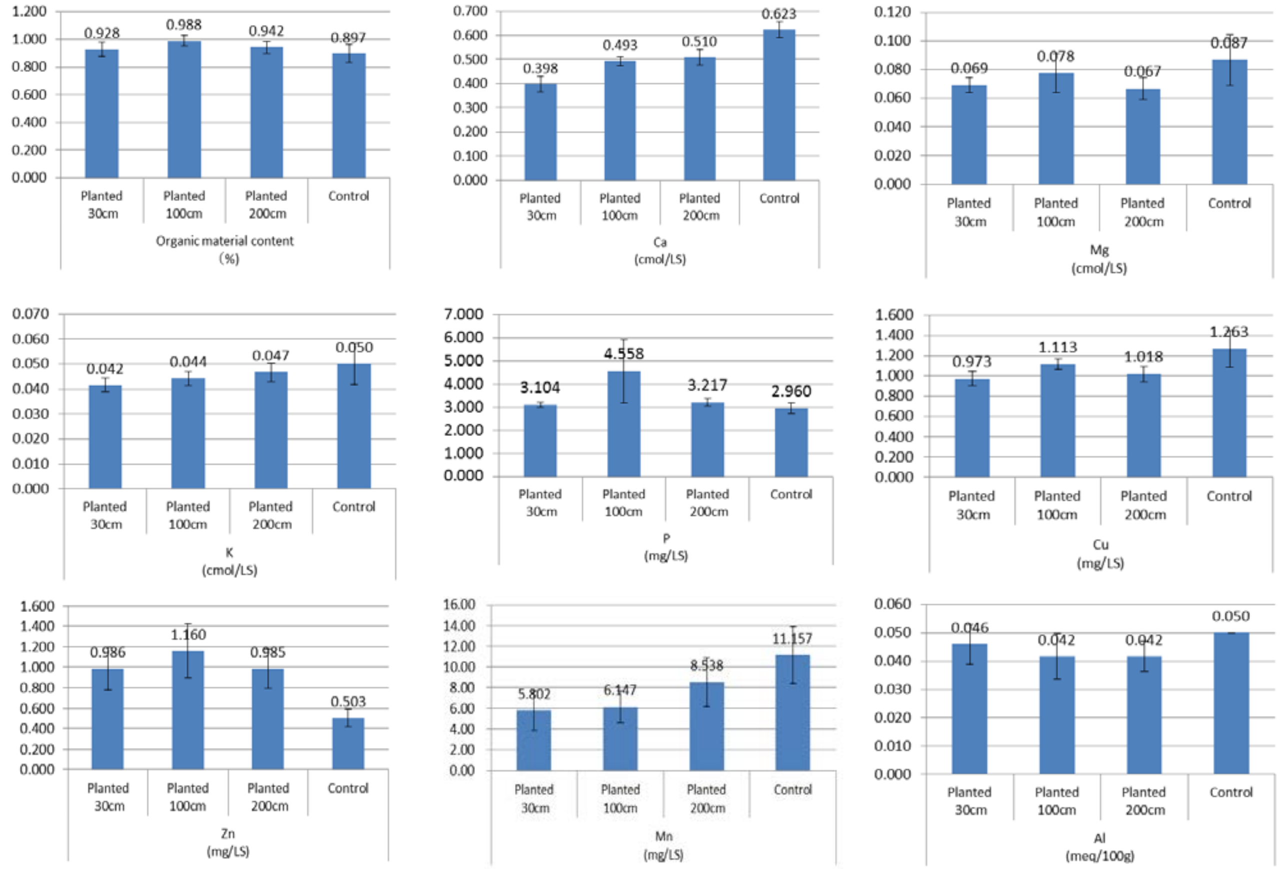


Reference Diagram 7. Image of soil sampling locations

2) Soil analysis results

The soil analysis results are shown in Reference Diagram 8 (error bars on the bar graph are standard differentials). Variance analysis of the differences between sampling points and soil nutrient contents was performed

(Reference Table 2).



Reference Figure 8. Average nutrient contents of planted and control area

Reference Table 2. Average soil nutrient content value and variance analysis results for the afforested and comparison sections

Group	Samples	OM	Ca	Mg	K	P	Cu	Zn	Mn	Al
Planted area 30cm	12	0.928	0.398	0.069	0.042	3.104	0.973	0.986	5.802	0.046
Planted area 100cm	12	0.988	0.493	0.078	0.044	4.558	1.113	1.160	6.147	0.042
Planted area 200cm	12	0.942	0.510	0.067	0.047	3.217	1.018	0.985	8.538	0.042
Control area	3	0.897	0.623	0.087	0.050	2.960	1.263	0.503	11.157	0.050
Variance ratio		0.390	5.050	0.408	0.603	0.726	1.383	0.565	0.696	0.154
P-value		0.761	0.005	0.748	0.617	0.544	0.264	0.642	0.561	0.926
		n.s.	<0.01	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.

n.s.: not significant

(3) Considerations and summation

The results of the investigation only confirmed a significant difference in soil nutrient contents with eucalyptus afforestation for calcium. It is known that the bark of eucalyptus has a particularly large calcium content, and it was assumed that a reduction of calcium represents a falling trend in soil nutrient contents unique to eucalyptus afforestation (in the case of a yield of 40 m^3/ha/year, calcium content is 218 kg/ha, and potassium content is 157 kg/ha, so decortication is important for maintaining soil nutrients).

Judging from the results for other analysis items at the present stage, the robbing of soil nutrients by eucalyptus afforestation, which is indicated by its critics, was not found. In either case, regarding the impact of eucalyptus afforestation on soil nutrients, assuming the situation is similar to that of agriculture, if the same land is repeatedly cultivated and harvested without fertilization, soil nutrient contents decline. Unlike a long-rotation forest, it is necessary to manage fertilization in order to maintain and improve yields, just as in the case of agriculture.

Acknowledgments

JIRCAS conducted the survey and prepared this Guideline subsidized by the Ministry of Agriculture, Forestry, and Fisheries of Japan and with the cooperation and backing of the Paraguay's Ministry of Agriculture and Livestock, the National Forestry Institute, the Asuncion National University, and the National University of Caaguazú. We wish to express our heartfelt gratitude to everyone from the above ministries and universities who supported our efforts.

The Caaguazú Department and the cities where we conducted the survey also cooperated fully with this project. We were also supported by the San Pedro, Caazapá, Guairá, and Paraguarí Departments.

We carried out reforestation, which was the major activity conducted as part of this project, with the participation of farmers from 28 groups in the Caaguazú Department. When carrying out the CPA in Coronel Oviedo, the technician, Jorge Ogasawara, gave us guidance with the coordination of the project activities in particular.

We also wish to express our gratitude for the assistance we received from the Japanese Embassy in Paraguay and from the experts at the Paraguay Office of the JICA.

We are also grateful to the following people who shared their insightful advice with us regarding the preparation of this Guideline in order that it will be even more useful and beneficial to its users.

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In conclusion, we wish to express our deep gratitude to all organizations, bodies, concerned parties, and staff for their cooperation and assistance with activities planned and implemented by JIRCAS.

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Attachments

Attachment 1　Small-scale Reforestation PoA-DD Draft

Attachment 2　Small-scale Reforestation CPA-DD Draft

Attachment 3　Program Flow from CDM Plan Formulation to Registration with the UN Board of Directors

Attachment 1

Program design document form for small-scale afforestation and reforestation CDM programs of activities

(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the program design document form for small-scale afforestation and reforestation CDM programs of activities" at the end of this form.

PROGRAM DESIGN DOCUMENT (PoA-DD)	
Title of the PoA	Reforestation Project for Low Income Regions of Paraguay
Version number of the PoA-DD	Ver.1.00
Completion date of the PoA-DD	1 December 2015
Coordinating/ managing entity	Ministry of Agriculture and Livestock of Paraguay
Host Party(ies)	Ministry of Agriculture and Livestock of Paraguay
Selected methodology(ies), and where applicable, selected standardized baseline(s)	*Afforestation and reforestation project activities implemented on lands other than wetlands*, Version 3.1

PART I. Program of activities (PoA)

SECTION . General description of PoA

A.1 Title of the PoA

(a) Reforestation Project for Low Income Regions of Paraguay
(b) Version 1
(c) Prepared on December 1, 2015

A.2 Purpose and general description of the PoA

Paraguay has been conducting large-scale agricultural development, including development of grasslands, since the early 1970s and this, accompanied by soaring demand for wood to generate energy accompanying population growth, has rapidly depleted the forested area of the country. Forests covered 21 million hectares in 1990, but only 14 million hectares in 2011, accounting for a loss of 6.7 million hectares in 22 years. The artificial forest share of forested land rose from 15,000 hectares in 1991 to 152,000 hectares in 2008 (2007 Ministry of Agriculture and Livestock census). This was a tenfold increase, but still accounts for less than 1% of total forests, and is far below the total annual 300,000 hectare decline of forest land area. Agricultural land, including grassland, increased from 17 million hectares in 1991 to 23.61 million hectares in 2008: a rise of 6.61 million hectares in 18 years. Considering soybeans in particular, the rising international price and introduction of genetically recombined seeds sharply increased cultivated land from 550,000 hectares in 1991 to 3 million hectares in 2011. Under these conditions, the Government of Paraguay also actively introduced legal measures to conserve or restore forest resources, but this has not slowed the decline of forest resources.

Among emissions of greenhouse gases announced by the Government of Paraguay in 2000, 95% of total emissions of CO_2 in Paraguay are emitted by land use and by forestry (LULUCF). The amount absorbed by forests is equal to only 1.6% of the total emission.

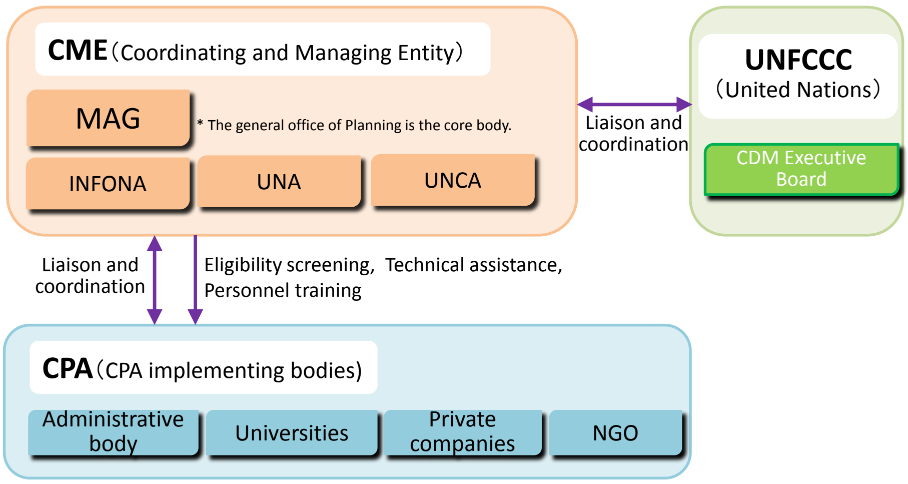
This project is a PoA for wide-area reforestation conducted by Paraguay applying the CDM framework. The CDM methodology can clarify the MRV (measurement, reporting, and verification) rules to accurately and quantitatively evaluate greenhouse gas absorption. Moreover, reforestation will contribute to the conservation and recovery of forest resources and to the improvement of the incomes of small farmers in poor regions.

The CME discussed in A.3 will implement this PoA through voluntary activities.

A.3 CME and participants of PoA

The CME, which consists of the Ministry of Agriculture and Livestock(MAG), the National Forestry (INFONA), the National University of Asunción(UNA), and the National University of Caaguazú(UNCA), has been approved by the Environment Agency (SEAM)), which is Paraguay's DNA (written approval required as a separate document).

The CME is constituted as shown below.



1) The CME consists of four organizations that support the smooth execution of the project by the CPA implementing bodies.
2) The representative of the CME is the general office of Planning of the MAG, and the CME conducts liaison and coordination with the Board of Directors, CPA eligibility inspections of the CPA implementing bodies, technical support, personnel training, etc.
3) The MAG conducts farming community poverty improvement projects, agricultural extension, and agricultural education, forging deep relationships with agricultural households. The general office of Planning plays the central role in the MAG, and therefore it is the heart of the CME.
4) The INFONA is the body in charge of forest land policies, and possesses abundant knowledge and experience of the forestry industry; therefore, it is in charge of quality assurance and quality control of afforestation/reforestation and silviculture by the CPA implementing bodies.
5) The UNA is involved in small-scale reforestation CDM projects in the Paraguarí Department and possesses knowledge and experience in CDM projects, and therefore, it is in charge of calculating forest carbon storage and calculating credit.
6) The UNCA is located in the Caaguazú Department, which is the center of the object region, permitting it to provide various kinds of support.

The CME consists of administrative bodies in charge of agricultural, forestry, and livestock industries and university bodies involved in related fields, permitting it to support the CPA administratively by contributing expertise. The CPA is the promotion of small-scale farming in the object region, which is conducted jointly by organizations such as administrative bodies, university bodies, and private companies in the said region, permitting it to promote afforestation activities that are effectively adapted to local conditions. Through these efforts, in the PoA object region, forest reserves will be conserved and restored, and the income earned through small-scale farming in impoverished regions will be improved.

The participants in the PoA project are the Agricultural Extension Bureau (DEAG) of the MAG, the Agricultural Education Bureau (DEA) of the MAG, regional offices of the INFONA, and various campuses of the UNA operating under the control of the aforementioned bodies. The DEA is a body that promotes agricultural education and operates schools of agriculture, which also participate in the project.
Support for the overall activities of the CME and for the preparation of the Project Design Document is given by the Japan International Research Center for Agricultural Sciences (JIRCAS).

A.4 Party (ies)

Party involved (host) indicates a host Party	Private and/or public entity(ies) project participants, CME (as applicable)	Indicate if the Party involved wishes to be considered as project participant (Yes/No)
Paraguay (host)	Ministry of Agriculture and Livestock Agricultural Extension Bureau (Public entity) National Forestry Institute (Public entity) National University of Asunción (Public entity) National University of Caaguazú (Public entity)	

A.5 Physical/Geographical boundary of the PoA

The PoA region includes many particularly impoverished districts. The degree of poverty in Paraguay is shown in the following table.

Table 1. Population and degree of poverty by Department (2002)

Department	2002 population	Degree of poverty	Household/(Gs)	Population in poverty (%)	Poverty and inequality (%)
Concepción	179,450	0.528	501,170	52.8	24.3
San Pedro	318,698	0.511	498,694	51.1	23.9
Caaguazú	435,357	0.487	633,774	48.7	22.3
Caazapá	139,517	0.465	622,693	46.5	20.9
Canindeyú	140,137	0.442	793,191	44.2	21.2
Misiones	101,783	0.427	645,893	42.7	17.3
Central	1,362,893	0.417	557,181	41.7	17.1
Itapúa	453,692	0.411	811,812	41.1	18.5
Ñeembucú	76,348	0.406	557,724	40.6	16
Amambay	114,917	0.398	892,272	39.8	17.8
Alto Paraguay	11,587	0.373	791,982	37.3	15.5
Guairá	178,650	0.366	667,879	36.6	15.1
Paraguarí	221,932	0.357	659,830	35.7	13.8
Cordillera	233,854	0.305	652,363	30.5	10.5
Presidente Hayes	82,493	0.303	852,909	30.3	12.8
Alto Paraná	558,672	0.291	883,915	29.1	11.6
Asunción	512,112	0.248	929,096	24.8	9.2
Boquerón	41,106	0.213	1,234,401	21.3	8.2
Nationwide	5,163,198		722,311	41.4	17.5

Source: Paraguay Pobreza y desigualdad de ingresos a nivel distrital, Dgeec, 2005

A.6 Technologies/measures

Reforestation, which is the PoA, is carried out by distributing seedlings to volunteer farmers and helping them to voluntarily perform afforestation and silviculture activities. Species are decided according to the farmer's intentions, but eucalyptus, which is an early ripening species, is recommended. Seedlings are generally produced by the each CPA implementing body, but it is predicted that according to region, CPA implementing bodies will purchase them from seedling producers and distribute them to the farmers.

1. Seedling field production

1) Location of the seedling field and facility operation

The seedling fields are to be formed and operated by improving part of the DEAG, which is located in Blas Garay. The operation of the seedling fields is managed by DEAG staff and contract workers.

2) Seedling production method

- Three types of two species of seeds, *Eucalyptus grandis*, *Eucalyptus camaldulensis*, and Eucalyptus hybrid (*E. grandis* × *E. camaldulensis*), were used to grow the seedlings.
- The method adopted was the tube pot use method that can lighten the silviculture work and seedling transport work.
  The tube pots, compost, and necessary machines were purchased from Plantec, eucalyptus Silviculture Company in the vicinity.
- The production procedure is as follows: [1] preparing the compost, [2] filling the tube pots with compost, [3] sowing seeds in the pots, [4] thinning sprouts after germination in a greenhouse, and [5] taking the seedlings outdoors from the greenhouse, and adjusting the silviculture density according to each silviculture stage outdoors in order to accustom the seedlings to the outside air and strengthen them (silviculture density 100%→50%). Productivity is governed by the weather, but it is predicted that between 200,000 and 300,000 seedlings will be produced annually.
- For transport, 50 tubes will be transported in each container.

It is necessary to plan the number of seedlings to be produced, which is set according to the estimation of the number of seedlings to be distributed. The approximate number of seedlings distributed is calculated by measuring the predicted afforestation area. The predicted afforestation area is calculated by the following procedure.

[1] The farmers visit the section where the predicted range of afforestation is planned and confirmed.

[2] The XY coordinates of the points of change of the predicted afforestation range are recorded using a portable GPS unit.

[3] Based on the coordinates of points of change recorded by GPS, the area is calculated applying Heron's formula.

The number to be planted per hectare is decided in advance; then the calculated area is used to calculate the number predicted to be distributed. The production plan is enacted by adding the number replanted to the calculated predicted number distributed, to calculate the total seedlings indicated in the production capacity and distribution plan.

2. Distributing and planting the seedlings

1) Distributing the seedlings

The seedlings are planted by the farmers in each section occupied by small-scale farmers. Before planting, the volunteer farmers are trained and given guidance about such as planting intervals planting methods. At the training site, a seedling distribution schedule is confirmed, and seedlings are transported from the seedling field and distributed directly to the homes of farmers who are prepared.

2) Planting the seedlings

The farmers are instructed to plant the seedlings as soon as possible—within two weeks at the latest after distribution—store the seedlings by selecting a cool shaded storage place, and erect a fence around the storage place so that farm animals will not eat the seedlings.

A.7 Public funding of PoA

This PoA is not publicly financed by any country that is a party to a treaty (see the confirmation document that is Attachment 2).

A.8 Approach for addressing non-permanence

For the net anthropogenic greenhouse gas removal achieved by a small-scale A/R-CDM project, issuing tCERs is selected.
The project period is assumed to extend for 20 years from 2013 to 2032, and verified and authorized every five years.

SECTION B. Demonstration of additionality and development of eligibility criteria

B.1 Demonstration of additionality for PoA

Barriers to investment
The cost required for afforestation in a project region where the land has deteriorated and agriculture production activities are at a low level, includes the cost of project preparation and hiring of technical experts. There is no credit mechanism for farmers to bear such costs because in a region where agricultural productivity and farm household incomes are particularly low, it takes a long time for investment in afforestation to reap benefits.
In such low income and small-scale farming regions, the shortage of public funds to implement projects is another restrictive factor. INFONA is an organization that can technically support afforestation, but it cannot fund such a project.

B.2 Eligibility criteria for inclusion of a CPA in the PoA

Standard required conditions	Eligibility criteria
(a) Geographical boundary The geographical boundary of the CPA including any time-induced boundary consistent with the geographical boundary set in the PoA;	The CME checks the boundary. The entire afforestation section of farmers who are participating in the afforestation project are measured by portable GPS to prepare the UTM coordinates table.
(b) Conditions that avoid double counting of emission reductions Conditions that avoid double counting of emission reductions, like unique identification of products and end-user locations (e.g. program logo);	There has only been one example of a small-scale afforestation CDM project commercialized in Paraguay; in Acahay City and San Roque González City in Paraguarí Department. In Paraguarí Department, CPA projects are formed to exclude these regions.
(c) Specifications of technology and measures including types and levels of service or performance The specifications of technology/measure including the level and type of service, performance specifications including compliance with testing/certifications;	CPA implementing bodies receive quality confirmations and guidance by CME (INFONA) concerning seedling production methods, and CPA implementing bodies give farmers guidance with afforestation and silviculture.
(d) Conditions to check the start date of the CPA through documentary evidence Conditions to check the start date of the CPA through documentary evidence	For each CPA, the date of the start of afforestation is data controlled for each afforestation section. And the CME controls records of the start of afforestation of each CPA by storing them in a data base.
(e) Conditions that ensure compliance with applicability and other requirements of methodologies applied by CPAs Conditions that ensure compliance with applicability and other requirements of single or multiple methodologies applied by CPAs	Methodologies applied at this time are AR-AMS0007," Afforestation and reforestation project activities implemented on lands other than wetlands" version 03.0, and each CPA must be implemented based on this methodology. CME confirms that the newest methodology is applied when the CPA implementing bodies have submitted a CPA-DD. If it is necessary to update the

	methodology or tools applied to the PoA-DD or CPA-DD, it is submitted to DOE for approval.
(f) The conditions that ensure that CPA meets the requirements for demonstration of additionality The conditions that ensure that the CPA meets the requirements pertaining to the demonstration of additionality as specified in Section 3.1 above;	The CPA implementing bodies show the CME and obtain its approval for conditions that apply to demonstration of additionality based on the PoA.
(g) The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis The PoA-specific requirements stipulated by the CME including any conditions related to undertaking local stakeholder consultations and environmental impact analysis;	The CPA implementing bodies must consult with local stakeholders to hear their comments and take necessary measures according to the PoA. An environmental impact analysis is unnecessary under the host country's standards.
(h) Conditions to provide an affirmation that funding from Annex I Parties, if any, does not divert ODA Conditions to provide an affirmation that funding from Annex I Parties, if any, does not result in a diversion of official development assistance;	The CPA implementing bodies must submit documents affirming that ODA is not diverted to the CME. If the CPA implementing bodies are CME members, this can be omitted.
(i) (Where applicable), target group and distribution method Where applicable, target group (e.g. domestic/commercial/industrial, rural/urban, grid-connected/off-grid) and distribution mechanisms (e.g., direct installation);	The CPA implementing bodies distribute seedlings after selecting farmers who wish to participate in the project.
(j) (When applicable), sampling requirements for the PoA in accordance with guideline or standard approved by the Executive Board adapted to sampling and surveys Where applicable, the conditions related to sampling requirements for the PoA in accordance with the "Standard for sampling and surveys for CDM project activities and program of activities";	CPA implementing bodies must submit results of sampling and surveys to the CME at least once a year to confirm the survey method, contents, and results.
(k) (When applicable), the conditions that ensure that every CPA meets the small-scale or microscale threshold, and remains within those thresholds throughout the crediting period of the CPA Where applicable, the conditions that ensure that every CPA (in aggregate if it comprises independent sub units) meets the small-scale or microscale threshold and remains within those thresholds throughout the crediting	The reforestation project does not correspond to small-scale.

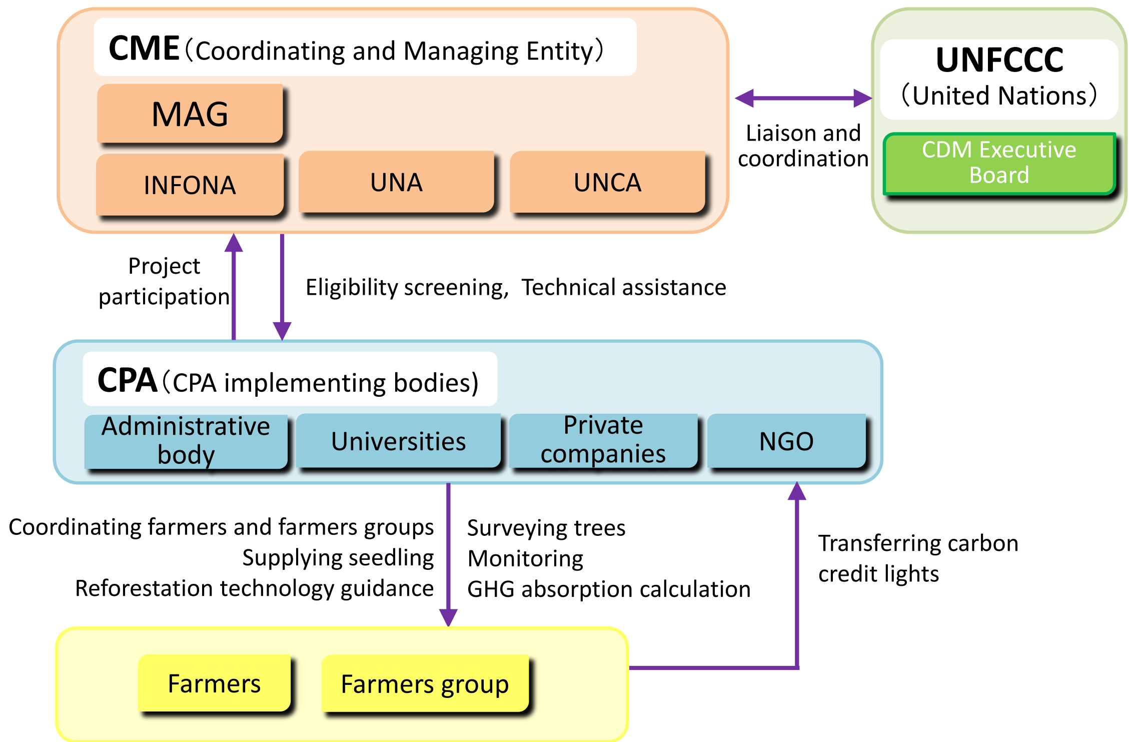
period of the CPA;	
(l) (Where applicable), the requirements for a de-bundling check in the case where the CPA belongs to small-scale (SSC) or microscale project categories Where applicable, the requirements for the de-bundling check, in case CPAs belong to small-scale (SSC) or microscale project categories.	A reforesting project does not apply.

B.3 PoA Application of technologies/measures and methodologies

The following methodology is applied to the PoA
AR-AMS0007, Afforestation and reforestation project activities implemented on lands other than wetlands, Version 3.1

B.4 Date of completion of application of methodology and standardized baseline and contact information of responsible person(s)/ entity (ies)

SECTION C. Management system



The CME manages the PoA as shown below.

Organization	Roles	Required qualifications
MAG (the general office of Planning)	・Coordination with CDM board of directors ・Coordination with bodies participating in or concerned with the PoA ・Providing information to CPA implementing bodies ・Checking and managing data from CPA implementing bodies ・Preparing and summarizing various reports concerning CPA implementation	・Understanding guidelines to CDM methodology and tools, and for the PoA ・Knowledge of CDM process ・Ability to coordinate with CPA implementing bodies
INFONA	・Improving capabilities of CPA implementing bodies through afforestation or silviculture training ・Performing quality control and quality assurance of afforestation project	・Understanding guidelines to CDM methodology and tools and the PoA ・Knowledge and experience of afforestation and silviculture
UNA	・Improving capabilities of CPA implementing bodies through CDM methodology and tools training ・Guidance with reporting done by CPA	・Understanding guidelines to CDM methodology and tools and the PoA
UNCA	・Improving capabilities of CPA implementing bodies by training in data collection methods. ・Guidance with reporting done by CPA	・Understanding guidelines to CDM methodology and tools and the PoA

SECTION D. Duration of PoA

D.1 Start date of PoA

●●, ●, 20●●. This is the date the MAG enacted the PoA-DD.

D.2 Duration of the PoA

20 years

SECTION E. Environmental impacts

E.1 Level at which environmental analysis is undertaken

The afforested area per CPA is predicted to be less than 500 hectares. According to Law of Paraguay 294/93, in the case of afforestation or reforestation smaller than 1000 hectares, an environmental impact analysis is unnecessary.

E.2 Analysis of the environmental impacts

Not applicable.

This project will convert part of farmland that has deteriorated or is unused or grassland to forest, without any negative impacts on the environment. The reforestation project will, on the other hand, lower the pressure to develop surrounding forests, contributing to the conservation of forest resources.

E.3 Environmental impact assessment

Not applicable.

SECTION F. Socio-economic impacts

F.1 Level at which socio-economic impact analysis is undertaken

The project activities will have positive social impacts. Participants in the project activities are small farmers who manage farms on small plots of land with low productivity in impoverished regions. This project can be counted on to supplement existing farm income by adding income from the sale of lumber, improving the livelihood of impoverished farm households.

F.2 Analysis of the socio-economic impacts

Not applicable.

F.3 Socio-economic impact assessment

Not applicable.

SECTION G. Local stakeholder consultation

G.1 Solicitation of comments from local stakeholders

At the project formation stage, the small-scale afforestation program CDM project will be explained to concerned organizations (department governments, city hall, farmers coops, schools of agriculture, etc.) to learn of their views and desires. By focusing on regions with a great desire for afforestation based on the view obtained from concerned organizations, hamlet workshops will be held to confirm the intention of farmers to participate and their opinions on the project.

G.2 Summary of comments received

Head of the Environmental Section of Paraguarí Department:

We will cooperate with the formation of the project. We want to implement it in cooperation with the Ybycuí Agricultural School.

Head of the Agricultural Section of Guairá Department:

In Guairá Department, soil is severely deteriorated and we are aware of the importance of the afforestation project.

Head of the Agricultural Section in Caazapá Department:

In this department, we are very interested in natural resource conservation projects and want to promote reforestation projects.

Head of the Agricultural Section of Caaguazú Department:

I think that in this department, where lumber is milled extensively, an afforestation project will have a significant economic impact. The department will help implement this project.

Head of the Agricultural Section of San Pedro Department:

In our department, the forestry industry is thriving and producing lumber extensively, and therefore reforestation projects are important. We will cooperate with this project.

Farmers in Caaguazú Department:

- We want to effectively use surplus land and deteriorated land through reforestation.
- There is a high demand for lumber and firewood, so we want to earn money selling planted trees.
- Planted trees will be a future asset that could replace pensions.
- We want planted trees to cover future cost of educating our children (in universities).

G.3 Report on consideration of comments received

There are no comments in particular to be considered.

SECTION H. Approval and authorization

Paraguay
See attached documents.

PART II Generic component project activity (CPA)

SECTION A. General description of a generic CPA

A.1. Purpose and general description of generic CPAs

Each CPA has satisfied eligibility criteria by the CME. The goal of each CPA is to contribute to the reduction of carbon dioxide by increasing forest resources.

A.2. Declaration on low-income communities

- Comité and farmers groups in low income regions managed by the DEAG will be narrowed down to farmers who wish to participate through confirmation of participation intention to the project.
- The appropriateness of project participation is judged by an afforestation survey (land ownership rights, present land use categories, desired afforestation area and state of plots, desirable species, and land use on the plots where afforestation was existed prior to 1989).

SECTION B. Application of a baseline and monitoring methodology and standardized baseline

B.1. Reference of methodology(ies) and standardized baseline(s)

The following methodologies will be applied to the PoA. (※the following methodology need not be translated.

- *Afforestation and reforestation project activities implemented on lands other than wetlands*, Version 3.1

The following tools will be applied to the PoA.

- *Combined tool to identify the baseline scenario and demonstrate additionally in A/R CDM project activities, Version 1,*
- *Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity, Version 4.0.0,*
- *Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities, Version 4.2,*
- *Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version 2.0,*
- *Calculation of the number of sample plots for measurements within A/R CDM project activities Version 2.1.0,*

B.2. Applicability of methodology(ies) and standardized baseline(s)

NO	Methodology application conditions	Appropriateness of selection
1	(a) The land subject to the project activity does not fall into the wetland category;	The project area is farmland or grassland and a farmer uses for farm operation activities. It does not include wetlands.
2	(b) Soil disturbance attributable to the project activity does not cover more than 10 per cent of area in each of the following types of land, when these lands are included within the project boundary (i) Land containing organic soils; (ii) Land which, in the baseline, is subjected to land-use and management practices and receives inputs listed in Appendices 2 and 3 to this methodology.	A survey of the forest carbon accumulation baseline before the start of the project confirms that the afforested land is land on which there were almost no trees before the start of the project. The afforestation tillage method is basically point tillage of 30×30 cm, or no tillage, and in the case of 1000 afforested trees per hectare, the tillage rate (soil disturbance) is less than 0.9%.

B.3. Carbon pools and emission sources

According to AR-AMS0007, Paragraph 12, the objects of the calculation of the baseline net GHG removals and the actual GHG removals are the following carbon pools.

Carbon pool	Selected	Appropriateness/ Explanation
Above-ground biomass	Yes	It is the object of the project activities.
Below-ground biomass	Yes	It is the object of the project activities.
Dead wood litter and soil organic carbon	No	It is not the object of the project activities.

B.4. Identification of strata

The strata in the baseline net GHG removals (baseline scenario) are set according to the farmers' land use categorization before the project. The land use categorization inside the project boundaries is either farmland or grassland, so it has two strata.
To calculate the actual GHG removals (project scenario), stratification is based on afforestation year, afforested tree species, and afforested tree interval.

B.5. Description of baseline scenario

The baseline scenario is considered to be the quantity of change of carbon accumulation of trees and of shrubs during the project period, in cases without project activity.
1) Regarding land use before project activities, direct interviews with all farmers who participate are held, confirming that since 1989, the land considered was not forested.
2) The baseline scenario is considered to be the quantity of change of carbon accumulation of the carbon pool that is the object in a case where the project was not implemented for land use before project activities (farmland and grassland).
3) According to AR-AMS0007, Paragraph 17, the object carbon pool is selected from among trees, shrubs, dead wood and litter, and soil organic carbon. In the case of this PoA, it is hypothesized that it is impossible to predict a significant increase of dead and drying wood and soil organic carbon, so the objects are trees and shrubs.
4) In the area that is the object of the project, the carbon accumulation is calculated based on the quantity of biomass of trees and shrubs before project activities, and to calculate the change of the carbon accumulation per year in a case where the project was not implemented, the biomass quantity of trees and shrubs for two or more years is measured.
5) According to tool AR-Tool 14, Paragraph 11, in cases where it has been confirmed that the trees that are the object of the baseline are neither felled nor removed, have not died and or dried up, and do not continue to exist even after the project activities, it is considered possible to consider the baseline value to be zero. However, because at PDD enactment time, it was impossible to predict in advance that they would not be felled or removed. During validation, the carbon accumulation is calculated as a conservative value premised on the absence of removal or felling. Therefore, at the time of monitoring, and before each verification, whether the presence of trees is confirmed, and the information used to revise the baseline value.
6) The following data were used to calculate the quantity of biomass of the shrubs in the basic scenario.

Contents	Value	Explanation
Biomass quantity in top of forested land by country	59 t/ha	IPCC-GPG-LULUCF Table 3A.1.4 "Paraguay"

B.6. Demonstration of eligibility for a generic CPA

See A.2.

B.7. Estimation of GHG removals by sinks of a generic CPA

B.7.1. Explanation of methodological choices

[1] Baseline Net GHG absorption

According to methodology AR-AMS0007, calculation is done by the following formula.

$$\Delta C_{BSL,t} = \Delta C_{TREE_{BSL},t} + \Delta C_{SHRUB_{BSL},t} + \Delta C_{DW_{BSL},t} + \Delta C_{LI_{BSL},t}$$

However, the carbon pool that is the object is considered to be the biomass both above ground and underground, so the calculation formula is written as shown below.

$$\Delta C_{BSL,t} = \Delta C_{TREE_{BSL},t} + \Delta C_{SHRUB_{BSL},t}$$

Where:

$\Delta C_{BSL,t}$	Baseline net removals: *tCO_{2e}*
$\Delta C_{TREE_{BSL},t}$:	Quantity of change of carbon accumulation by trees in *t* years in a case where project activities computed by the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*" were not implemented: *tCO_{2e}*
$\Delta C_{SHRUB_{BSL},t}$:	Quantity of change of carbon accumulation by shrubs in *t* years in a case where project activities computed by the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*" were not implemented: *tCO_{2e}*
$\Delta C_{DW_{BSL},t}$:	Quantity of change of carbon accumulation by dead wood and litter in *t* years in a case where project activities computed by the tool "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*" were not implemented: *tCO_{2e}*
$\Delta C_{LI_{BSL},t}$:	Quantity of change of carbon accumulation by soil organic carbon in *t* years in a case where project activities computed by the tool "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*" were not implemented: *tCO_{2e}*
T	Number of years passed in *t* years

The baseline is obtained by measuring the tree biomass over two years and performing a calculation based on the quantity of change of the annual carbon accumulation, so the carbon accumulation by trees and shrubs over two years is calculated. The following is the calculation procedure.

Step 1: The biomass of trees and shrubs inside the sample plot is measured. The tree and shrub items are measured differently because of the methodology tool. In the case of trees, breast height diameter and tree height are measured, while in the case of shrubs, crown area is measured.

Step 2: For trees, the trunk wood volume biomass above ground is calculated and the wood carbon accumulation both above ground and underground are calculated. For shrubs, the crown coverage per unit of area is obtained and multiplied by the quantity of biomass in the forest above-ground by country to calculate the shrub carbon accumulation.

Step 3: The carbon accumulation before the start of the project and the quantity of change of the carbon accumulation during the project period are calculated.

[2] Actual net GHG removals

According to methodology AR-AMS0007, net removal is calculated using the following formula.

$$\Delta C_{ACTUAL,t} = \Delta C_{p,t} - GHG_{E,t}$$
$$\Delta C_{P,t} = \Delta C_{TREE_{PROJ},t} + \Delta C_{SHURB_{PROJ},t} + \Delta C_{DW_{PROJ},t} + \Delta C_{LI_{PROJ},t} + \Delta SOC_{ALI,t}$$

However, the following is the calculation formula because significant non-CO_2 is not produced, and because the carbon pool that is the object is considered to be the above ground and underground biomass of the trees.

$$\Delta C_{ACTUAL,t} = \Delta C_{p,t} = \Delta C_{TREE_{PROJ},t} + \Delta C_{SHURB_{PROJ},t}$$

Where:

$\Delta C_{p,t}$	=	Change of carbon accumulation by the project produced by the selected carbon pool in t years: tCO_{2e}
$GHG_{E,t}$	=	Increase of quantity of emissions of non-CO_2 GHG inside the project boundaries calculated using the tool "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*" based on implementing the A/R CDM project activities for *t* years: tCO_{2e}
$\Delta C_{TREE_{PROJ},t}$	=	Change of carbon accumulation by tree biomass for the project *t* years calculated using the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*": tCO_{2e}
$\Delta C_{SHURB_{PROJ},t}$	=	Change of carbon accumulation by shrub biomass in project *t* years calculated using the tool "*Estimation of carbon stocks and change in carbon stocks of trees and shrubs in A/R CDM project activities*": tCO_{2e}
$\Delta C_{DW_{PROJ},t}$	=	Change of carbon accumulation by dead and drying wood biomass in project *t* years calculated using the tool "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*": tCO_{2e}
$\Delta C_{LI_{PROJ},t}$	=	Change of carbon accumulation by litter biomass in project *t* years calculated using the tool "*Estimation of carbon stocks and change in carbon stocks in dead wood and litter in A/R CDM project activities*": tCO_{2e}
$\Delta SOC_{ALI,t}$	=	Change of carbon accumulation by soil organic carbon biomass in project *t* years calculated using the tool "*Tool for estimation of change in soil organic carbon stocks due to the implementation of A/R CDM project activities*": tCO_{2e}

The actual net GHG removals are obtained by directly measuring and calculating the tree biomass and shrub crown coverage at the time of verification. The following is the calculation procedure.

Step 1: A sampling plot is randomly selected and a standard section is set inside the plot to calculate the quantity of biomass of trees and shrubs. The items measured are breast height diameter and tree height for trees and crown coverage area for shrubs.

Step 2: The above ground and underground carbon accumulations are calculated from the measurement results.

[3] Leakage

According to methodology AR-AMS0007, leakage is calculated using the following formula.

$$LK_{AGRIC,t} = LK_{AGRIC,t}$$

$LK_{AGRIC,t}$ = Leakage caused by displacement of agricultural activities in *t* years

The calculation is done using the following formula in the tool 15 "*Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity,* Version 2.0"

$$LK_{AGRIC,t} = \left(\Delta C_{BIOMASS,t} + \Delta SOC_{LUC,t}\right) \times 44/12$$
$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + b_{TREE}) \times (1 + R_S)] \times CF \times A_{DISP,t}$$
$$\Delta SOC_{LUC,t} = SOC_{REF} \times (f_{LUP} \times f_{MGP} \times f_{INP} - f_{LUD} \times f_{MGD} \times f_{IND}) \times A_{DISP,t}$$

However, the calculation formula is written as follows because the carbon pool that is the object is considered to be biomass above ground and underground.

$$LK_{AGRIC,t} = \Delta C_{BIOMASS,t} \times 44/12$$

Where:

$\Delta C_{BIOMASS,t}$	=	Decline of carbon accumulation in the carbon pool of land where displaced agricultural

		activities are conducted in t years: *tC*
$\Delta SOC_{LUC,t}$	=	Quantity of change of soil organic carbon (SOC) accompanying change of land use of displaced land: *tC*
CF	=	Carbon factor of tree biomass: *tC/t.d.m*
b_{TREE}	=	Average above-ground tree biomass subject to displacement activities: *t.d.m/ha*
$A_{DISP,t}$	=	Land area of agricultural activities displaced in t years (planting year) (ha)
R_S	=	Root – trunk ratio
SOC_{REF}	=	Reference SOC accumulation for standard state according to climate region and soil type applied to the displaced land: *tC*
$f_{LUP}, f_{MGP}, f_{INP}$	=	Causes of change of SOC accumulation related to land use (LUP), management (MGP), and input (INP) of land before displacement (no units)
$f_{LUD}, f_{MGD}, f_{IND}$	=	Causes of change of SOC accumulation related to land use (LUD), management (MGD), and input (IND) of land after displacement (no units)

Leakage must be calculated by measuring the tree biomass in the range where agricultural activity is displaced outside the project area by project activities, and an interview survey with project participants must be carried out. The following is the calculation method.

Step 1: In order to clarify whether or not agricultural activities before the project have been displaced outside the project area, change of the land use and numbers of pasturage by the project activities are surveyed.

Step 2: In the case where displacement has occurred, the quantity of tree biomass in land use in the displacement destination is measured to obtain the carbon removals.

[4] Number of sample plots

For the number of sample plots used to calculate the baseline net GHG removals, actual net GHG removals, and leakage, the following formula in the methodology tool "*Calculation of the number of sample plots for measurements within A/R CDM project activities*" (Version 2.1.0)" is applied.

$$n = \frac{N \times t_{VAL} \times (\sum_i wi \times si)^2}{N \times E^2 + {t_{VAL}}^2 \times \sum_i wi \times si^2}$$

Where:

n	=	Number of sample plots necessary to estimate the biomass inside the project boundaries	One plot is considered one afforestation block.
N	=	Total of plots predicted inside the project boundaries	This is the number of afforestation blocks of each farmer.
t_{VAL}	=	*t* verification value on both sides of student distribution in limitless degrees of freedom at the required degree of reliability	Reliability category of 90%.
wi	=	Relative weight of stratum *i*	Each stratum of project ÷ overall project area
si	=	Standard differential that estimated the biomass of stratum *i*: t.d.m/ha	Set based on tree survey results.
E	=	Allowed error range of estimation of biomass inside the project boundaries: t.d.m/ha	It is 10% of estimated average value.
i	=	Strata 1, 2, and 3 of estimation of biomass inside project boundaries	

B.7.2. Data and parameters fixed ex-ante

(Copy this table for each piece of data and parameter.)

Data / Parameter	Stem volume factor (SVF)
Unit	Dimensionless
Description	Stem volume coefficient of *Peltophorum dubium* as a

	representative normal tree species
Source of data	HUTCHINSON, J. 1972. Inventario forestall de reconocimiento de la Region Oriental del Paraguay. PNUD/FAO/SFN
Value(s) applied	0.775
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (stem volume) of representative normal tree species before afforestation.
Additional comment	No

Data / Parameter	Stem volume factor (SVF)
Unit	Dimensionless
Description	Stem volume coefficient of *Acrocomia totai* as a representative normal palm species
Source of data	HUTCHINSON, J. 1972. Inventario forestall de reconocimiento de la Region Oriental del Paraguay. PNUD/FAO/SFN.
Value(s) applied	0.800
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (stem volume) of representative palms before afforestation.
Additional comment	No

Data / Parameter	Stem volume factor(SVF)
Unit	Dimensionless
Description	Stem volume coefficient of *Eucalyptus grandis*
Source of data	JIRCAS, UNA, DETERMINACION DE FACTOR DE FORMA DE *Grevillea robusta*, *Eucalyptus camaldulensis* y *Eucalyptus grandis*
Value(s) applied	0.5023
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (stem volume) of *Eucalyptus grandis*
Additional comment	No

Data / Parameter	Stem volume factor(SVF)
Unit	Dimensionless
Description	Stem volume coefficient of *Eucalyptus camaldulensis*
Source of data	JIRCAS, UNA, DETERMINACION DE FACTOR DE FORMA DE *Grevillea robusta*, *Eucalyptus camaldulensis* y *Eucalyptus grandis*
Value(s) applied	0.5343
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (stem volume) of *Eucalyptus camaldulensis*
Additional comment	No

Data / Parameter	Biomass expansion factor(BEF)
Unit	Dimensionless
Description	BEF of *Peltophorum dubium* as a representative normal tree species
Source of data	HUTCHINSON, J. 1972. Inventario forestall de reconocimiento de la Region Oriental del Paraguay. PNUD/FAO/SFN.

Value(s) applied	1.5
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (biomass quantity above ground) of a representative normal tree species before afforestation
Additional comment	No

Data / Parameter	Biomass expansion factor (BEF)
Unit	Dimensionless
Description	BEF of *Acrocomia totai* as a representative palm species
Source of data	HUTCHINSON, J. 1972. Inventario forestall de reconocimiento de la Region Oriental del Paraguay. PNUD/FAO/SFN.
Value(s) applied	1.0
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (quantity of biomass above ground) of representative palm before afforestation
Additional comment	No

Data / Parameter	Biomass expansion factor (BEF)
Unit	Dimensionless
Description	BEF of *Eucalyptus* spp.
Source of data	LULUCF Table 3A.1.10
Value(s) applied	1.5
Choice of data or measurement methods and procedures	IPCC Table 3A.1.10, Tropical/Broadleaf/average
Purpose of data	To be used to calculate the carbon accumulation baseline value (quantity of biomass above ground) of *Eucalyptus* spp.
Additional comment	No

Data / Parameter	Wood density (WD)
Unit	t.d.m/m^3
Description	WD of *Peltophorum dubium* as a representative normal tree species
Source of data	IPCC-GPG-LULUCF Table 3A.1.9-2 "*Peltophorum pterocarpum*"
Value(s) applied	0.62
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (wood density of tree) of a representative normal tree species before afforestation
Additional comment	No

Data / Parameter	Wood density (WD)
Unit	t.d.m/m^3
Description	WD of *Acrocomia totai* as a representative palm species
Source of data	IPCC-GPG-LULUCF Table 3A.1.9-2 "*Cocos nucifera*"
Value(s) applied	0.5
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (wood density of tree) of a representative normal tree species before afforestation
Additional comment	No

Data / Parameter	Wood density (WD)
Unit	$t.d.m/m^3$
Description	WD of *Eucalyptus* spp.
Source of data	"Determinación de la Densidad Específica de la Madera de *Eucalyptus camaldulensis*, *E. grandis* y *Grevillea robusta* A. Cunn", conducted by Asunción National University in April 2007.
Value(s) applied	0.528181
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the carbon accumulation baseline value (wood density of tree) of *Eucalyptus* spp.
Additional comment	No

Data / Parameter	Root-shoot ratio
Unit	Dimensionless
Description	Root-shoot ratio of *Eucalyptus* spp.
Source of data	LULUCF Table 3A.1.8
Value(s) applied	0.45 (<50t/ha) 0.35 (50–150t/ha) 0.2 (>150t/ha)
Choice of data or measurement methods and procedures	Selected according to weight of biomass above ground
Purpose of data	To be used to calculate the carbon accumulation baseline value (wood density of tree) of *Eucalyptus* spp.
Additional comment	No

Data / Parameter	Allometry formula of *E. grandis*
Unit	cm, m
Description	*E. grandis*
Source of data	JIRCAS's demonstration farm
Value(s) applied	$DBH_{,t} = 8.4395 \times \ln(t) - 48.239$ $Height_{,t} = 6.6403 \times \ln(t) - 35.253$
Choice of data or measurement methods and procedures	Quantity of growth in time *t* (days of growth)
Purpose of data	To be used to calculate tree biomass quantity of *Eucalyptus* spp.
Additional comment	No

Data / Parameter	Growth ratio of *E. camaldulensis* and *E. grandis*
Unit	Dimensionless
Description	*E. camaldulensis* ÷ *E. grandis*
Source of data	From a JIRCAS study: Survey of trees on Paraguarí Department
Value(s) applied	0.91
Choice of data or measurement methods and procedures	
Purpose of data	To be used to calculate the tree biomass quantity of *E. camaldulensis*
Additional comment	No

B.7.3. Ex ante calculation of GHG removals by sinks

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(a) **B.7.3.1 Advance calculation of actual GHG absorption quantity**

Step 1: The above ground wood carbon accumulation is calculated based on the above ground stem volume.

$$C_{TREE\_AG_{i,j,l.t}} = SV_{i,j,l,t} \times WD_j \times BEF_j \times CF_j$$

Where:

$C_{TREE\_AB_{i,j,l.t}}$	=	Tree above ground carbon accumulation of species *j* of stratum *i* in *t* years: *tC*
$SV_{i,j,l,t}$	=	Stem volume of *l* of species *j* of stratum *i* in t years: m^3/ha Calculated based on allometry formula and stem volume coefficient in B.7.2
WD_j	=	Basic wood density of species *j: t.d.m/*m^3 Based on B.7.2
BEF_j	=	Expansion coefficient of above ground biomass of species *j*: dimensionless Based on B.7.2
CF_j	=	Carbon ratio of species *j*: dimensionless Default value of AR-tool14 “0.47”

Step 2: The underground tree carbon accumulation weight is calculated based on the above ground tree carbon accumulation weight.

$$C_{TREE\_BG_{i,j,l.t}} = C_{TREE\_AB_{i,j,l.t}} \times R_j$$

Where:

$C_{TREE\_BG_{i,j,l.t}}$	=	Tree underground carbon accumulation of species *j* of stratum *i* in *t* years: *tC/ha*
$C_{TREE\_AB_{i,j,l.t}}$	=	Tree above ground carbon accumulation of species *j* of stratum *i* in *t* years: *tC/ha*
R_j	=	Underground biomass ratio to above ground part of species *j*: dimensionless From LULUCF Table 3A.1.8 Case where above ground biomass weight is less than 50 t/ha, “0.45”, where it is 50 t/ha or higher but less than 150 t/ha, “0.35”, and where it is 150 t/ha or higher, “0.2”

Step 3: Above ground and underground tree carbon accumulations of each stratum are calculated.

$$C_{TREE,i,t} = \sum_{l=1}^{N_{J,i,t}} \left(C_{TREE\_AG_{l,j,t}} + C_{TREE\_BG_{l,j,t}} \right)$$

Where:

$C_{TREE,i,sp,t}$	=	Tree carbon accumulation of stratum *i* in *t* years: *tC*
$C_{TREE\_AG_{l,j,t}}$	=	Above ground carbon accumulation of species *j* of stratum *i* in *t* years: *tC/ha*
$C_{TREE\_BG_{l,j,t}}$	=	Underground carbon accumulation of species *j* of stratum *i* in *t* years: *tC/ha*
$N_{J,sp,i,t}$	=	Number of trees of species *j* of stratum *i* in *t* years
l	=	Stratum array 1,2,3….$N_{j,I,t}$

Step 4: The tree carbon accumulation of a stratum is calculated based on tree carbon accumulation.

$$C_{TREE,i,t} = \sum_{i=1}^{P_i} C_{TREE,i,t} \times A_i$$

Where:

$C_{TREE,i,t}$	=	Tree carbon accumulation of stratum *i* in *t* years: *tC*
$C_{TREE,i,sp,t}$	=	Tree carbon accumulation of stratum *i* in *t* years: *tC*
A_i	=	Area of stratum *i : ha*
i	=	Strata in the project scenario (*1,2,3….i*)
t	=	Years passed since the start of the AR-CDM project (*1,2,3….t*)

(b) B.7.3.2 Ex-ante calculation of the baseline net GHG removals

Step 1: The breast height diameter (DBH) and tree height (H) of trees and crown covering area of shrubs (m^2) are measured on a sample plot inside each stratum before project activities.

Step 2: The above ground stem volume of each tree is calculated based on the results of measurements of trees.

$$SV_{j,t} = \pi \times DBH_{j,t}^2 \times \frac{1}{4} \times H_{j,t} \times SVF_j$$

Where:

$DBH_{j,t}$	=	Chest height diameter of species *j* in *t* years: *cm*
$Height_{j,t}$	=	Tree height of species *j* in *t* years: *m*
$SV_{j,t}$	=	Stem volume of species j in *t* years: m^3/*tree*
SVF_j	=	Stem volume coefficient of species *j*: dimensionless Based on HUTCHINSON, J. 1972 As a representative normal tree species, *Peltophorum dubium* “0.775” As a representative palm species *Acrocomia totai* “0.800”

Step 3: The above ground tree carbon accumulation is calculated based on the above ground stem lumber volume.

$$C_{TREE\_AG_{i,sp,j,l.t}} = SV_{i,sp,j,l,t} \times WD_j \times BEF_j \times CF_j$$

Where:

$C_{TREE\_AB_{i,sp,j,l.t}}$	=	The tree above ground carbon accumulation of species *j* on a sample plot of stratum *i* in *t* years: *tC*
$SV_{i,sp,j,l,t}$	=	Stem volume of *l* of species *j* on a sample plot of stratum *i* in *t* years: m^3/*tree*
WD_j	=	Basic wood density of species *j*: t.d.m/m^3 IPCC-GPG-LULUCF Table 3A.1.9-2 As a representative normal tree species, as *Peltophorum dubium,* “*Peltophorum pterocarpum*” is selected “0.62” As a representative palm species, as *Acrocomia totai*, “*Cocos nucifera*” is selected “0.5”
BEF_j	=	Above-ground biomass expansion coefficient of species *j*: dimensionless Based on HUTCHINSON, J. 1972. As a representative normal tree species, *Peltophorum dubium* “1.5” As a representative palm species, *Acrocomia totai* “1.0”
CF_j	=	Carbon density of species *j*: *tC/t.d.m* Default value of AR-tool14 “0.47”

Step 4: The underground tree carbon accumulation weight is calculated based on the above ground tree carbon accumulation weight.

$$C_{TREE\_BG_{i,sp,j,l.t}} = C_{TREE\_AB_{i,sp,j,l.t}} \times R_j$$

Where:

$C_{TREE\_BG_{i,sp,j,l.t}}$	=	Tree underground carbon accumulation of sample plot tree species *j* of stratum *i* of *t* years: *tC/tree*
$C_{TREE\_AB_{i,sp,j,l.t}}$	=	Tree above ground carbon accumulation of sample plot tree species *j* of stratum *i* of *t* years: *tC/tree*
R_j	=	Above ground / underground biomass ratio of tree species *j*: dimensionless

		Based on LULUCF Table 3A.1.8 Case where above ground biomass weight is less than 50 t/ha, "0.45", where it is 50 t/ha or higher but less than 150 t/ha, "0.35", and where it is 150 t/ha or higher, "0.2"

Step 5: Above ground and underground tree carbon accumulation inside the sample plot of each stratum is calculated.

$$C_{TREE,i,sp,t} = \sum_{l=1}^{N_{J,sp,i,t}} \left(C_{TREE\_AG_{l,j,sp,t}} + C_{TREE\_BG_{l,j,sp,t}}\right)$$

Where:

$C_{TREE,i,sp,t}$	=	Tree carbon accumulation of sample plot of stratum *i* in *t* years: *tC*
$C_{TREE\_AG_{l,j,sp,t}}$	=	Above ground carbon accumulation of tree species *j* inside a sample plot of stratum *i* in *t* years: *tC/tree*
$C_{TREE\_BG_{l,j,sp,t}}$	=	Underground carbon accumulation of tree species *j* inside a sample plot of stratum *i* in *t* years: *tC/tree*
$N_{J,sp,i,t}$	=	Number of trees of species *j* inside a sample plot of stratum *i* in *t* years
l	=	Strata array 1,2,3….$N_{J,sp,i,t}$

Step 6: Tree carbon accumulation of a stratum is calculated based on the tree carbon accumulation inside a sample plot.

$$C_{TREE\_BSL,i,t} = \frac{A_i}{ASP_i}\sum_{sp=1}^{P_i} C_{TREE,i,sp,t}$$

Where:

$C_{TREE\_BSL,i,t}$	=	Baseline tree carbon accumulation of stratum *i* in *t* years: *tC*
$C_{TREE,i,sp,t}$	=	Tree carbon accumulation of a sample plot of stratum *i* in *t* years: *tC*
ASP_i	=	Total sample plot area of stratum '*i*': *ha*
A_i	=	Area of stratum 'i' : *ha*
sp	=	Sample plot of stratum *i* in the project scenario (*1,2,3…..Pi*)
i	=	Strata in the project scenario (*1,2,3,…i*)
t	=	Years elapsed since start of AR-CDM project (*1,2,3,… t*)

Step 7: Quantity of change of tree carbon accumulation of each stratum is calculated.

$$\Delta C_{TREE\_BSL,t} = \frac{C_{TREE\_BSL,i,t2} - C_{TREE\_BSL,i,t1}}{t_2 - t_1}$$

Where:

$\Delta C_{TREE\_BSL,t}$	=	Annual average quantity of change of tree carbon accumulation of stratum '*i*': *tC/year*

Step 8: Shrub biomass quantity per unit of area is calculated.

$$b_{SHURB,i} = BDR_{SF} \times b_{forest} \times CC_{SHURB,i}$$

Where:

$b_{SHURB,i,t}$	=	Shrub biomass quantity per unit of area of stratum 'i': *t.d.m/ha*

$BDR_{SF,t}$	=	Shrub biomass rate per unit of area
b_{forest}	=	Forest above ground biomass quantity by country: *t.d.m/ha* LULUCF Table3A.1.4
$CC_{SHURB,i,t}$	=	Shrub coverage rate in stratum *'i'* : dimensionless

Step 9: Shrubs carbon accumulation in each stratum is calculated.

$$C_{SHURB_{BSL},i,t} = CF_S \times \left(1 + R_{s,j}\right) \times \sum_i A_{SHURB,i} \times b_{SHURB,i}$$

Where:

$C_{SHURB,i,t}$	=	Carbon accumulation of shrubs: *tC*
CF_S	=	Carbon density of shrubs: *tC/t.d.m*
$R_{s,j}$	=	Shrubs underground carbon ratio: dimensionless
$A_{SHURB,i,t}$	=	Shrub area of stratum *'i'*: *ha*

Step10: Quantity of change of shrubs carbon accumulation on each stratum is calculated.

$$\Delta C_{SHURB\_BSL,t} = \frac{C_{SHRUB\_BSL,i,t2} - C_{SHRUB\_BSL,i,t1}}{t_2 - t_1}$$

Where:

$\Delta C_{SHRUB\_BSL,t}$	=	Annual average quantity of change of shrubs carbon accumulation of stratum *'i'*: *tC/year*

Step 11: Tree and shrubs carbon accumulation and total accumulated quantity of change in each stratum is converted to quantity of carbon dioxide.

$$C_{BSL,t} = [C_{TREE\_BSL,t1} + C_{SHRUB\_BSL,t1} + \sum_{i=1}^{l}(\Delta C_{TREE\_BSL,t} + \Delta C_{SRUB\_BSL,t})] \times \frac{44}{12}$$

Where:

$C_{BSL,t}$	=	Baseline net GHG removals in *t* years: tCO_{2-e}

(c) B.7.3.3 Ex-ante calculation of leakage

Step 1: Above ground biomass of trees at location of displaced agricultural activities is calculated.

$$b_{TREE} = SV_j \times BEF_j \times WD_J$$

Where:

b_{TREE}	=	Average above ground tree biomass of land where displaced activities are performed: *t.d.m/ha*
SV_j	=	Stem volume of species *'j'*: m^3/ha
WD_j	=	Basic wood density of tree species *'j'*: *t.d.m/m*^{3} IPCC-GPG-LULUCF Table 3A.1.9-2 As representative normal tree species, as *Peltophorum dubium*, "*Peltophorum pterocarpum*" is selected "0.62" As representative palm species, as *Acrocomia totai*, "*Cocos nucifera*" is

		selected "0.5"
BEF_j	=	Above ground biomass extension coefficient of tree species *j*: dimensionless Based on HUTCHINSON, J. 1972. As representative normal tree species, *Peltophorum dubium* "1.5" As representative palm species, *Acrocomia totai* "1.0"

Step 2: Tree carbon accumulation at location where displaced agricultural activity is performed is calculated.

$$\Delta C_{BIOMASS,t} = [1.1 \times b_{TREE} \times (1 + b_{TREE}) \times (1 + R_s)] \times CF \times A_{DISP,t}$$

Where:

$\Delta C_{BIOMASS,t}$	=	Quantity of reduction of carbon accumulation in the carbon pool of land where displaced activity is performed in *t* years: *tC*
CF	=	Tree biomass carbon coefficient: *tC/t.d.m*
b_{TREE}	=	Average above ground tree biomass of land where displaced activity is performed: *t.d.m/ha*
$A_{DISP,t}$	=	Land area of agricultural activity displaced in *t* year (afforestation year) (ha)
R_s	=	Ratio of underground to above ground

Step 3: Leakage is calculated.

$$LK_{AGRIC,t} = \Delta C_{BIOMASS,t} \times 44/12$$

(d) B.7.3.4 Ex-ante calculation of net artificial GHG removals

Net artificial GHG removals are calculated as follows from the above calculation results.

$$C_{AR\text{-}CDM,t} = C_{ACTUAL,t} - C_{BSL,t} - LK_{,t}$$

Year	$C_{AR\text{-}CDM,t}$	$C_{ACTUAL,t}$	$C_{BSL,t}$	$LK_{,t}$
	tCO_{2e}	tCO_{2e}	tCO_{2e}	tCO_{2e}
1				
2				
:				
n-1				
N				
Total				

B.8. Application of the monitoring methodology and description of the monitoring plan

B.8.1. Data and parameters to be monitored by each generic CPA

(This table is reproduced for each data set and parameter)

Data/Parameter	Locations where project activities were performed
Unit	Latitude/longitude
Description	Project participants' activity locations are confirmed.
Source of data	On site measurement
Value(s) applied	None in particular
Measurement methods and procedures	Location confirmation by GPS
Monitoring frequency	Done before each verification
QA/QC procedure	Confirmation by multiple GPS

Purpose of data	To calculate actual net absorption
Additional comment	No comment

Data/Parameter	Range in which project activities were performed
Unit	Ha
Description	Project participants' project activity locations are confirmed. Range where silviculture is abandoned, range lost by fire, etc. are omitted.
Source of data	On site measurement
Value(s) applied	None in particular
Measurement methods and procedures	GPS measurement of project activity range
Monitoring frequency	Done before each verification
QA/QC procedure	Confirmation by multiple GPS
Purpose of data	To calculate actual net absorption
Additional comment	No comment

Data/Parameter	Location of standard plot
Unit	Latitude and longitude
Description	Randomly selected from project activity range
Source of data	On site measurement
Value(s) applied	None in particular
Measurement methods and procedures	Location confirmation by GPS
Monitoring frequency	Done before each verification
QA/QC procedure	None in particular
Purpose of data	To calculate actual net absorption
Additional comment	No comment

Data/Parameter	Chest height diameter (Tree diameter at H = 1.3m)
Unit	Cm (centimeter)
Description	
Source of data	Measurement on site
Value(s) applied	None in particular
Measurement methods and procedures	Measured using a tree tape measure
Monitoring frequency	Done before each verification
QA/QC procedure	Measured often
Purpose of data	To calculate actual net absorption
Additional comment	No comment

Data/Parameter	Tree height
Unit	M (meter)
Description	
Source of data	Measurement on site
Value(s) applied	None in particular
Measurement methods and procedures	Measured using a tree height measurement pole
Monitoring frequency	Done before each verification
QA/QC procedure	Measured often
Purpose of data	To calculate actual absorption
Additional comment	No comment

Data/Parameter	Number of trees remaining in baseline survey plot
Unit	Number of trees

Description	Follow-up survey of trees remaining from before the project
Source of data	Measurement on site
Value(s) applied	None in particular
Measurement methods and procedures	[1] Numbering and obtaining location information by GPS of trees remaining from before the project. [2] Confirming whether any remain at verification time
Monitoring frequency	Done before each verification
QA/QC procedure	None in particular
Purpose of data	To calculate baseline net GHG removals
Additional comments	No comment

Data/Parameters	Leakage
Unit	Ha
Description	Cultivated and grassland areas inside the project boundaries where project activities are displaced
Source of data	Measurement or estimation on site
Value(s) applied	None in particular
Measurement methods and procedures	Interviewing farmers
Monitoring frequency	Once before first verification
QA/QC procedure	None in particular
Purpose of data	To calculate leakage
Additional comment	No comment

(Copy this table for each piece of data and parameter.)

Data/Parameter	
Unit	
Description	
Source of data	
Value(s) applied	
Choice of data or Measurement methods and procedures	
Purpose of data	
Additional comment	

B.8.2. Description of the monitoring plan for a generic CPA

(a) Monitoring baseline net GHG removals

According to approval methodology AR-AMS0007, monitoring to calculate baseline net GHG removals is not necessary.

(b) Project emissions

According to Paragraph 3 of the methodology tool, "*Estimation of non-CO2 GHG emissions resulting from burning of biomass attributable to an A/R CDM project activity*", in the case where the carbon accumulation area impacted by fire is greater than 5% of the project area, non-CO_2 GHG emissions must be considered. Therefore, during monitoring, whether or not a fire has occurred, and the area involved, are confirmed from the number of sample plots based on the methodology tool.

(c) Leakage

Based on Paragraph 15 of the methodology tool "*Estimation of the increase in GHG emissions attributable to displacement of pre-project agricultural activities in A/R CDM project activity, Version*

2.0", the area of cultivated land and grassland inside the project boundaries, where displaced project activities are performed, is surveyed from the number of sample plots based on the methodology.

(d) Project boundaries

Regarding project boundaries, all plots are confirmed using GPS before each verification. In the case where fire or abandonment of silviculture has been confirmed, the project boundaries and area are corrected and reflected in the calculation of actual net GHG removals.

(e) Monitoring actual net GHG removals

- Sample plots (plots monitored) are set to calculate the actual GHG removals by stratum inside the project boundaries confirmed in (d). The number of plots to be monitored is set based on the methodology tool *Calculation of the number of sample plots for measurements within A/R CDM project activities, Version 2.01.0.*
- The standard plot is set inside the plots that are monitored. The standard plot is considered to be the state of tree silviculture that represents the plots that are monitored.
- The breast height diameter and tree height inside the standard plot are measured to calculate the above ground biomass quantity, and to calculate the carbon accumulation inside the plots that are monitored.
- The actual net GHG removal by stratum is calculated based on the carbon accumulation in the plots that are monitored.

Appendix 1. Contact information of project participants and responsible persons/ entities

CME and/or responsible person/entity	☐ **CME** ☐ **Person/entity responsible for application of the selected methodology(ies) and, where applicable, the selected standardized baseline(s) to the PoA**
Organization name	
Street/P.O. Box	
Building	
City	
State/Region	
Postcode	
Country	
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	
Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct telephone no.	
Personal e-mail	

CME and/or responsible person/entity	☐ **CME** ☐ **Person/entity responsible for application of the selected methodology(ies) and, where applicable, the selected standardized baseline(s) to the PoA**
Organization name	Mnisterio de Agrricultura y Ganaderia, Direccion General de Planificacion
Street/P.O. Box	Yegros 437 c/ 25 de Mayo
Building	Edificio San Rafael Piso19
City	Asunción
State/Region	
Postcode	
Country	Paraguay
Telephone	
Fax	
E-mail	
Website	http://www.mag.gov.py
Contact person	
Title	
Salutation	
Last name	

Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct telephone no.	
Personal e-mail	

CME and/or responsible person/entity	☐ **CME** ☐ **Person/entity responsible for application of the selected methodology(ies) and, where applicable, the selected standardized baseline(s) to the PoA**
Organization name	Instituto Forestal Nacional
Street/P.O. Box	Ruta Mariscal Estigarribia Km 10,5
Building	-
City	San Lorenzo
State/Region	
Postcode	
Country	Paraguay
Telephone	+595 21 570516
Fax	+595 21 570516
E-mail	
Website	www.infona.mag@gmai.com
Contact person	
Title	Director General
Salutation	Mr.
Last name	
Middle name	
First name	
Department	Dirección General de Educación y Extensión Forestal
Mobile	
Direct fax no.	+595 21 524382 / +595 21 570960
Direct telephone no.	+595 21 524382 / +595 21 570960
Personal e-mail	

CME and/or responsible person/entity	☐ **CME** ☐ **Person/entity responsible for the application of the selected methodology(ies) and, where applicable, the selected standardized baseline(s) to the PoA**
Organization name	University of National Asunción
Street/P.O. Box	Barrio Villa Universitaria
Building	
City	San Lorenzo
State/Region	
Postcode	
Country	Paraguay
Telephone	

Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	
Middle name	
First name	
Department	
Mobile	
Direct fax no.	
Direct telephone no.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

This project does not use funds diverted from an ODA.

Appendix 3. Applicability of methodology(ies) and standardized baseline(s)

Appendix 4. Further background information on ex ante calculation of GHG removals by sinks

Appendix 5. Further background information on monitoring plan

Appendix 6. Geographic delineation of project boundary

Appendix 7. Summary of post registration changes

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Document information

Version	*Date*	*Description*
4.0	9 March 2015	Revisions to: • Include provisions related to choice of start date of PoA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Editorial improvement.
3.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the program design document form for small-scale afforestation and reforestation CDM program of activities (these instructions supersede the "Guideline: Completing the program design document form for small-scale afforestation and reforestation CDM program of activities" (Version 3.0)); • Include provisions related to standardized baselines; • Add contact information on a responsible person(s)/ entity(ies) for the application of the methodology (ies) to the PoA in B.4 and 0; • Add general instructions on post-registration changes in Paragraph 2 and 3 of general instructions and 0; • Change the reference number from *F-CDM-SSC-AR-PoA-DD* to CDM-SSC-AR-PoA-DD-FORM; • Editorial improvement.
2.0	13 March 2012	EB 66, Annex 15 Revision required to ensure consistency with the “Guidelines for completing the program design document form for small-scale afforestation and reforestation CDM programs of activities”
1.0	30 November 2007	EB 36, Annex 28 Initial publication

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: afforestation reforestation, program of activities, project design document, simplified methodologies

Attachment 2

Component project activity design document form for small-scale afforestation and reforestation CDM component project activities

(Version 04.0)

Complete this form in accordance with the Attachment "Instructions for filling out the component project activity design document form for small-scale afforestation and reforestation CDM component project activities" at the end of this form.

COMPONENT PROJECT DESIGN DOCUMENT (CPA-DD)	
Title of the CPA	Reforestation project for low income areas in Coronel Oviedo City in Caaguazú Department and elsewhere
Version number of the CPA-DD	Ver1.0
Completion date of the CPA-DD	December 1, 2015
Title of the PoA in which the CPA is included	Reforestation Project for Low Income Regions of Paraguay
Host Party	Ministry of Agriculture and Livestock of Paraguay (the general office of Planning)
Estimated amount of annual average GHG removals by sinks	5,992 tCO_2

SECTION A. General description of the CPA

A.1. Title of the proposed or registered PoA

Reforestation Project for Low Income Regions of Paraguay

A.2. Title of the CPA

Reforestation project for low-income areas in Coronel Oviedo City in the Caaguazú Department and elsewhere

A.3. Description of the CPA

This project is a eucalyptus species (*Eucalyptus grandis* and *Eucalyptus camaldulensis*) reforestation project for unforested impoverished regions. The afforestation regions are Coronel Oviedo City, La Pastora City, and Carayaó City in the Caaguazú Department, covering an area of 297.30 ha (October 2015). The Caaguazú Department is impoverished, with 48.7% of its population living in poverty; at a poverty degree of 0.487, it is the third poorest department of Paraguay.[1]
The purpose of this project is to prevent warming by absorbing carbon dioxide through a reforestation project conducted by small famers in Coronel Oviedo City and elsewhere, and it is to improve the incomes of small farmers through forestry.
A small-scale CDM afforestation project in Paraguay has been undertaken by the Paraguarí Department, and both the National Forestry Institute (INFONA) and National University of Asunción (UNA) have experience and knowledge. This CPA is a project conducted with the participation of the INFONA, UNA, and the National University of Caaguazú (UNCA) and represented by the Coronel Oviedo City office of the Agricultural Extension Bureau (DEAG) of the Ministry of Agriculture and Livestock (MAG), which is a department that possesses the information and the ability to coordinate with farmers. As the implementation system, the Coronel Oviedo City office of the DEAG coordinates and leads CDM project participants in the hamlets to form the project and to produce and supply seedlings to participating farmers during the credit period. The INFONA gives the farmers guidance regarding silviculture and monitors their activities while the universities, UNA and UNCA, calculate credits. The farmers participate voluntarily by providing workers to carry out afforestation and silviculture.
Additionally, the Japan International Research Center for Agricultural Science (JIRCAS) supports the activities of those bodies carrying out each project and the preparation of the written project designs.

A.4. Entities/individuals responsible for the operation of the CPA

The Coronel Oviedo City office of the DEAG of MAG, the Oviedo regional office of the INFONA, UNA, and UNCA are responsible for the operation of the CPA.

A.5. Environmental conditions

The afforestation region is land with deteriorated soil unsuited for farmland or grassland and with no rare flora or fauna. Judging from the area of the plots, reforestation could improve the environment and will have few harmful effects on it.

(a) Climate
Paraguay is in a subtropical zone, its annual rainfall is 1,300 mm, and its average annual temperature is between 21 and 23°C. Rainfall and temperature in the Caaguazú Department are shown below (average values from 1990 to 2011).[2]

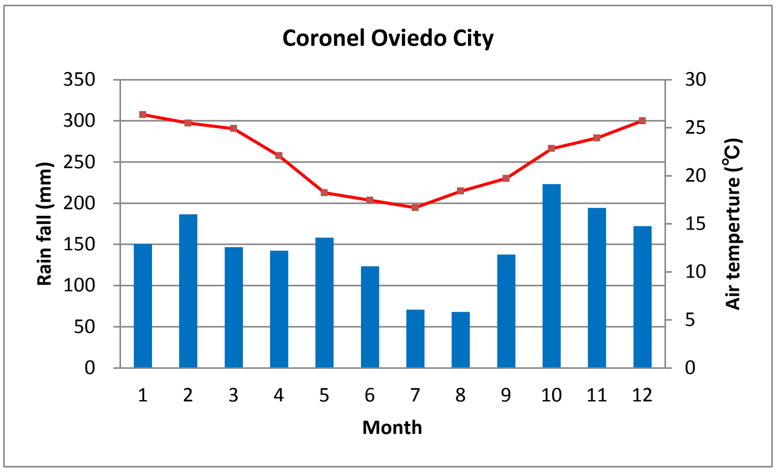

Figure A.5. Rainfall and air temperature in Coronel Oviedo City

(b) Hydrology

The project region is in the drainage basin of the Paraguay River and is part of the Guarani Aquifer. The Paraguay River is 2,600 km in total length, and its major tributaries are the Apa River, Aquidabán River, and the Tebicuay River; it flows into low land from its source on the Parana plateau. On this low land, as its tributary rivers flow to the west, the river broadens, and its flow calms.

The Parana River, which is the second longest river in Paraguay, flows for 800 km through Paraguay from Salto del Guairá, which is the point where it flows into Paraguay, to its convergence with the Paraguay River; then, called the La Plata River, it flows south through Argentina to Buenos Aires.

(c) Soil

The results of the soil analysis in a project demonstration field located in Coronel Oviedo City are shown below. The soil was sampled in June 2015. According to the results, it is infertile acidic soil with extremely little organic material or nutrients.

Table A.5.1. Results of the soil analysis in the demonstration field (6 points × 3 layers)

Analysis items	Unit	0–10cm	10–20cm	20–30cm
pH (H2O)		5.07	5.13	5.54
Organic material content	%	0.99	0.38	0.29
Ca	cmol/LS	1.01	0.55	1.79
Mg	cmol/LS	0.09	0.05	0.58
K	cmol/LS	0.06	0.03	0.06
P	mg/LS	6.61	4.41	3.81
Fe	mg/LS	418.21	203.97	69.28
Cu	mg/LS	1.00	0.56	0.97
Zn	mg/LS	0.65	0.24	0.25
Mn	mg/LS	15.09	4.16	3.70
Al	mEq/100g	0.88	1.05	1.05
Clay	%	11.91	10.24	18.91
Base saturation	%	16.16	10.19	32.87
CEC	cmol/LS	7.15	6.37	7.30

(d) Ecosystems

Paraguay is divided into five ecosystem regions known as Cerrado, Pantanal, Chaco (divided into Dry Chaco and Humid Chaco), the Upper Parana Atlantic Forest, and the Misiones grassy plain.

The Upper Parana Atlantic Forest (which originally covered about 60% of eastern Paraguay) and Dry Chaco (Western Paraguay River) are considered to be forest ecosystems, Humid Chaco (southern 1/3 of Paraguay Chaco), Cerrado (Part of Eastern Paraguay), and the Misioines grassy plan (South-west Paraguay) are

considered to be grassy ecosystems, and Pantanal (northeast corner of Paraguay Chaco) is considered to be a wet ecosystem.
The Upper Parana Atlantic Forest, Cerrado, and Pantanal include diverse biota and are in danger of serious losses, so they are viewed as a global scale important region or a hotspot. Chaco is famous for its dense populations of mammals, and Misiones grassy plain is well known as part of a bird habitat region because of its unique avifauna.
The project region is part of Humid Chaco, which has a grassland ecosystem considered unique because of its widesapread palm savanna. Table A.5.2 shows the ecosystem regions of Paraguay.

Table A.5.2. Ecosystem regions of Paraguay

Ecosystem regions	Area (ha)	Percentage of land area (%)
Dry Chaco	17,484,326	42
Humid Chaco	12,858,489	32
Upper Parana Atlantic Forest	8,591,121	21
Cerrado	819,101	2
Pantanal	198,494	1
Other areas	723,669	2
Total	40,675,200	100

(e) Rare species and endangered species and their habitats and breeding grounds

Documents affirming that no animals designated as rare or endangered species inhabit the project region have been issued to the Project from the Caaguazú Department administration.
Two endangered species (14 trees) established by the Environment Agency (SEAM) based on a 2015 survey were confirmed as Tajy (*Tabebuia*sp) and Cerdo (*Cedrelapissilis*). These are very rare, with only a few trees remaining in the surveyed region. JIRCAS will also produce seedlings of native species, including these, and distribute them to the concerned organizations.

A.6. Technical description of the CPA

1. Seedling field production
1) Location of the seedling field and facility operation
The seedling fields are to be formed and operated by improving part of the DEAG, which is located in Blas Garay. The operation of the seedling fields is managed by DEAG staff and contract workers.
2) Seedling production method

- Three types of two species of seeds, *Eucalyptus grandis*, *Eucalyptus camaldulensis*, and Eucalyptus hybrid (*E. grandis* × *E. camaldulensis*), were used to grow the seedlings.
- The method adopted was the tube pot use method that can lighten the silviculture work and seedling transport work.
  The tube pots, compost, and necessary machines were purchased from Plantec, eucalyptus silviculture company in the vicinity.
- The production procedure is as follows: [1] preparing the compost, [2] filling the tube pots with compost, [3] sowing seeds in the pots, [4] thinning sprouts after germination in a greenhouse, and [5] taking the seedlings outdoors from the greenhouse, and adjusting the silviculture density according to each silviculture stage outdoors in order to accustom the seedlings to the outside air and strengthen them (silviculture density 100%→50%). Productivity is governed by the weather, but it is predicted that between 200,000 and 300,000 seedlings will be produced annually.
- For transport, 50 tubes will be transported in each container.

It is necessary to plan the number of seedlings to be produced, which is set according to the estimation of the number of seedlings to be distributed. The approximate number of seedlings distributed is calculated by measuring the predicted afforestation area. The predicted afforestation area is calculated by the following procedure.

[1] The farmers visit the section where the predicted range of afforestation is planned and confirmed.
[2] The XY coordinates of the points of change of the predicted afforestation range are recorded using a portable GPS unit.

[3] Based on the coordinates of points of change recorded by GPS, the area is calculated applying Heron's formula.

The number to be planted per hectare is decided in advance; then the calculated area is used to calculate the number predicted to be distributed. The production plan is enacted by adding the number replanted to the calculated predicted number distributed, to calculate the total seedlings indicated in the production capacity and distribution plan.

2. Distributing and planting the seedlings
1) Distributing the seedlings
The seedlings are planted by the farmers in each section occupied by small-scale farmers. Before planting, the volunteer farmers are trained and given guidance about such as planting intervals planting methods. At the training site, a seedling distribution schedule is confirmed, and seedlings are transported from the seedling field and distributed directly to the homes of farmers who are prepared.
2) Planting the seedlings
The farmers are instructed to plant the seedlings as soon as possible—within two weeks at the latest after distribution—store the seedlings by selecting a cool shaded storage place, and erect a fence around the storage place so that farm animals will not eat the seedlings.

A.7. Party(ies)

Name of Party involved (host) indicates host Party	Private and/or public entity(ies) CPA implementer(s) (as applicable)	Indicate if the Party involved wishes to be considered as CPA implementer (Yes/No)
Government of Paraguay Ministry of Agriculture of Paraguay (directorate of Planning)	Coronel Oviedo City office of the Agricultural Extension Bureau of the Ministry of Agriculture and Livestock, National Forestry Institute, National University of Asunción, National University of Caaguazú	NO

A.8. Geographic reference or other means of identification

The project sites are 28 farmers groups (comité) in Coronel Oviedo City, La Pastora City, and Carayaó City (October 2015), and the project area includes 347 plots (October 2015). For each afforestation plot, coordinates are read using portable GPS to confirm the shape and area.

Table A.8. Numbers of afforestation plots and afforestation plot areas in three regions (October 2015)

Distrito	Number of afforestation plots	Afforestation areas
Coronel Oviedo	300	252.27
La Pastora	27	34.99
Carayaó	20	10.04
Total	347	297.30

A.9. Duration of the CPA

A.9.1. Start date of the CPA

July 2013

A.9.2. Expected operational lifetime of the CPA

20 years 0 months

A.10. Choice of the crediting period and related information

20 years 0 months

A.10.1. Start date of the crediting period

July 2013

A.10.2. Length of the crediting period

20 years 0 months

A.11. Estimated amount of GHG removals by sinks

GHG removals by sinks during the crediting period	
Years	**Annual GHG removals by sinks (in tons of CO_2e) for each year**
2013-2014	0
2014-2015	94
2015-2016	4,458
2016-2017	12,007
2017-2018	16,502
2018-2019	19,954
2019-2020	20,440
2020-2021	7,244
2021-2022	11,344
2022-2023	16,298
2023-2024	15,836
2024-2025	-27,206
2025-2026	-96,969
2026-2027	65
2027-2028	3,076
2028-2029	8,329
2029-2030	12,672
2030-2031	12,905
2031-2032	13,860
2032-2033	8,373
Total number of crediting years	20
Annual average GHG removals by sinks over the crediting period	2,964
Total GHG removals by sinks (tons of CO2e)	59,282

A.12. Legal title to the land and rights to tCERs/lCERs issued for the CPA

Land inside the project boundaries is managed by individual farmers or families who continue long-term use. However, many landholders do not have legal rights to the land they cultivate or use as dwelling land. The following is the landholding status of farmers in Caaguazú Department, which is the project region.

Table A.12. State of landholding

Categories	Number of farmers (households)
Have deed	17,656
Are in process of obtaining deed	8,971
Using leased land	3,075
Exclusive use	10,648
Use in other ways	1,574
Total	39,006

Source: 2008 Agricultural census

It is confirmed that farmers who do not have deeds will continue to make decisions personally concerning the land in the future, as they have in the past. This fact is supported by Paraguay's Civil Code, which states, "Continued exclusive use for more than 20 years of real estate without obstruction shall permit the occupier to receive a deed in accordance with legal procedures for making a request."

As the first step a farmer takes to obtain a deed, the National Farmland Development Institute (INDERT), which is the land deed issuing body, issues an "Occupancy Certificate," which certifies that the land in question has been occupied exclusively by a specified person. The "Occupancy Certificate" is issued before the start of procedures to obtain a deed, and in legal procedures in Paraguay, it is treated as a substitute for a deed.

Considering the history and cultural state of this region, many farmers are not the legal owners of the land they cultivate and live on, but it can be concluded that they will continue to possess it in the future. The project implementing bodies will obtain rights to access the land and implement the project by signing agreements with each participating farmer.

A.13. Assessment of the eligibility of the land

According to Version 01, EB 35, Annex 18, it is held that the following evidence of eligibility to conduct A/R CDM project activities must be submitted. The following table shows the criteria for the eligibility of land for project activities.

	Eligibility Criteria	Project Applicability
(a)	Certification of land at time of project start	
(i)	Vegetation on this land shall be below the limit for definition as a forest.	The Government of Paraguay definition of forest as: [1] a minimum area of 0.5 ha, tree coverage rate of 25% or more, and tree height at maturity of 5 m or higher. All farmers' plots are visited to confirm the state of vegetation before the project starts. These are within the range of definition by the UNFCCC.
(ii)	All young natural trees and artificial trees on this land have not reached the minimum crown coverage ratio and tree height based on the definition of forest by the host country	The land is deteriorated land, and it is impossible to convert it to a state that satisfies the definition of forest without artificial intervention.
(iii)	This land is not in a temporarily un-accumulated state. There are no artificial impacts, such as harvesting, nor any natural causes.	As stated in (i) and (ii), it is not a forest and it is land without artificial intervention.
(b)	Proof of new afforestation or of reforestation	
(i)	For reforestation, it is certified that as of	At the time of the on-site survey of each plot in (i), it

	December 31, 1989, this land did not satisfy the conditions of a forest indicted in (a) above.	was confirmed with the landholders, that it was not forest on December 31, 1989.
(ii)	For new afforestation, it is certified that the land has not been forest at least 50 years, and if there is the vegetation it has not satisfied with definition of forest of host country.	This project is not applicable because it is reforestation.

A.14. Approach for addressing non-permanence

The issuance of tCERs was selected for the net anthropogenic greenhouse gas removals achieved by the small-scale A/R-CDM project.
The project period was set as 20 years, from 2013 to 2032, and the afforestation was conducted in 2013 and 2014. The first tCER will be issued in 2017, and later, the inspection and certification will be conducted every five years until the end of the credit period (2022, 2027, and 2032).

A.15. Public funding of the CPA

Information about public funding for this project is as described in Annex 2.

A.16. Confirmation of the CPA

It was confirmed as shown by the following table based on the eligibility criteria of the CME of the PoA.

From CDM-EB65-A03-STAN 3.2: Development and update of eligibility criteria, paragraph 16

Standard required conditions	Eligibility criteria confirmation method
(a) Geographical boundaries	All afforestation plots of farmers who participate in the afforestation project were measured using portable GPS, confirming the geographical boundaries based on maps generated by inputting afforestation plots.
(b) Conditions to avoid double counting the quantity of reduction	It was confirmed that Akai City and San Pedro Gonzales City in Paraguarí Department are not included in any past afforestation CDM projects.
(c) Specifications of technology and measures, including types and levels of services or performances	INFONA, which is a CME member, confirmed the seedling production method and the types and quality of seedlings.
(d) Conditions to check the start date of the CPA based on documentary evidence.	The date of the start of afforestation was controlled by data from each afforestation plot.
(e) Conditions that ensure compliance with applicability and other requirements of methodologies applied to the CPAs	The methodology applied at this time is that of AR-AMS0007—"Afforestation and reforestation project activities implemented on lands other than wetlands," and the CME confirmed that it was implemented according to the methodology at the time the CPA-DD was submitted.
(f) The conditions that ensure that the CPA meets the requirements for demonstration of additionality	The CME confirmed that this CPA is eligible based on this PoA-DD.
(g) The PoA-specific requirements stipulated by the CME, including any conditions related to undertaking local stakeholder consultations and environmental impact analysis	The CME confirmed that this CPA consulted with local stakeholders and obtained comments according to the PoA; there are no negative comments. The environmental impact assessment need not be done, according to the host country's

	criteria, in the case of this afforestation project.
(h) Conditions to provide an affirmation that funding from Annex I Parties, if any, does not divert to the ODA	The CPA implementing bodies are CME members, so this condition does not apply. Additionally, it is as stipulated by Annex 2.
(i) Target group and distribution method, where applicable	The project activities are participated in voluntarily by small-scale farmers, so this condition is not applicable.
(j) When applicable, sampling requirements for the PoA in accordance with the Guidelines or standards approved by the Board of Directors adapted to sampling and surveys	The CME surveyed the results of a sampling survey submitted by the CPA implementing bodies confirming that there were no problems.
(k) When applicable, the conditions that ensure that every CPA meets the small-scale or microscale threshold and remains within those thresholds throughout the crediting period of the CPA	Not applicable.
(l) Where applicable, the requirements for a debundling check in the case where the CPA belongs to small-scale (SSC) or microscale project categories	Not applicable.

A.17. Debundling the CPA

The small-scale afforestation CDM projects already executed were limited to the Paraguarí Department, and the shortest distance between project boundaries is 1 km or more.

A.18. Contact information of persons/entities responsible for completing the CDM-SSC-AR-CPA-DD-FORM

Lic. Anibal Oviedo de gerente de Dirección de Extensión Agraria (DEAG) Coronel Oviedo, Ministerio de Agricultura y Ganadería (MAG)

SECTION B. Environmental analysis

B.1. Analysis of the environmental impacts

This project is the conversion to forest of a portion of farmland and grassland that is used by small-scale farmers, and it will have no negative impacts on the environment. On the other hand, this afforestation project will contribute to the conservation of surrounding forest resources.

B.2. Environmental impact assessment

Since the project activities will have no negative impacts on the environment, an environmental impact evaluation analysis is unnecessary. In addition, under Law No. 294/93 of Paraguay, an environmental impact evaluation analysis is only demanded for a large-scale afforestation project of 1,000 hectares or more.

SECTION C. Socio-economic impacts

C.1. Analysis of the socio-economic impacts

The project activities will have positive social impacts. The participants are small-scale farmers who manage farms on small plots of land with low productivity in impoverished regions. This project can be counted on to supplement existing farm income by adding the sale of lumber, improving their livelihoods.

C.2. Socio-economic impact assessment

Not applicable.

SECTION D. Local stakeholder consultation

D.1. Solicitation of comments from local stakeholders

When the project started, prior arrangements were made with the stakeholders and farmers, confirming their opinions and desires. None was negative.

D.2. Summary of comments received

Head of the Environmental section of the Caaguazú Department:
In this department, where lumber processing is flourishing, I think an afforestation project will have a great economic impact. This department will help form this project.

Participating farmers:
・We want to effectively use surplus land and deteriorated land through afforestation.
・There is a high demand for lumber and firewood, so we want to earn money by selling planted trees.
・Planted trees will be a future asset that could replace pensions.
・We want planted trees to cover the future cost of educating our sons (in universities).

D.3. Report on consideration of comments received

There are no comments in particular that require consideration.

SECTION E. Eligibility of CPA and estimation of emissions reductions

E.1. Reference of methodology(ies) and standardized baseline(s)

AR-AMS0007
Afforestation and reforestation project activities implemented on lands other than wetlands, Version 3.1

E.2. Applicability of methodology(ies) and standardized baseline(s)

This CPA satisfies the required conditions of the methodology, as shown below.

NO	Conditions for applicability of methodology	Suitability of selection
1	(a) The land subject to the project activity does not fall into the wetland category	The project area is farmland or grassland farmers use for farm operation. It does not include wetlands.
2	(b) Soil disturbance attributable to the project activity does not cover more than 10% of the area in each of the following types of land, when these lands are included within the project boundary: (i) Land containing organic soils; (ii) Land that, on its baseline, is subjected to land-use and management practices and that receives inputs listed in	At the time of the baseline survey before project activities, it was confirmed that there were many predicted afforestation plots where almost no trees existed. Many farmers have no intentions of felling existing trees in the afforestation plots. The tillage method on the land at the time of afforestation is basically point tillage of 30 cm × 30 cm, and there will be 1,000 trees planted per hectare, so the soil disturbance will be about 0.9%.

	Appendices 2 and 3 of this methodology.	

E.3. Carbon pools and emission sources

Under AR-AMS0007, Ver. 3.1, paragraph 12, the baseline net GHG removal, as well as the actual net GHG removal, will be calculated with the following carbon pools as the objects.

Carbon pools	Selected?	Justification/Explanation
Above ground	Yes	Selected as a major carbon pool for project activities
Underground	Yes	Selected as a major carbon pool for project activities
Dead and drying wood, litter, and soil organic carbon	No	Not selected

E.4. Identification of strata

The stratification for baseline net GHG removal (baseline scenario) is set according to farmers' land use categorization before the project. The land use categorization inside the project boundaries is either farmland or grassland, so it has two strata.

Table E.4.1. Strata according to land use categorization

Stratum	Land use
S1	Cultivated land
S2	Grassland

The actual net GHG removal (project scenario) is calculated assuming six strata according to the afforestation year and species.

Table E.4.2. Strata setting

Stratum	Afforested species	Afforestation year
S1	*E. grandis*	2013
S2	*E. grandis*	2014
S3	*E. camaldulensis*	2013
S4	*E. camaldulensis*	2014
S5	*E. grandis* x *E. camaldulensis*	2013
S6	*E. grandis* x *E. camaldulensis*	2014

E.5. Description of the baseline scenario

See B.5 in PoA-DD.

E.6. Demonstration of eligibility for a CPA

The same as in A.13.

E.7. Estimation of GHG removals by sinks

E.7.1. Explanation of methodological choices

The methodology applied was "Afforestation and reforestation project activities implemented on lands other than wetlands, Version 3.1," and the calculation was conducted as shown below.

E.7.2. Data and parameters fixed ex-ante

(Copy this table for each data and parameter.) See B.7.2 of the PoA-DD.

Data/Parameter	
Unit	
Description	
Source of data	
Value(s) applied	
Choice of data or measurement methods and procedures	
Purpose of data	
Additional comment	

E.7.3. Ex-ante calculation of GHG removals by sinks

Ex-ante calculation of actual GHG removals
See B.7.3.1 of PoA-DD
Ex-ante calculation of baseline net GHG removals
See B.7.3.2 of PoA-DD
Ex-ante calculation of leakage
See B.7.3.3 of PoA-DD
Ex-ante calculation of net anthropogenic GHG removals
See B.7.3.4 of PoA-DD

E.7.4. Summary of the ex-ante estimates of GHG removals by sinks

Year	Baseline net GHG removals by sinks (tCO_2e)	Actual net GHG removals by sinks (tCO_2e)	Leakage (tCO_2e)	Net anthropogenic GHG removals by sinks (tCO_2e)	Cumulative net anthropogenic GHG removals by sinks (tCO_2e)
2013	524	0	0	-524	-524
2014	197	94	0	-103	-626
2015	197	4,458	0	4,261	3,635
2016	197	12,007	0	11,810	15,445
2017	197	16,502	0	16,305	31,751
2018	197	19,954	0	19,757	51,508
2019	197	20,440	0	20,243	71,751
2020	197	7,244	0	7,047	78,799
2021	197	11,344	0	11,147	89,946
2022	197	16,298	0	16,101	106,047
2023	197	15,836	0	15,639	121,687
2024	197	-27,206	0	-27,403	94,284
2025	197	-96,969	0	-97,166	-2,882

2026	197	65	0	-132	-3,014
2027	197	3,076	0	2,879	-134
2028	197	8,329	0	8,132	7,998
2029	197	12,672	0	12,475	20,473
2030	197	12,905	0	12,708	33,182
2031	197	13,860	0	13,663	46,845
2032	197	8,373	0	8,176	55,021
Total number of crediting years	20				
Total (tons of CO_2e)	4,261	59,282	0	55,021	

E.8. Application of the monitoring methodology and description of the monitoring plan

E.8.1. Data and parameters to be monitored

(Copy this table for each data and parameter.) See B.8.1 of PoA-DD.

Data/Parameter	
Unit	
Description	
Source of data	
Value(s) applied	
Measurement methods and procedures	
Monitoring frequency	
QA/QC procedures	
Purpose of data	
Additional comment	

E.8.2. Description of the monitoring plan

For the monitoring plan, see B.8.2 of PoA-DD.

SECTION F. Approval and authorization

※A letter authorizing implementation of the project from DNA (SEAM) and a letter stating that the Oviedo office of the Agricultural Extension Bureau, Oviedo regional office of INFONA, Asuncion National University, and the National University *of* Caaguazú are the implementing bodies are attached.

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Appendix 1. Contact information of the CPA implementer(s) and person(s)/entity(ies) responsible for completing the CDM-SSC-AR-CPA-DD-FORM

CPA implementer and/or responsible person/entity	☐ CPA implementer(s) ☐ Responsible person/ entity for completing the CDM-SSC-AR-CPA-DD-FORM
Organization	
Street/P.O. Box	
Building	
City	Coronel Oviedo
State/Region	Caaguazú
Postcode	
Country	Paraguay
Telephone	
Fax	
E-mail	
Website	
Contact person	
Title	
Salutation	
Last name	
Middle name	
First name	
Department	
Mobile	
Direct fax	
Direct tel.	
Personal e-mail	

Appendix 2. Affirmation regarding public funding

This project does not use funds diverted from an ODA.

Appendix 3. Applicability of methodology(ies) and standardized baseline(s)

Appendix 4. Further background information on ex-ante calculation of GHG removals by sinks

Appendix 5. Further background information on the monitoring plan

Appendix 6. Geographic delineation of the project boundary

Appendix 7. Declaration regarding low-income communities

Appendix 8. Summary of post registration changes

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Document information

Version	*Date*	*Description*
04.0	9 March 2015	Revisions to: • Include provisions related to statement on erroneous inclusion of a CPA; • Include provisions related to delayed submission of a monitoring plan; • Provisions related to local stakeholder consultation; • Provisions related to the Host Party; • Editorial improvement.
03.0	25 June 2014	Revisions to: • Include the Attachment: Instructions for filling out the component project activity design document form for small-scale afforestation and reforestation CDM component project activities (these instructions supersede the "Guidelines for completing the component project activity design document form for small-scale afforestation and reforestation CDM component project activities" [Version 02.1]); • Include provisions related to standardized baselines; • Add contact information of the CPA implementer and/or person/entity responsible for completing the CDM-SSC-AR-CPA-DD-FORM in A.18 and Appendix 1; • Add general instructions on post-registration changes in paragraphs 4 and 5 of the general instructions and Appendix 8; • Change the reference number from *F-CDM-SSC-AR-CPA-DD* to *CDM-SSC-AR-CPA-DD-FORM*; • Editorial improvement.
02.0	13 March 2012	EB 66, Annex 19 Revision was required to ensure consistency with the "Guidelines for completing the component project activity design document form for small-scale afforestation and reforestation component project activities."
01.0	30 November 2007	EB 36, Annex 31 Initial adoption.

Decision Class: Regulatory
Document Type: Form
Business Function: Registration
Keywords: component project activity, project design document, SSC AR project activity

Attachment 3: Flow from enacting the project plan to UN CDM Executive Board Registration

A CDM Project is the execution of a project to reduce or absorb emitted GHG and the issuing, buying, and selling of carbon credits according to the quantity of GHG reduced or absorbed; however, a complex mechanism has been introduced to normalize these activities.

CDM Project procedures are broadly divided into two stages, as explained below.

First Stage: from planning the project to registration by the CDM Executive Board

Second Stage: until estimation of the quantity of GHG anthropogenically reduced (absorbed) and issuing carbon credits by monitoring the project.

The First Stage, the process from planning the project to registration with the CDM Executive Board, is presented here. The First Stage Process is divided into the following steps.

① Enacting the plan for the CDM project

↓ Project participants enact a plan for the CDM project.

② Preparing a Project Design Document (PDD)

↓ Project participants prepare a CDM Project Design Document.

③ Validation inspection of the project

↓ A Designated Operational Entity (DOE) evaluates and judges whether it is eligible as a CDM and whether the calculation of emission reduction quantity is correct, based on the Project Design Document.

④ Approval by the concerned parties of the treaty, including the Host Country

↓ Project participants obtain written approval of the CDM Project from the concerned parties of the treaty, including the Host Country.

⑤ Registration of the Project

An application for registration of the Project, once it has passed the Validation Inspection, is made by the DOE to the CDM Executive Board. The CDM Executive Board Registers the Project following the set procedures if no problems are identified.

Annexed Figure 3.1. Steps in the First Stage Process

The core parts of the project are judging whether or not it is eligible to be a CDM Project, planning the CDM project, and preparing the Project Design Document. However, the CDM procedure that is the most time-consuming and key to whether it is established as a CDM Project is the Project Validation Inspection. The following is a detailed explanation of the flow of the Validation Inspection of the Project.

① Project participants select and contract a DOE from a published list.

↓

② Project participants submit a PDD and related documents to the selected DOE.

↓

③ The DOE performs an inspection to decide if the project satisfies the required conditions of a CDM.

↓

④ The DOE announces the PDD in PDF format on the UNFCCC-CDM website.

↓

⑤ The DOE receives comments from the parties concerned with the treaty, interested parties, and the designated NGO for 30 days, and if there are comments, it confirms reception of them. It clearly indicates in detail how comments are exchanged, by e-mail or fax, for example, and announces all comments when the comment reception period has ended.

↓

⑥ The DOE judges whether or not the project is valid as a CDM.

↓

⑦ If the result of the validation inspection is negative, the DOE informs the project participants of the reason.

↓

⑧ Project participants make revisions to the project as necessary to satisfy validity.

↓

⑨ If the DOE confirms validity based on revisions made to the project by the project participants, the DOE notifies the Project Participants and submits a Validity Inspection Report to the CDM Executive Board (including the PDD, written approval by the Host Country, and am explanation of response to any comments on the PDD).

Annexed Figure 3.2. Validation Inspection Flow

The results of the validation inspection by the DOE are sent by e-mail to the UNFCCC Secretariat, and procedures by the CDM Executive Committee at the UNFCCC begin. The following is a detailed explanation of the procedures up to the registration of the project by the CDM Executive Committee.

① The UNFCCC Secretariat confirms whether the documents submitted by the DOE are complete (by checking not only the formal required conditions but also the contents).

⇩

② After the UNFCCC Secretariat has received the registration fee and confirmed that the documents the DOE has submitted are complete (the registration application is considered accepted at this time), "Registration applied for" is announced for eight weeks on the UNFCCC-CDM web site, starting on the same day. It is not necessary to pay a registration fee for a CDM project if its average annual emission reduction quantity throughout the credit period is lower than 15,000 tCO_2. In addition, a small-scale CDM Project is registered within four weeks as long as a review is not requested; therefore, the announcement on the website only continues for four weeks.

⇩

③ For each registration application, one member of the CDM Executive Board Registration and Issuance Team (EB-RIT) is nominated to perform an assessment. The assessment judges whether the required conditions for the validation inspection are satisfied and if they were handled appropriately by the DOE. The Secretariat prepares an outline of the registration application accompanied by the results of the member's assessment and submits it to the CDM Executive Board within ten days (within five days for a small-scale project) after receiving the results of the member's assessment.

⇩

④ The CDM Executive Board confirms whether there is a request for a review from a party concerned with the treaty or from three or more members of the CDM Executive Board within eight weeks (within four weeks for a small-scale project) after receiving the registration application.

⇩

⑤ If there was a request for a review, the review is completed and the contents of and reason for the decision are sent to the project participants and are announced before the second meeting of the CDM Executive Board following the review application.

⇩

⑥ If there was no application for a review, the project is registered as a CDM project.

⇩

⑦ When the project has been registered, it is listed on the UNFCC-CDM website as a "Registration Completed" project, and the contents of the CDM Project and related documents that can be announced are also posted.

Annexed Figure 2.3. Procedures until Registration by the CDM Executive Committee

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