No.

INFOR (Instituto Forestal)
ODEPA (Oficina de Estudio y Politicas Agrarias, Ministerio de Agricultura)
CONAF (Corporacion Nacional Forestal)
INDAP (Instituto de Desarollo Agropecuario)
FIA (Fundacion para la Innovacion Agraria)
Republic of Chile

Capacity Development and Enhancement of A/R CDM in Republic of Chile

Final Report

March 2009

JAPAN INTERNATIONAL COOPERATION AGENCY

MITSUBISHI RESEARCH INSTITUTE, INC.

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09-044

PREFACE

In response to a request from the Government of the Republic of Chile, the Government of Japan decided to conduct the Study on Capacity Development and Enhancement of A/R CDM and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA dispatched a team to Chile between December 2005 and March 2009, which was headed by Mr. HATANAKA Kunio of Mitsubishi Research Institute, INC. and consists of Mitsubishi Research Institute, INC. and Japan Forest Technology Association.

The JICA Study Team held a series of discussions with the relevant officials of the Government of Chile and conducted the study in Chile. Upon returning to Japan, the Team duly finalized the study and delivered this report.

I hope that this report will contribute to promotion of AR-CDM in Chile and to enhancement of friendly relations between the two countries.

Finally, I wish to express my sincere appreciation to the officials of the Government of Chile for their close cooperation.

March 2009

MATSUMOTO Ariyuki
Vice President
Japan international Cooperation Agency

Executive Summary

After ratifying the Framework Convention on Climate Change in December 1995 and the Kyoto Protocol in 2002, the Chilean government has been materializing efforts in relation to strategies against global warming. In 2003, DNA (Designated National Authority) was established, being composed by several governmental agencies including the National Commission of the Environment (CONAMA) as a system of governmental authorization for CDM (Clean Development Mechanism) projects. It is now widely recognized that Chile is one of the host countries with the most streamlined system to promote CDM in the world. Also, in the course of the development of different projects in Chile, some baseline and monitoring methodologies for CDM project were approved by CDM executive board.

Moreover Chile is a leading silvicultural country, but until the present, reforestation has mainly been carried out by major national forestry companies. The Chilean government recognizes the importance of the recovery of vegetation on degraded lands and reforestation by small-scale landowners as a counterpart to the large-scale industrial forestry production. In this context Chile has a system of government subsidies which stimulates and supports reforestation and investment. However, until the moment reforestation by small landowners has not produced the expected results. Within this context, the government of Chile is considering the application of CDM in order to promote reforestation by the private landowners.

The government of Chile made independent efforts to carry out studies in relation to reforestation with CDM. However it recognizes that the system of government organisms and implementation capacities are still insufficient. For this reason the Chilean government has asked for cooperation from Japanese government in order to contribute to the improvement of these capacities, both on a scientific and organizational level, in view of the preparation and implementation of a reforestation project under CDM. Consequently, after the examination by JICA preliminary evaluation team in October 2004 to carry out a basic CDM study in potential sequestration areas in the different countries of South America and a preliminary study, the agreement about the scope of the definite study was signed by both parties in June 2005.

Under such circumstances, this development study got a green light and seven missions in total were conducted by JICA study team for the study; the first mission was from February 27 to April 7, 2006, the second was from July 3 to August 3, 2006, the third was from November 19 to December 23, 2006, the fourth was from May 13 to June 24, 2007, the fifth and the sixth were from September 23 to March 6, the seventh was from June 22.

During these missions, the JICA study team has engaged in efforts of capacity buildings and enhancement of A/R CDM among Chilean stakeholders through conducting activities include pilot projects in Region X and Region XI, various workshops, seminars, In-Japan training and preparation and dissemination of the manual.

Pilot Project in Region XI

The purpose of the pilot Project in Region XI falls within Type 3 Rehabilitation of degraded land of the CDM forestation project type defined by the National Strategy Study for CDM.

The project will be implemented in the commune of Coyhaique, where some 50 years ago large area of forest was fired to develop habitable area, by which soil was degraded. Due to

the cold climate of the region the vegetation cover could not regenerate, so that today there are large extensions of land where the dead trees are still not completely decomposed.

In accordance with the Chilean definition (Forest law 701), the area is categorized as degraded land, fragile land and land in endangered of the desertification. This project will use *pinus ponderosa* for forestation in order to rehabilitate soil and get carbon credits.

Region XI pilot project will be conducted at where grazing activities are currently taking place and these livestock will be relocated beyond the project boundary for the project implementation. Once the project is started, grazing activities are not allowed within the boundary till the first pruning planned at approximately age 12.

As INFOR was conducting a research on Region XI pilot project with Seremi Agricola funds, the team focused on information sharing with counterpart stakeholders and establishing effective system for project implementation at the first mission. Practical study was started from the second mission including consideration of whole PDD items and methodology selection. AR-AM0003, approved methodology applicable to grazing land, was selected based on general conditions of the land even though the candidate area had not been determined. Moreover, workshops for counterpart organizations and seminars for academics, NGO, forest engineers were conducted in order to establish a base for enhancing project effects. During the third mission, based on the project idea and the results of the land eligibility study, the co-development work of PDD with counterparts was started and farmers workshops for the recruitment of the project participants were held.

Prior to the fourth mission, project participants were almost finalized, baseline study of the actual project area was started, and socio economic study was conducted. In the fifth and sixth missions, identification of remained issues toward PDD finalization, discussion about possible solutions of such issues, support of DOE selection, coordination of institutionalization of project participants were carried out.

PDD was finalized with cange of methodloty to AR-ACM0001 and application for institutionalization of project participants was submitted during the seventh mission. The remained project period will be spent on support of validation and submission.

The summary of the pilot project is shown in Table 1.

Table 1 Initial plan of Region XI pilot project

	Region XI
Project surface	489.5 ha
Project participants	PULMAHUE S.A. (A closed stock company consists of 5 large/medium land owners)
Current land use	grazing land (grass land)
Planting tree	*Pinus Ponderosa*
Forest management	Pruning x2, thinning x1, trimming 40 years
Crediting period	30 years
Methodology	AR-ACM0001 ver.2
Plantation	2008 and 2009

The estimation of carbon sink volume by planted trees used the harvest estimation model developed by INFOR for *Pinus Ponderosa*. Anthropogenic net GHG absorption was calculated as 243,136.8 tons of CO_2 in total for 30 years.

Region X Pilot Project

Region X pilot project is placed as a model of Type I A/R CDM project (small-scale, plantation to low income farmers' land) and its objectives are set as follows.

- improvement of living environment through efficient land use and productivity recovery
- establishment of high quality timber production model and technology transfer
- rural poverty eradication by enhancing employment and technical training
- reduction of atmospheric CO_2 and obtaining income by CER sales

The initial plan for this pilot project is summarized in the following table.

Table 2 Initial plan for Region X pilot project

	Region X
Area	6,000ha in total (La Union, San Pablo, San Juan de La Costa, Osorno)（Initial plan）
Land-owner	small land owners
Authorities	being jointly considered by INFOR, FIA, INDAP and CONAF
Planting tree	Eucalyptus nitens
Method of operation	20yrs trimming
Implementation framework	Institutionalization of small farmers

From the first mission to the third mission, information required for PDD preparation was collected. At the same time, issues for project implementation were analyzed and, as a result of the analysis, many issues need to be solved were identified among the areas of organizing farmers, project's additionality and its methodology. Considering such obstacles, Chilean couterpart desiced to develop a small-scale CDM project during the third mission.

Participating farmer：30～50 people
Planting area : approx.120 ha
Methodology : Small-scale A/R CDM（AR-AMS0001）

Eucalyptus nitens was selected as the specie of planting tree of the Region X pilot project. The condition of operation included trimming at 20 years of tree age was decided and production of high value added timbers was set as the target through pruning and thinning.

Economic analysis was also conducted with the estimated CO_2 absorption volume obtained from existing yield volume estimation model or other tools. The result of the economic analysis and land eligibility study based on the satellite data etc. conducted showed 29.2% of the target area was eligible to A/R CDM project.

In line with the above mentioned basic concept of the project, the JICA study team had supported INFOR actively and organized workshops in order to recruit project participants. As one outcome of the workshops and other efforts, potential participants including the native community of San Juan de la Costa were identified. However, farmers showed concerns for planting *Eucalyptus nitens* and as of October 2007, only approx. 40ha. were obtained as project area despite INFOR's continued effort for recruiting farmers through small workshops and house-to-house visits. So, following options were considered by JICA study team and Chilean counterparts.

- Feasibility of plantation of alternative tree species which do not conflict with farmers' needs

- Possibility of Program CDM

Despite above all efforts, farmers got suffered from the drought started in the latter half of 207 and had become very anxious about their yields. Such situation made the recruitment of additional participants even tougher and JICA study team and Chilean counterparts agreed to suspend implementation of Xth pilot project for a whole. But it was also decided that the project would be continued by Chilean stakeholders' own efforts in the future.

Outcome of the Project

An A/R CDM project has been successfully formulated in Region XI through present cooperation project. In Region X, although project formulation could not be attained, various aspects of small scale CDM project as well as of program CDM have been explored. Through these experiences, including training program in Japan, Chilean counterparts have obtained a certain level of capability to formulate and implement by themselves A/R CDM projects.

It is also quite obvious that, through steering committee meetings, seminars and workshops, many people from counterpart institutions, other related ministries, universities, forest companies and NGOs have gained latest information about A/R CDM as well as about experiences on pilot projects. This information dissemination must have contributed to the capacity reinforcement of those who might have some concerns with A/R CDM projects in the future.

Important Issues for the promoting A/R CDM in Chile and some suggestions

One of the objectives of this project was to realize a good coordination scheme among various Chilean institutions concerned with A/R CDM.

As mentioned above, on various occasions, namely those of steering committee held at least once or two times during the visit of JICA Study Team in Chile, not only JICA's counterpart institutions such as ODEPA (Oficina de Estudio y Politicas Agrarias, Ministerio de Agricultura), INFOR (Instituto Forestal), CONAF (Corporacion Nacional Forestal), INDAP (Instituto de Desarollo Agropecuario), FIA (Fundacion para la Innovacion Agraria), but also other institutions like CONAMA (Comision Nacional del Medio Ambiente), CORFO (Corporacion de Fomento de la Produccion), PROCHILE (Programa de fomento a las exportaciones chilenas), AGCI (Agencia de Cooperacion Intenacional de Chile), MIDEPLAN (Ministerio de Planificacion) have participated and have had fruitful discussions. It is also the same in Region X and Region XI that, in addition to the regional representatives of above-mentioned institutions, farmers' associations or other groups like foundation have participated to seminars and workshops organized by INFOR and JICA Study Team on the subject of promoting pilot projects in these regions. It is without saying that many official or unofficial meetings have been also organized among institutions concerned in order to discuss and find our solutions on specific topics of pilot projects.

Based on these experiences, several points described below may be identified as important issues for promoting A/R CDM projects in Chile in the future, as well as some suggestions may be made for the government of Chile, if it intends to define A/R CDM projects as one of major policy issues in Chile.

(1) Ceration of coordinating mechanism at the central government level

The related ministries of the central government of Chile have deepened their concerns on A/R CDM and the related officials also have increased their interests. Therefore, it is desirable that;

a) An establishment of regular meetings, under the chairmanship of ODEPA, inviting CONAF, INDAP, CORFO, PROCHILE, INFOR and other agencies concerned. Such meetings will examine fundamental policy issues in order to promote A/R CDM projects. Urgent agenda among others to be addressed are;
   1) Policy framework to assist technically project formulation, including feasibility study and PDD elaboration,
   2) Policy framework to assist financially and organizationally project preparation,
   3) Policy framework to provide advices on administrative procedures, very particular to A/R CDM project, such as validation, registration etc.
   4) Policy framework to promote sales of CER or VER produced under A/R CDM projects.

b) Creation of needed mechanism to respond to above policy frameworks;
   1) A mechanism, composed of INFOR, CONAF, INDAP etc. to address technical issues of 1) above,
   2) A mechanism, composed of CORFO, CONAF, INDAP, FIA etc. to address financial and organizational issues of 2) above,
   3) A mechanism, not excluding an establishment of specialized independent company, composed of INFOR, CONAF, INDAP etc. to address, under the CONAMA's advices, administrative issues of 3) above,
   4) A mechanism, composed of PROCHILE and other agencies concerned, to address external sales issues of 4) above.

(2) Creation of specialized groups in CONAF and INDAP

According to our experiences of pilot projects in Region X and Region XI, we can say that;

a) It is quite difficult to organize large-medium scale farmers together with small scale farmers, in particular indigenous people, in only one organization which is aimed to promote and to implement an A/R CDM project.
b) CONAF has an advantage to promote relatively large and medium scale forestation projects in degraded area.
c) INDAP has, on the other hand, is a suitable institution to organize small scale farmers including those of indigenous people.

Therefore, with a purpose of efficiently promoting A/R CDM projects, it is desirable;

a) To establish a specialized group in CONAF in charge of promoting relatively large and medium scale A/R CDM projects mainly in degraded area.
b) To establish a specialized group in INDAP in charge of promoting small scale A/R CDM projects, as one of policy measures of poverty eradication in rural areas.

(3) Extension of LD (Ley-Decreto) 701

The LD 701 has been contributing a lot since its initial adoption in 1974 and its modification in 1996 to the forestation in Chile by providing currently subsidies covering up to 75% of the forestation cost (for degraded land but only for landowners of less than 200ha of non-degraded land). At the end of year 2009 it comes to its end of application, but it is our

understanding that the extension of LD 701 after the year 2010 is under consideration by relevant authorities of the government of Chile. Such extension seems to us a prerequisite for the promotion of A/R CDM projects which do not bring, in general, a high financial rate of return.

(4) Special considerations for small-scale A/R CDM

With the purpose of promoting small scale A/R CDM projects and by taking into account their characteristics, following issues are expected to be examined by respective Chilean authorities.

a) INDAP will carry out an overall survey to find out in different regions potential areas suitable for small scale A/R CDM projects.
b) Since the formulation of a small scale A/R CDM project at each time is not very efficient, the possibility to seek for a program CDM will be investigated. Indeed, during this JICA project, interest for program CDM was shown by Chilean counterpart in relation to the X Region pilot project. It could be efficient to provide necessary assistance based on the experience of the pilot project in order to build capacity for program CDM in Chile.
c) In case small scale A/R CDM projects are to be implemented in the framework of poverty eradication policy, applicability of all kinds of existing subsidies as well as creation of new necessary subsidy (subsidies) will be examined.
d) In case where indigenous people are involved, INDAP will examine the possibility to become by itself an implementing agency, or to create another form of organization under its control, since it is not an easy task to organize these people as an implementing body of their project.
e) It is also not realistic and advisable to request indigenous people to share financial burdens necessary for the creation and operation of implementing organization. Such cost will be examined as part of above-mentioned subsidies. It is rather recommended to ask indigenous people only for the permission to utilize their land for forestation and to provide them, from the view point sustainability, with short-term tailored incomes (in stead of only one income every five years from the sales of CER) such as remuneration for their labor works in planting, pruning, etc. or divided yearly anticipated payment of their income from sales of CER, in five installments for example. All other measures to facilitate their participation should be also explored.

(5) Transfer of know-how in project formulation

It is not the duty of the central government or regional authorities to formulate all A/R CDM projects forever. It is rather desirable in a long-run that the project formulation of A/R CDM will be carried out by private companies, consultants, academic people, operadores etc. It is therefore quite important to transfer to these people the experiences and know-how gained by INFOR, CONAF, INDAP or other institutions through our pilot projects. Continuous renewing of web-site, continuous activities inviting these people to seminars or workshops like those which have been organized during our study period, or all other relevant activities are key factors to this transfer of know-how.

(6) Function of operadores

At present, operadores are working in the field to give advice to farmers and to formulate eventually forestation projects under CONAF or CONAF/INDAP program. Their knowledge about the current situation of each individual farmer is very accurate and they are to

some extent complementing the work of CONAF or INDAP. Therefore, even in case of A/R CDM project formulation their function seems to be indispensable. Under such situation, it is recommended to review their functions at policy level including their remuneration system and to take necessary measures, if needed, with a view to utilize their capacity at maximum.

(7) Contribution to discussions in the world forum regarding A/R CDM

The fact that, as of December 2008, there exists only one A/R CDM project in the world which has been registered at UNFCCC, shows clearly the necessity to improve some part of the procedures or requirements of A/R CDM projects. We understand also that the recent scale-up of maximum ceiling of CER for small scale CDM from 8tons to 16 tons per year was the result of valuable efforts by Chilean delegation. We therefore believe that it is the utmost contribution of the present project, if, based on experiences and difficulties our counterparts have encountered, some improvements of A/R CDM are identified and proposed to the international forum by the Government of Chile. Follwings are some of the further suggestions;

- Rules and regulations of A/R CDM are very complex and person with sufficient knowledge on these rules usually in the central government. However, implementations of projects take place not in the capital but in rural areas. In this JICA pilot project, JICA Study Team tried to build capacity in local and regional level. In order to promote A/R CDM projects, more efforts on capacity building and knowledge sharing for local and regional level human resources are necessary.
- One of the most serious obstacles in promoting A/R CDM projects is the replacement obligation of tCER and lCER and this replacement obligation hampers creation of credit market for A/R CDM. If we want to promote A/R CDM project, it is time to consider easing or abolishing this obligation.
- During this JICA cooperation project, several baseline and monitoring methodologies and some useful tools were approved. Yet, it requires an advanced knowledge and skills to develop a PDD. Development of more simple methodologies and tools are necessary.

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Figures and Tables

Abbreviations

Chile	
AGCI	Agencia de Cooperacion International de Chile/ Chilean International Cooperation Agency
BECH	National Bank of Chile
Bienes Nationales	Ministry of National Goods
CASEN	Socio-economic data of household income
CERTFOR	Forest Authorization System established by INFOR and Fundacion Chile
CIREN	Natural Resources Information Center
CONAF	Corporacion Nacional Forestal/ National Forest Corporation
CONAMA	Comision Nacional del Medio Ambiente/ National Comission on Environment（DNA）
CORFO	Corporacion de Fomento de la Produccion/ Industrial Promotion Organization
DL701	Forestry Law 701
FIA	Fundacion para la Innovacion Agraria/ Foundation for Agriculture Innovation (Chilean Counterpart）
Ficha CAS2	Socio-economic data of household income (under transferring phase to new system called Ficha Familia)
FNDR	Regional Development National Foundation
FOMP	Field Operation Manual for Plantation
INDAP	Instituto de Desarollo Agropecuario/ Chiean Institute for Agriculture and Pastoralism Development
INFOR	Instituto Forestal/ Forest Institute (Counterpart)
MIDEPLAN	Ministerio de Planificacion/ Ministry of Planning
MININCO	Private Forest Company
NSS	National Strategy Study for CDM
ODEPA	Oficina de Estudios y Políticas Agrarias/ Agricultural Policy Planning Office
OGANA	Austral Cattle Agricultural Organization (Region XI)
PLADECO	Community Development Plan
PROCHILE	Programa de fomento a las exportaciones chilenas/ Chilean Export Promotion Bureau
PRODESAL	Special Mechanism for Institionalization of Small Farmers
SAG	Servicio Agricola y Ganadero/ Agriculture and pastoralism Service
Seremi Agricola	Regional Agriculture Department
SERPLAC	Regional Planning Department
SNASPE	Sistema National de Areas Silvestres Protegidas del Estado/ National System for the conservation area
UACH	Universidad Austral de Chile/ Austral University
Operador	Private Forest Company

General	
A/R CDM	Afforestation/Reforestation CDM
BEF	Biomass Expansion Factor
CAI	current annual increment (m3/ha/year)
CDM EB	CDM Executive Board
CER	Certified Emission Reduction
CF	Carbon Fraction of dry matter (t C/t dm)
D	basic wood Density (t dm/m3)
DBH	Diameter at Breast Height
DEM	Digital Elevation Model
dm	dry matter
DNA	Designated National Authority
EIA	Environmental Impact Assessment
GIS	Geographic Information System
IRR	Internal Rate of Return
lCER	long tem Certified Emission Credit
MAI	Mean Annual Increment
NPV	Net Present Value
PDD	Project Design Document
R	Root-shoot ratio (dimensionless)
SRTM	Shuttle Radar Topography Mission (NASA's digital elevation data)
S/W	Scope of Work
t CO_2	ton CO_2 equivalent
tCER	temporary Certified Emission Reduction
U.F.	1 U.F.=approx. 17,900 Peso
WD	Wood Density

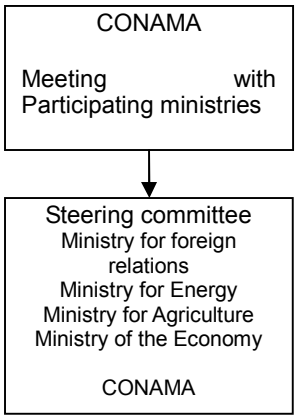
1. Background of the Project

1.1 Chilean Efforts toward CDM

1.1.1 Current status and issues of CDM in Chile

Chile is a country enjoying an important economic growth with a very low country risk, compared to other developing countries[1]. Hence it has very attractive background for other countries to invest projects including CDM. Also, as for CDM, Chile ratified Kyoto Protocol in 2002, established its DNA in May 2003, subsequently signed MoU with many countries including Canada, Denmark, France and Japan (JBIC). Moreover, it has established a system similar to the emission trading in 1992 and institutional frameworks for credit taxation and ownership, etc. are already in place.

Chilean DNA is CONAMA and operated in a practical manner through the steering committee, which is held monthly and participated by important ministries such as the Ministry of Economy, of Agriculture and Energy. One of the key features of the approval process of CDM with Chilean DNA is that existing systems like environmental impact assessment and domestic emission trading and personnel are well utilized and that makes approval process quicker and transparent. Specifically speaking, the existing environmental impact assessment is used as the standard for sustainable development required to the host country approval. That means if a project subjected to the environmental impact assessment has completed such assessment and obtained approval, host country approval is automatically provided. On the other hand, if a project is not subject to an environmental impact assessment, requirements of host country approval can be satisfied by obtaining normal commercial license. Owing to such simple process, fee for CDM project approval is free in charge in Chile. Because of such Chilean DNA's high efficiency and transparency, Chile is always ranks high in the host country ranking by PointCarbon[2].



- Monthly meeting
- Utilize existing institutions or procedures.
- Free of charge approval
- Approval standard→Existing environmental impact assessment (or normal commercial license for project not under the obligation of EIA)

Source: Carbon Investors Forum 2005 material published by CONAMA and elaborated by Mitsubishi Research Institute

Figure 1 Organizational framework of Chilean DNA

As CONAMA is the governmental organization in charge of environmental issues in Chile, in order to promote CDM projects in Chile, it has formed a strategic alliance with PROCHILE and CORFO.

[1] The economic growth rate for 2003 was 4,2% and foreign investment reached 7,1 billion US$.
[2] http://www.pointcarbon.com/

As mentioned, Chile has established the excellent environment for CDM project development/investment and many projects are under development.

The following table shows that there are 56 CDM projects currently in the validation and registration phase as of October 2008, and the total volume of CO_2 reductions by these projects will be 40,430,000 tons by 2012.

Table 3　CDM projects in Chile（At validation, registration phase、Oct. 2008）

No.	Title	Status	Type	2012 ktCO2
1	Graneros Plant Fuel Switching Project (NM16)	Registered	Fossil fuel switch	114
2	Methane capture and combustion from swine manure treatment for Peralillo (NM22)	Registered	Agriculture	735
3	Methane capture and combustion from swine manure treatment for Pocillas and La Estrella	Registered	Agriculture	2265
4	Methane capture and combustion from swine manure treatment for Corneche and Los Guindos	Registered	Agriculture	953
5	Copiulemu landfill gas project	Registered	Landfill gas	631
6	Cosmito landfill gas project (Improvement of Gas Extraction System in Old Cosmito Dump)	Registered	Landfill gas	593
7	Advanced swine manure treatment in Maitenlahue and La Manga	Registered	Agriculture	1228
8	La Higuera Hydroelectric Project	Registered	Hydro	2388
9	Lepanto Landfill Gas Management Project	Registered	Landfill gas	2702
10	El Molle – Landfill gas (LFG) capture project	Registered	Landfill gas	968
11	Trupan Biomass Power Plant in Chile	Registered	Biomass energy	897
12	Nueva Aldea Biomass Power Plant Phase 1	Registered	Biomass energy	828
13	Nueva Aldea Biomass Power Plant Phase 2	Registered	Biomass energy	962
14	Russfin Biomass CHP Plant Project.	Registered	Biomass energy	243
15	Loma Los Colorados Landfill Gas Project	Registered	Landfill gas	3275
16	Metrogas Package Cogeneration Project	Registered	EE supply side	18
17	Santa Marta Landfill Gas (LFG) Capture Project	Registered	Landfill gas	1439
18	Chile: Chacabuquito 26 MW Run-of-River Hydroelectric Power Project	Registered	Hydro	840
19	Ojos de Agua Hydroelectric Project	Registered	Hydro	99
20	Catalytic N2O destruction project in the tail gas of the nitric acid plant PANNA 3 of Enaex S.A.	Registered	N2O	4386
21	Coronel landfill gas capture project	Registered	Landfill gas	117
22	Regional landfill projects in Chile	Registered	Landfill gas	382
23	Chile: Quilleco Hydroelectric Project	Registered	Hydro	861
24	Chile: Hornitos Hydroelectric Project	Registered	Hydro	551
25	Puclaro Hydroelectric Power Plant	Registered	Hydro	49
26	Ramirana Emission Reduction Project of Agrícola Super Limitada	Reg. request	Agriculture	98
27	Valdivia biomass power plant	Reg. request	Biomass energy	729
28	De Martino WWTP upgrade	Correction request	Biogas	29
29	Metrogas methane recovery from pipeline rehabilitation	At validation	Fugitive	151
30	Advanced swine manure treatment in Las Palmas and Santa Rosa	At validation	Agriculture	530
31	Chile: Pullihue Composting Project, Chile	At validation	Landfill gas	2903
32	Cuchildeo Hydroelectric Project	At validation	Hydro	23
33	AWMS Methane Recovery Project CL06-S-01, Región del Libertador General Bernardo O'Higgins, Chile.	At validation	Agriculture	109
34	Forestal y Papelera Concepción Biomass Residues Cogeneration Plant	At Validation	Biomass energy	153
35	El Panul – EcoMethane Landfill Gas to Energy Project	At Validation	Landfill gas	304
36	Advanced swine manure treatment for the Huasco Valley Agroindustry	At validation	Agriculture	3699
37	Bundled addition of renewable energy units to existing biomass based co-generation systems in Constitución and Laja	At Validation	Biomass energy	50
38	Canela Wind Farm Project Project	At Validation	Wind	130
39	El Empalme Landfill Gas Recovery Project	At Validation	Landfill gas	333
40	Chile: Chiburgo Run-Of-River Project	At Validation	Hydro	190
41	Nerquihue Small-Scale CDM Afforestation Project using Mycorrhizal Inoculation in Chile	At Validation	Afforestation	93
42	Methane capture and destruction on La Hormiga landfill in San Felipe	At Validation	Landfill gas	134
43	Methane capture and destruction on El Belloto landfill in Quilpue	At Validation	Landfill gas	108
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45	Chile: Lircay Run-Of-River Project	At Validation	Hydro	221
46	Fundo Las Cruces Landfill Gas Recovery Project	At Validation	Landfill gas	240
47	La Confluencia Hydroelectric Project	At Validation	Hydro	881
48	PANITAO Biomass Thermal Energy Project	At Validation	Biomass energy	98
49	MASISA Biomass Power Project	At Validation	Biomass energy	129
50	Santa Marta de Liray indoor mechanized composting project	At Validation	Landfill gas	95
51	El Alto landfill gas project	At Validation	Landfill gas	201
52	Mafrisur renewable thermal energy	At Validation	Biomass energy	91
53	Improvement of energy efficiency in Laja and Constitución	At Validation	Biomass energy	33
54	Alto Cautín Hydropower Plant (HPP)	At Validation	Hydro	80
55	Viñales biomass power plant	At Validation	Biomass energy	366
56	Horcones biomass power plant expansion project	At Validation	Biomass energy	479
合計				40,436

Source: made by MIRI by referring UNEP RISO Centre's data

1.2 Current situation of Chilean forest industry

1.2.1 General conditions of forests

The land surface of Chile amounts to 756,626 km2, which can be divided by soil type into land without vegetation (32.7%) grazing land, grassland (27.4%) and forests (20.8%). The forest land corresponds to 1,550 million hectares, out of which natural forests account for approximately 1,340 million ha and plantations account for 2 10 million ha.

The natural forests stretch from the center of Chile to the South with conifer and broadleaf evergreen species accounting for 31%, Lenga forests (*Nothofagus pumilio*) are mainly found in Regions XI and XII, totaling 25%, and Coigüe(*Nothofagus betuloides*), also mainly in Regions XI and XII accounting for 13%.

The study areas lie in Region X, Southern latitude 41° and Region XI, Southern latitude 45° with temperate climate and many precipitations. Within the same climate zone, the coastal area has more precipitation so that forests in these areas known as fire-free area are categorized as coastal forests with temperate climate with more precipitation.

Plantations stretch from Regions VII to X for wood production. Planted species are *pinus radiate*, accounting for 67.8% from Regions VII to X, and *Eucalyptus spp*, with 23.6% between Regions VIII and IX. These two species together amount to 91.4% of the total plantation.

The most planted species is *Pinus radiata* from North America and Eucalyptus globules from Australia. The growth rates of these species excel in Chile compared to most other countries, granting Chile a competitive advantage. Considering *Eucalyptus nitens* as planted in Region X and *Pinus Ponderosa* as planted in Region XI, the actual experience is not abundant but there is an expectation for the future.

1.2.2 General situation of silviculture

Silvicultural production in Chile can be divided into three major sectors: 1) between Regions VI and VIII, where *Pinus radiata* occupies 2) between Regions IX and X, where native forest is mixed with plantation 3) in Regions XI and XII, where native forest is predominant. From this silvicultural production point of view, the study area in Region X falls under 2) and in Region XI falls under 3).

The overall volume of harvest in Chile reached 32 million m3 in 2004. 98% of the volume comes from plantations consisting of 80% of *Pinus radiata* and 17% of Eucalyptus spp. When analyzing the origin of that volume, the concentration lies in Region VIII, followed by Regions VII, IX and X. Timbers are processed and sold at domestic and foreign markets. Export amount of forestry products are just behind copper exports, major markets are USA (25%), Japan and China (10% for each), followed by Mexico, Italy, Korea and others.

The main reasons for Chile’s competitiveness are known as below in general. These conditions apply both for Region X and Region XI, however, due to the harder environmental conditions compared to Regions VIII and IX, their commercial ability is less favorable. This is particularly the case for the XI Region, which has a rather small population and a comparatively smaller industrial activity.

Reasons for Chile´s competitiveness

- Environment
- Abundant rainfall and temperate climate.
- Fast tree growth (*Pinus radiata* reaches its maturity at 25 years)
- The Chilean territory is long and narrow, so the transport distances to processing plants and ports are relatively short.

- Social
- Public and private bidding systems are well established and highly transparent.
- Labor is cheap compared to other developed countries.
- High technical level of workforce.

- Administration
- The regulations of foreign investment are flexible (DL600).
- The free trade agreements have developed positively.
- Corporate tax is 16%, which is the one of the lowest in the world.

- Forestry sector
- The legal framework for the forestry sector is modern and appropriate.
- Currently forest land is not subjected to property tax and corporate income tax is low (approx.15%)
- Forest lands are mainly privately owned, facilitating comercial activities.
- The technical ability and knowledge level are high.
- Forestry activity is subsidized by DL701.

1.2.3 Forest legislation

In order to preserve the forests, the first forestry law was introduced in 1931, subsequently the law decree 701 was come effective in 1974 and further modified in 1996.

The reasons for the modifications of DL 701 are related to the criticism of local residents and ecological organizations, who considered that the original law was rather favoring the big forestry companies who own large properties. Consequently this national policy was believed to be changed from enriching forest resources by support of large-scale plantation to support of plantation that places focuses on the society and the environment.

A/R CDM is carried out with subsidy provision for small land owners based on 1996 modified DL 701. This law defines forestation activities especially at the area suitable to plantation for preservation/rehabilitation of national land and provides incentives for plantation of degraded land or land owned by small scale landowners.

Table 4　Outlines of Forestry law DL701 and Modified DL701

Name	Outline
DL 701	Abolished in 1994. It defined 1) subsidizing plantation/nursery costs (forestation subsidy, maintenance cost for 5 years, pruning x2) for new forestation activity at area preferable for forestation(APF), 2) Tax privilege for who conducts forestation (Artificial forest inheritance/cession/gift tax are exempted, income tax regarding natural forest/artificial forest harvest are deducted by 50%) Tax exemption. In such ways, forests owned by landowners whose land was assessed were provided with 1) non-diversion potential of land, 2) tax exemption, 3) subsidy and especially 2)&3) became strong incentives for landowners and consequently the profitability of forestation activity was improved.
Modified DL701	The modified DL 701 entered into force in 1996 and is valid until 2010. One of the main features of this law is the subsidy granted to landowners who own less tan 200ha (no limit with the case of degraded soils). 1) land use transformation and 3) subsidy of the original law continue to exist, but 2) 50% reduction of income tax is eliminated.

Note: “APF” defined by the law means “all land that are not allowed by climate/ atmospheric conditions to be used for cultivation whether with or without vegetation except land usable for agriculture, fruit farming or intensive stockbreeding without land depletion.

INFOR confirms that A/R CDM projects are not illegal after consulting the forestry legislation in Chile. The conformity with 1994 basic environmental law is also taken into consideration. According to the environmental impact assessment carried out by CONAMA, forestation within an A/R CDM project is not subjected to EIA unless forest more than 500ha will be cut down.

In the “National Strategy Study for CDM in Chile” (NSS) prepared in March 2003, selection criteria and project types for sink projects in Chile were proposed.

Table 5　Chilean selection criteria and project type of CDM sink project

Item	**Contents**
Selection criteria	Environmental criteria: degraded soil rehabilitation Social criteria: alleviate rural poverty, prevent rural migration Economic criteria: contribution to income increase, national forestry incentive
Project types	Forestation by small landowners Forestation by associations Forestation on degraded soils

Source: National Strategy Study for CDM in Chile (NSS)

According to this, Region X pilot project is focused on the social criteria, rural poverty alleviation, and Region XI pilot project is focused on the environmental criteria, rehabilitation of degraded land among A/R CDM selection criteria of NSS. As for the project type, Region X pilot project falls under forestation by small landowners and Region XI pilot project falls under degraded land forestation but also matches to forestation by small landowners.

1.2.4 Forestation program by CONAF

This project is carried out based on the modification of forestry law DL701 that enhances plantation of land owned by small landowners and degraded land. Between 1996 and 2004 the CONAF forestation program has forestated 31,070 ha in average (between 19,920 and 42,719 ha, depending on the year), dropping to 19,920 ha in 2004. Regions X and XI show a similar tendency.

Within the framework of this Project, subsidy calculated by multiplying plantation cost defined by CONAF forestation cost table and the grant rate will be provided to participant landowners.

The Region X project is for small landowners' land forestation and Region XI project is to support degraded land forestation. As for the former, the grant rate will be 90% for the first 15ha and 75% for the surface beyond 15ha. For the latter the grant rate is fixed at 75%.

In order to mitigate the impact of the initial investment of forestation for the small landowners, CONAF and INDAP started a joint support program in 1998, combining the CONAF subsidy with INDAP bridge loan and this program will be valid until 2010.

These forestation programs will mainly be carried out by so-called "operators" who are forestry engineers. Upon A/R CDM project implementation, technical study report describing details of forestation activities and forestation plan on tree trimming should be submitted to CONAF under modified DL701.

1.3 Current situation of A/R CDM project

Various rules and guidelines have been formulated for A/R CDM in the past several years. The following ten methodologies and one consolidated methodology have been approved up to now.

AR-AM0001: Reforestation of degraded land
AR-AM0002: Restoration of degraded lands through afforestation/reforestation
AR-AM0003: Afforestation and reforestation of degraded land through tree planting, assisted natural regeneration and control of animal grazing
AR-AM0004: Reforestation or afforestation of land currently under agricultural use
AR-AM0005: Afforestation and reforestation project activities implemented for industrial and/or commercial uses
AR-AM0006: Afforestation/Reforestation with Trees Supported by Shrubs on Degraded Land
AR-AM0007: Afforestation and Reforestation of Land Currently Under Agricultural or Pastoral Use
AR-AM0008: Afforestation or reforestation on degraded land for sustainable wood production
AR-AM0009: Afforestation or reforestation on degraded land allowing for silvopastoral activities
AR-AM00010: Afforestation and reforestation project activities implemented on unmanaged grassland in reserve/protected areas

AR-ACM0001: Afforestation and reforestation of degraded land

The Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin project (China) was registered as the first A/R CDM project on November 2006. Moreover, the following twenty-six projects are in the validation phase. However, A/R CDM project still has small percentage both in number[3] and credit volume in the whole CDM project portfolio.

[3] As of Oct. 2007, number of CDM project registered or in the validation phase is over 4,000.

Table 6　A/R CDM project（at validation or registration phase Oct. 2008）

Title	Host country	Status	Type	Methodology	2012 ktCO2	2020 ktCO2	Validator
Nerquihue Small-Scale CDM Afforestation Project using Mycorrhizal Inoculation in Chile	Chile	At Validation	Afforestation	AR-AMS1	93	167	TUV-SUD
Small-scale Afforestation for Desertification Combating at Kangping County, Liaoning Province	China	At Validation	Afforestation	AR-AMS1	4	11	JQA
Small Scale Cooperative Afforestation CDM Pilot Project Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana	India	At Validation	Afforestation	AR-AMS1	52	145	TUV-SUD
Laguna de Bay Community Watershed Rehabilitation Project -2	Philippines	At Validation	Afforestation	AR-AMS1	19	53	TUV-SUD
Afforestation in grassland areas of Uchindile, Kilombero, Tanzania & Mapanda, Mufindi, Tanzania	Tanzania	At Validation	Afforestation	AR-AM5	1696	6682	TUV-SUD
Reforestation of grazing Lands in Santo Domingo	Argentina	At Validation	Reforestation	AR-AM5	3335	2624	TUV-SUD
CARBON SEQUESTRATION THROUGH REFORESTATION IN THE BOLIVIAN TROPICS BY SMALLHOLDERS OF "The Federacion de Comunidades Agropecuarias de Rurrenabaque (FECAR)"	Bolivia	At Validation	Reforestation	AR-AMS1	23	62	JACO
Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil	Brazil	At Validation	Reforestation	AR-AM5	3148	5287	TUV-SUD
Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	China	Registered	Reforestation	AR-AM1	174	381	TUV-SUD
Small-scale Reforestation for Landscape Restoration	China	At Validation	Reforestation	AR-AMS1	28	68	TUV-SUD
Afforestation and Reforestation on Degraded Lands in Northwest Sichuan	China	At Validation	Reforestation	AR-AM3	160	373	TUV-SUD
Reforestation on Degraded Lands in Northwest Guangxi	China	At Validation	Reforestation	AR-ACM1	74	1287	TUV-SUD
Multiple-purposes Reforestation on Degraded Lands in Longyang, Yunnan	China	At Validation	Reforestation	AR-ACM1	37	99	TUV-SUD
PROCUENCA: Forestry Project to Restore the Watershed of the Chinchina River, an Environmental and Productive Alternative for the City of Manizales and the Surrounding Region	Colombia	At Validation	Reforestation	AR-AM4	1515	4115	TUV-SUD
Argos CO2 Offset Project, through reforestation activities for commercial use	Colombia	At Validation	Reforestation	AR-AM5	106	254	TUV-SUD
Reforestation project using native species in Maringa-Lopori-Wamba region (Democratic Republic of Congo): establishment of the "Bonobo Peace Forest"	Congo DR	At Validation	Reforestation	AR-AM1	543	1628	RINA
Reforestation of severely degraded landmass in Khammam District of Andra Pradesh India under ITC Social Forestre Project	India	At validation	Reforestation	AR-AM1	470	990	BV Cert
Bagepalli CDM Reforestation Programme	India	At Validation	Reforestation	AR-AM1	446	2027	TUV-SUD
Reforestation Project at Shree Nasik Panchavati Panjrapole (SNPP), Nasik	India	At Validation	Reforestation	AR-AM1	68	160	TUV-SUD
Reforestation of degraded land in Chhattisgarh	India	At Validation	Reforestation	AR-AM1	0	46	TUV-Nord
The International Small Group and Tree Planting Program (TIST)	India	At Validation	Reforestation	AR-AMS1	34	125	TUV-SUD
Mali Jatropha Curcas Plantation Project	Mali	At Validation	Reforestation	AR-AM4	41	100	TUV-SUD
Moldova Soil Conservation Project	Moldova	At Validation	Reforestation	AR-AM2	1493	3316	SGS
Reforestation of croplands and grasslands, in low income communities of Paraguari Department	Paraguay	At Validation	Reforestation	AR-AMS1	33	82	TUV-SUD
Laguna de Bay Community Watershed Rehabilitation Project -1	Philippines	At Validation	Reforestation	AR-AM1	15	37	TUV-SUD
Uganda Nile Basin Reforestation Project No.3	Uganda	At validation	Reforestation	AR-AMS1	30	77	DNV
Cao Phong Reforestation Project	Vietnam	At Validation	Reforestation	AR-AMS1	10	89	JACO

Source: UNEP RISOCENTER

2. Outline of the initial plan

2.1 Background of the project

After ratifying the Framework Convention on Climate Change in December 1995 and the Kyoto Protocol in 2002, the Chilean government has been materializing efforts in relation to strategies against global warming. In 2003, DNA (Designated National Authority) was established, in which National Commission of the Environment (CONAMA) holds main role, as Chilean CDM project approval system. Chile is one of the host countries with the most advanced system to promote CDM in the world and several methodologies used in projects hosted by Chile have already been approved so far.

Moreover Chile is a world-leading silvicultural country, but until the present, reforestation has mainly been carried out by major national forestry companies. The Chilean government recognizes the importance of the recovery of vegetation in degraded lands and reforestation by small-scale landowners in addition to large scale industrial forestry production. In this context Chile support such activities through forestation subsidy or loan system but until now satisfying results has not been recognized in reforestation by small farmers. Taking into this situation, the government of Chile considers utilizing CDM project to enhance small farmers' plantation.

Until the present, the government of Chile has been making efforts on A/R CDM by carrying out its own studies. However, still, it recognizes its governmental framework and implementation capacities are still insufficient. For this reason the government of Chile asked the government of Japan for cooperation on institutional/ technical capacity development regarding A/R CDM project formation and implementation. So far, the basic study on CDM sinks in south Latin America (October 2004) and dispatch of preliminary study team (June 2005) have been carried and in October 2005, S/W for this full-scale study was agreed and signed.

2.2 Objectives

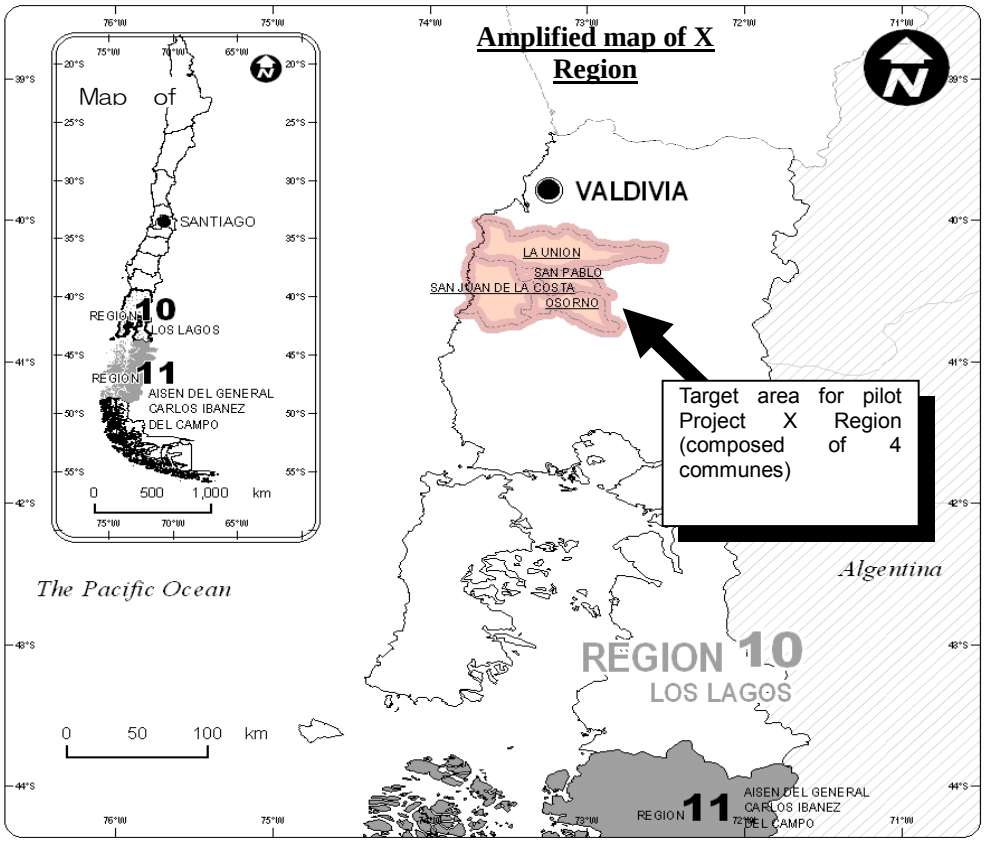
The objective is to strengthen the capacities required for enhancing A/R CDM project, especially projects involved by small/medium landowners, implementation of stakeholder organizations of Ministry of Agriculture by forming A/R CDM projects.

2.3 Study Site (Pilot project sites)

The target area of this study will be the pilot project sites in Regions X and XI where the government of Chile is formulating projects. The target surface is supposed to be approximately 6000ha in each Region but will be finalized during the study process.

2.4 Counterpart organizations

The counterpart institutions are the Chilean Forestry Research Institute (INFOR) and the Ministry of Agriculture (Office of Agricultural Studies and Policies ODEPA); the National Forest Corporation CONAF, and the Institute of Agricultural Development INDAP). Moreover the Foundation for Agricultural Innovation FIA will be the counterpart agency in charge of the negotiations in relation to global warming. Valdivia office of INFOR (Region X) will perform the role of the secretariat.



Note: for Region XI, see general map (top left) Figure:

Figure 2 General location map of study area (6,000 ha for each region will be finalized during the course of the study)

Table 7 Summary of Initial concepts for the pilot projects

	Region X	Region XI
Project area	6000 ha in 4 communes of Osorno, La Unión, San Pablo, San Juan de La Costa	Approx. 6,000ha of degraded land
Landowners	Small landowners	Medium/large landowners
Implementing authority	Joint implementation by INFOR, FIA, INDAP, CONAF	INFOR, CORFO, regional government and regional organizations related to the Ministry of Agriculture.
Planting tree	*Eucalyptus Nitens*	*Pinus ponderosa*
Management method	Harvesting period 20 years	Replantation on degraded lands
Implementation system	Institionalization of small farmers	OGANA (43 members)

INFOR

Plantation and farmland

Interview to landowner

Eucalypus plantation conducted by community

Interview to landowner

Workshop

Figure 3 Region X pilot project site

Subject land

Subject land

Subject land

Subject land

Interview to landowner

Baseline study

Figure 4 Region XI pilot project site

3. Region XI project

3.1 Formulation of the pilot project

3.1.1 Initial plan

The pilot project in Region XI aims at recovery of degraded soils which correspond to the 3rd type of AR CDM defined in National Strategy Study for the CDM.

The purpose of Region XI pilot Project in accordance with the definition of the National Strategy Study for CDM is the recovery of the degrades soils within a forestation project type 3.

The Project will be conducted in Coyhaique, where some 50 years ago immigration led to the removal of the forest by large fires and consequent soil degradation. Later the cold climate of the region did not allow any natural regeneration of the original vegetation, and today there are still vast stretches of land where dead trees could not yet decompose completely.

According to the Chilean definition (DL 701), these lands are categorized as degraded soils, fragile soils and soils in danger of desertification. This project was planned in order to rehabilitate degraded land by planting *Pinus ponderosa* and obtain carbon credits. Table 8 below summarizes the initial plan for this project.

Table 8 Initial plan of Region XI pilot project

	Region XI
Project area	Approx. 6,000 ha of degraded land
Landowners	Medium/large landowners
Implementing authority	INFOR, CORFO, regional government and regional organizations related to the Ministry of Agriculture.
Planting tree	*Pinus ponderosa*
Management method	Replantation on degraded lands
Implementation system	OGANA (43 members)

3.1.2 Summary of missions

1) First mission

Understandings of system and current activities in Region XI and cooperative relationship with counterparts were established. Issues toward project implementation were identified and organized to clarify further study direction. INFOR had already obtained fund from the regional agriculture department (Seremi Agricola) and started its study on the pilot project. Therefore, JICA study team and Chilean counterparts agreed on that the full-scale study would start after completion of INFOR's study in June 2006

2) Second mission

Based on the work sheet prepared by JICA study team in advance, data required to PDD preparation were collected and issues were listed. Utilizing data collected, JICA study team and counterparts started PDD documentation. In addition, JICA study team began DOE selection process. Approved methodology AR-AM0003 was selected as most suitable methodology for the pilot project in Region XI.

3) Third mission

JICA study team and counterparts continued PDD documentation. Initially, the draft of PDD for this pilot project was supposed to be finalized by Chilean counterpart before the third mission but it could not realize because of delay in work and lacks of resources.

4) Fourth mission

Project participants were almost finalized, and necessary steps toward the project implementation were done. Baseline field survey was started with technical supports from JICA study team and financial support from ODEPA, and socio-economic survey was carried out. PDD development was continued.

5) Fifth and Sixth missions

Final arrangement for institutionalization and support for DOE selection as well as identifying and discussing issues toward PDD finalization were conducted.

6） Seventh mission

PDD was finalized, and support for actualizing organization, validation and request for registration were continued.

3.1.3 Implementation scheme

The following figure describes stakeholder organizations and their roles.

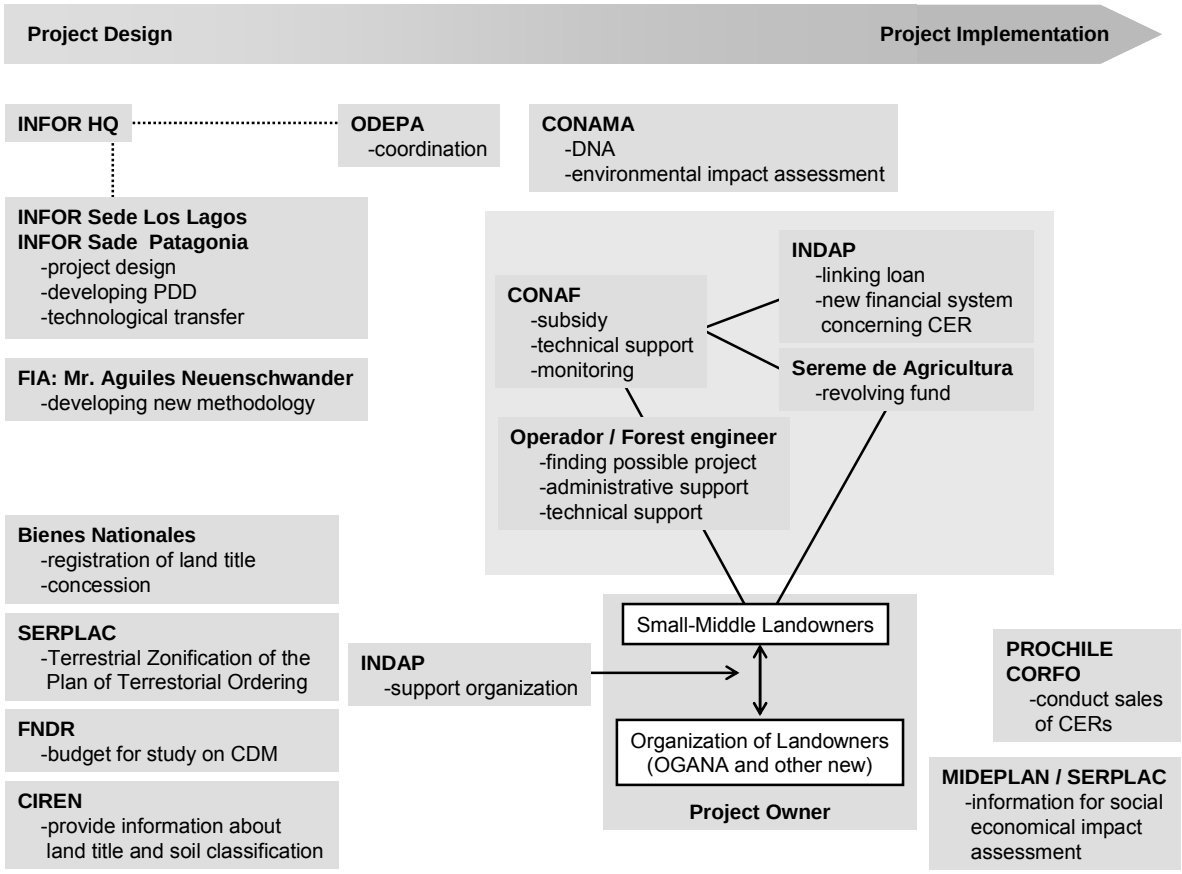


Figure 5 Roles of relevant organizations in Region XI

During the second mission, the scheme for preparing Region XI project' PDD was confirmed as Mr. Paulo Moreno, director of INFOR Region XI, as the coordinator and lead officer under supervision of Mr. Carlos Bahamondez, director of INFOR Valdivia, and with support from Mr. Enrique Villalobos and other INFOR staff and Mr. Aquiles Neuenschwander as an advisor.

In the third mission, it was pointed out from both of JICA study team and Chilean counterpart that human resource in Chilean side was limited and inadequate. Although reinforcement of Chilean counterparts for completing PDD was agreed, it was not realized. Mr. Paulo Moreno and Mr. Enrique Villalobos took charge of the overall PDD development.

3.1.4 Materialization of the pilot project

Although the project implementation scheme and project area were largely changed from the original plan (Table 8), the plantation plan has not been changed. The following reasons can be pointed; the project participant has not been unchanged from grandes y medianos propietarios, the plantation type which those land owners prepare were appropriately interpreted, possible plantation types are limited because of severe environmental conditions in Region XI, and the stakeholders, including NGO, shared the common understanding about the limited possible plantation types.

Selection of candidate project areas

Before starting recruiting project participants, candidate project areas were identified by examining land eligibility as AR CDM project and accordance with the local land use plan.

Step1 : Identification of eligible land

Total area of Coyhaique commune was analyzed for their eligibility as AR CDM project using "the procedures to demonstrate the eligibility of lands for afforestation and reforestation project activities (EB22 Annex 16)", and eligible land were selected. Although the procedure was updated in EB35, it was confirmed that re-analysis was not necessary by examined this updated procedure

Step2 : Identification of subject land

Land suitable for plantation was extracted based on their soil condition and steepness. Land use class map (Figure 6), which is a soil classification under the governmental law, and Ecoregion (Figure 7), which is a classification based on climate and vegetation available for Region XI, were used for the extraction. By dominating these two classifications, it can be judged what kind land use is preferable (Table 9)

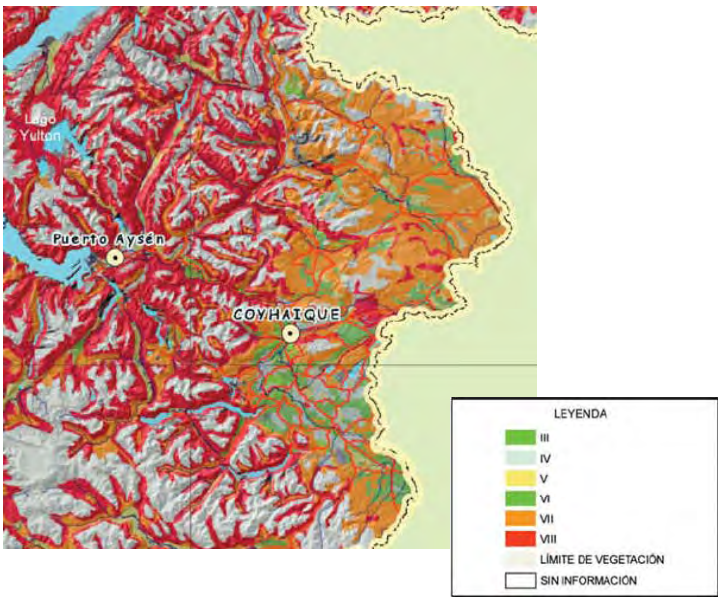
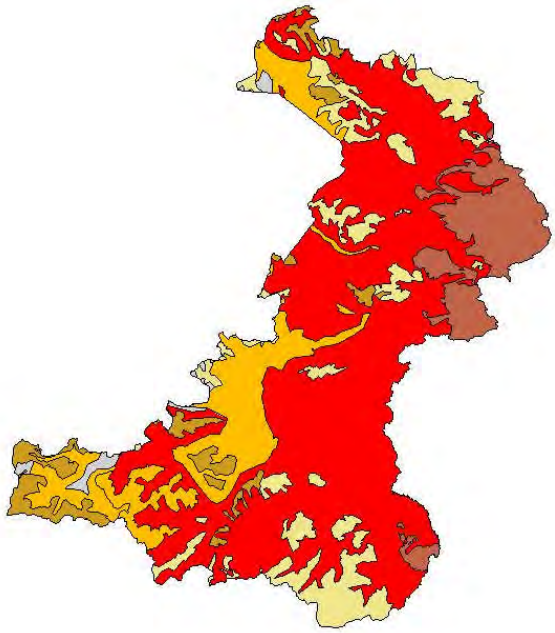


Figure 6　Land Use Class Map（Class VII is in orange）



Templada Inter,edia：yellow, Borea Humeda：red、Templada Humeda：gray、Esteparia Fria：brown

Figure 7　Ecoregion Map

Table 9　Land Use Class and Ecoregion

Ecoregion	Land Use Class					
	III	IV	V	VI	VII	VIII
Esteparica Fria	A	AP	P	P	Pfa2	Pfa2
Templada Intermedia	A	AP	P	**PF**	**F**	Pfa2
Boreal Humeda	A	AP	P	**PF**	**F**	Pfa2
Templada Humeda	A	AP	P	**PF**	**F**	Pfa2

A = most appropriate for agriculture ; AP = appropriate for agriculture ; P = appropriate for grazing ; PF = appropriate for grazing and plantation ; F = appropriate for plantation ; Pfa2 = reserved area

In Region XI, the land use class VI and VII are recognized to be preferable for forestation (Table 9).

A plan to construct a slaughterhouse in near future, which came to be known by the study team during the mission, led the decision to exclude class VI included in the planned construction area as grazing was more beneficial than A/R CDM plantation in economic sense for farmers if the plan was executed these area would fall under the land improvement subsidy (SIRSD) by INDAP and SAG. So, class VII that would not fall under SIRSD was selected as possible project site. Land use class VII is characterized to be steep slopes with shallow soil which is easily eroded

Project participants and project boundary

The first workshop inviting land owners were held on to introduce the pilot project, and recruitment of project participant was started in the third mission (see 5.1.3). As a result of continuous efforts of INFOR staffs, most of the project participants were listed during the forth mission. It was decided to establish new company (PULMAHUE S.A), and CONAF lawyer, who is also one of the project participants, greatly contributed to prepare legal documents for establishment of the company.

The application for formation of new organization, which is the company establishment in this case, was presented during the seventh mission (23rd September 2008), after withdrawal of participation of some land owners and rearrangement of alternative lands. The fixed project boundary consists of 8 land parcels and has 489,52 ha.

Necessary steps for project implementation

The necessary steps for the project implementation in Region XI are shown in Figure 8.

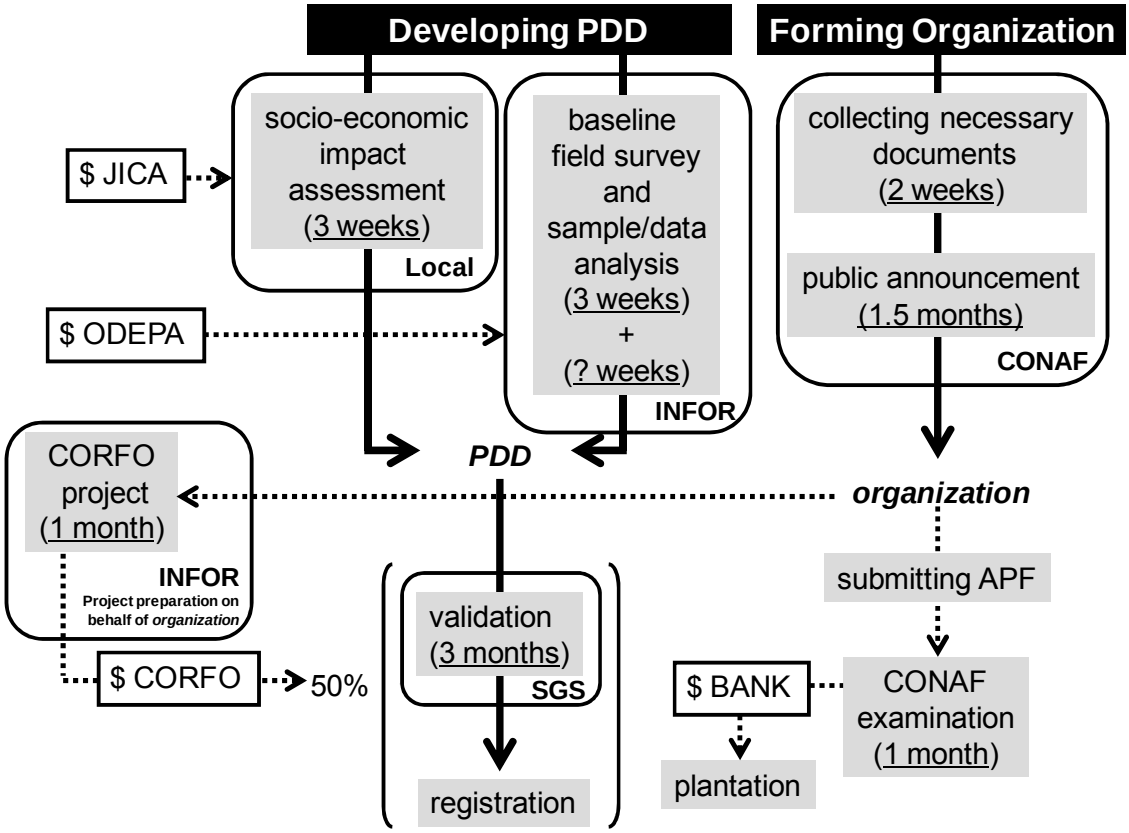


Figure 8 Implementation scheme

In the forth mission, socio-economic survey was conducted, and baseline field survey was started. The application documents necessary for public announcement for organization were prepared mainly by CORFO, but it was required to re-collect and modify these documents every time when there was a change of the project participants. After the organization was formed legally, application for financing validation and registration costs was presented to CORFO. 50% of the cost for project formation is expected to be financed by CORFO, and the validation and registration costs will be covered using this. The organization submitted APF for CONAF, and plantation cost will be financed by bank loan when APF is approved. APF is normally accepted after an organization formed legally, and then CONAF examines land cover in the past and present. However, the project was treated as a special case and examined prior to that the organization was formally established so at the same time of formal establishment of the organization the project would be able to lend a loan from the bank. Plantation will be conducted in the autumn 2008 and the spring 2009.

3.2 PDD development

The first steps for developing PDD are data/information gathering and analysis of pre-project condition of the project boundary and of plantation plan. Based on these, characteristics and activities which can cause emissions of GHG inside/outside the project boundary are identified, and applicable methodologies can be listed and compared their advantages and disadvantages.

3.2.1 Pre-project condition of the project boundary

Existence of deadwoods and grazing activities within the project boundary were identified as possible causes of GHG emission.

Deadwoods

In Region XI, the forest was eliminated through large forest fires mainly between 1920 and 1950, and as a result, 22% of the total area of the region was burnt. Even after more than 50 years, a large quantity of deadwoods exist on the ground（Figure 9）。It was pointed out that forest plantation might moderate severe conditions which have prevented decomposition of these deadwoods and might start decomposition process, and that carbon stocks in deadwood pool might decrease. To exclude deadwood pool from selected carbon pools or to apply a methodology which does not cover deadwood pool, it is required to demonstrate that carbon stocks in excluded carbon pools can be expected to decrease more or increase less in the absence of the project activity relative to the project scenario. Strategy for deadwoods treatment was examined.

Figure 9　Grazing land with deadwoods

When this study was started, there was no data about deadwoods in Region XI, and the only way to consider this problem was to rely on non-objective information. In June 2007, deadwood survey was conducted as a part of baseline field survey, and total mass of deadwoods

within the project boundary and their degrees of decomposition were measured and calculated. As a result, it was shown that the amount of remaining deadwoods in the project boundary was 103,161 tons CO_2, and that 47.8% of the remaining deadwoods had already lose their shape and 48.8% had been decomposed their xylem (Figure 10). See Appendix 9 for details of the survey. These results mean that deadwoods have been decomposed under the present condition, and that remaining deadwoods will disappear regardless the plantation. Moreover, no deadwoods will be moved from inside to outside the project boundary.

Figure 10　Decomposition process of deadwoods in grassland

On the other hand, it was impossible to make quantitative analysis on changes in decomposition rate due to the plantation, because no data was available to be obtained.

Under such circumstances, three options were considered there advantages and disadvantages.

Option 1: Include deadwood pool, and monitor deadwoods.
Option 2: Exclude deadwood pool, but monitor deadwoods.
Option 3: Exclude deadwood pool, and not monitor deadwoods.

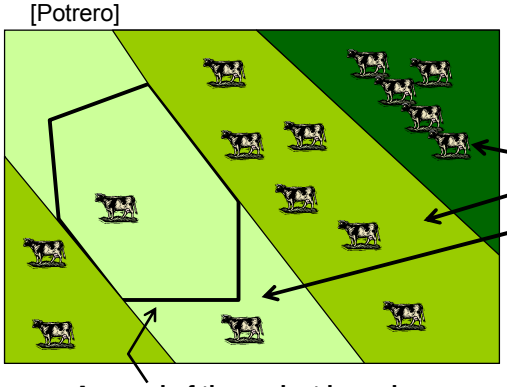
The certainty of PDD approval would be highest with option 1, but at the same time, project cost is highest with option 1. JICA study team and Chilean counterparts were discussed the best strategy, and decided to develop PDD with option 3 and see DOE judgments. In PDD, the results of field survey were shown together with an explanation that no deadwoods would be taken out from the project boundary.

Grazing

Since the project boundaries are lands which are currently used as grazing land, leakage due to land cover change caused by displacement of grazing activity have to be considered. Although methods for judging the occurrence of leakage and for calculating GHG emission differ among methodologies, number of animals within the project boundary should be measured regardless which methodology to be applied.

Each parcel of the project boundary is part of potrero, cattle animals cross the boundary freely, and therefore the numbers of cattle animals within the parcel are merely recorded directly, whereas that for a potrero is recorded. It is possible to assume that cattle animals equally graze whole potrero, and to calculate the number of cattle animals within the parcel using relative area of the parcel to that of potrero. However, since these parcels were selected because they have lower productivity than other part of potrero, this method likely brings overestimation of the number of cattle animals within the parcel. In the pilot project, if precise estimation of number of cattle animals was needed, an estimation method incorporating different productivity within a potrero was applied (Figure 11).

[Potrero]



A parcel of the project boundary

Productivity	Relative area**	Carrying capacity/ ha	Relative number of carrying animals (where: *i = b, r,p* ; b= buena; r=regular; p=pobre)
Unit of area with productivity information			
High	*A_b*	*UA_b*	*R_b=A_b*UA_b / Σ (A_i * UA_i)*
Mid	*A_r*	*UA_r*	*R_r=A_r * UA_r / Σ (A_i * UA_i)*
Low	*A_p*	*UA_r*	*R_p=A_p*UA_p / Σ (A_i * UA_i)*
A parcel of the project boundary			
Low	*A_p1*		*R_p1=R_p * (A_p1 / A_p)*

**A_b + A_r + A_p = 1

Calculation of number of animals within a parcel of the project boundary (*N_p1*)

(a) If precise estimation is necessary so that N_p1 would be as small as possible
1. Divide potrero into units of area based on their productivity
2. Calculate relative carrying number of animals for each unit with its relative area and carrying capacity
3. Calculate relative carrying number of animals for the parcel of the project boundary (*R_p1)*
4. Calculate number of animals within the parcel

*N_p1 = N_total * R_p1* (where, *N_total* = total number of animals in potrero)

(b) If there is large grazing land outside the project boundary , and overestimated number of animals is acceptable
1. Calculate relative area of the parcel (*A_p1*)
2. Calculate number of animals within the parcel

*N_p1 = N_total * A_p1* (where, *N_total* = total number of animals in potrero)

Figure 11 Estimation method of number of cattle animals

3.2.2 Plantation plan

In the pilot project, cattle animals can be re-introduced into the planted forest after the first pruning in the 12th year. Although grazing activities within the planted forest also involve CO_2 emissions from fodder consumption and CH_4 emissions from enteric fermentation, these emissions do not have to be included. According to Decision EB 22 Annex 15, only the increase of pre-project GHG emissions as a consequence of the implementation of the project activity has to be taken into account in the calculation of net anthropogenic GHG removals by sinks. In the pilot project, number of re-introduced cattle animals is expected to be smaller than that of currently in the project boundary for achieving sustainable land use. Some of the approved

methodologies, for example AR-AM0003 and AR-ACM0001, which accept land under grazing activity as a project boundary do not set a applicability condition “grazing will not occur within the project boundary in the project case”

Pinus ponderosa was selected as plantation species by taken into account good growth in the local conditions, existence of technology and knowledge for plantation, quality of wood, and capacity of seedling supply. It is planed to prune in 12th and 22nd years, to thin in 22nd year, and to harvest high quality wood in the 40th year. Land owners have to reforest if they used subsidy for plantation by Chilean law.

3.2.3 Methodology selection

Methodology selection was started in the 2nd mission, and AR-AM0003, which was just approved by EB, was identified as the candidate methodology for the pilot project in Region XI. After that, examination of newly approved methodology was continued. Methodologies applicable for projects on grazing land were AR-AM0003, AR-AM0004, AR-AM0007, AR-AM0009 and AR-ACM0001. ARAM0004 was developed based on ARAM0003 so that it could be applied to projects on crop land, not only those on grazing land. There was practically no difference between AR-AM0003 and AR-AM0004 as a methodology if grazing lands were considered as project sites, and AR-AM0003 was selected for this analysis.

Through the examination of these methodologies, a possible treatment of cattle animals in the project boundary under each methodology was identified as a key feature for comparison of the methodologies.

- AR-AM0003 considers decrease of livestock within the boundary as increase outside the boundary,
- AR-AM0007 does not allow livestock to be displaced somewhere else, but requires to be slaughtered or sold to be slaughtered,
- AR-AM0009 requires that the land under the proposed CDM A/R project activity can continue to provide at least the same amount of goods and services as in the absence of the project activity, i.e., to accept grazing from the beginning of the project, and
- AR-ACM0001 provides several scenarios. Livestock can be displaced from inside to outside the project boundary or slaughtered/sold.

In the case of the pilot project, the scenarios provided by AR-AM0007 and AR-AM0009 were considered to be unrealistic, and therefore these methodologies were excluded form the candidate list.

Another issue should be mentioned for comparison between AR-AM0003 and AR-ACM0001. At the time when AR-ACM0001 was approved, PDD for the pilot project was close to be completed. Although it was recognized that AR-AM0003 would be withdrawn in later 2008, JICA study team and Chilean counterparts once decided not to change the applied methodology to AR-ACM0001. However, because of delay in forming organization, AR-AM0003 was withdrawn before PDD was submitted to DOE. The methodology applied to the pilot project PDD is finally AR-ACM0003 ver.3.

3.3 Summary of the pilot project

Outline of the pilot project is described in line with PDD below.

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

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

>>

Reforestation on degraded, fragile soils and soils in danger of desertification in Coyhaique commune

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

>>

Reforestation with *Pinus ponderosa* Douglas ex Lawson & C. Lawson is conducted for 489,52 ha in Coyhaique commune of the region of Aysén, Chile. This project is focused on those areas that have a high rate of environmental degradation and has been declared as area in danger of desertification by the Chilean government; therefore the main objective of the project is erosion control.

The region of Aysén was one of the last Chilean territories to be colonized with migratory movements from the North at the beginning of the 20th century. Due to the need for lands suitable for livestock farming the forest was eliminated through large forest fires mainly between 1920 and 1950, resulting in an overall burned area of 2,334,785 ha in the region, which corresponds to 22% of the regional surface (CONAF, 1980). These forest fires caused major soil degradation due to the sudden loss of protection. Strong grazing activity has been taking place until the present time, even in lands that do not have conditions for this type of activity, mainly due to steep slopes. Currently the project area is under extensive grazing due to the loss of productivity of grounds by erosion. As the forests that existed in these lands are associations of semi-tolerant species, the drying effects of the wind and the grazing have not permitted natural regeneration of the forests.

The species to be used by the project is *P. ponderosa* and was selected considering historical, operational, economic and environmental factors. It is the species that has given the best results in the commune of Coyhaique.

A.3. Project participants:

>>

Name of Party involved (*) ((host) indicates a host Party)	Private and/or public entity(ies) project participants (*) (as applicable)	Indicate if the Party involved wishes to be considered as a project participant (Yes/No)
Republic of Chile (host)	• Private entity: PULMAHUE. S. A • Public entity: Ministry of Agriculture	No
(*) In accordance with the CDM A/R modalities and procedures, at the time of making the CDM-AR-PDD public at the stage of validation, a Party involved may or may not have provided its approval. At the time of requesting registration, the approval by the Party(ies) involved is required.		
Note: When the CDM-AR-PDD is prepared to support a proposed new baseline and monitoring methodology (form CDM-AR-NM), at least the host Party(ies) and any known project participant (e.g. those proposing a new methodology) shall be identified.		

PULMAHUE S.A., hereafter PULMAHUE, is a closed joint stock company under Chilean law with the only purpose to carry out this forestation with the benefits of a CDM project under the Kyoto Protocol. This company is made up of 5 partners who are mainly livestock farmers of the region and who will guarantee the company usufruct of their land on the sectors to be planted and contribute to the initial investment of the forestation costs. This company will be in charge of the plantation as well as the technical and administrative decisions of management and project monitoring.

A.4. Description of location and boundaries of the A/R CDM project activity:

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

A.4.1.1. Host Party(ies):

>>

Republic of Chile.

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

>>

Región de Aysén del General Carlos Ibáñez del Campo (Aysén Region), Coyhaique province.

A.4.1.3. City/Town/Community etc:

>>

Commune of Coyhaique, near to Coyhaique city, Valle Simpson, Coyhaique Alto and El Blanco.

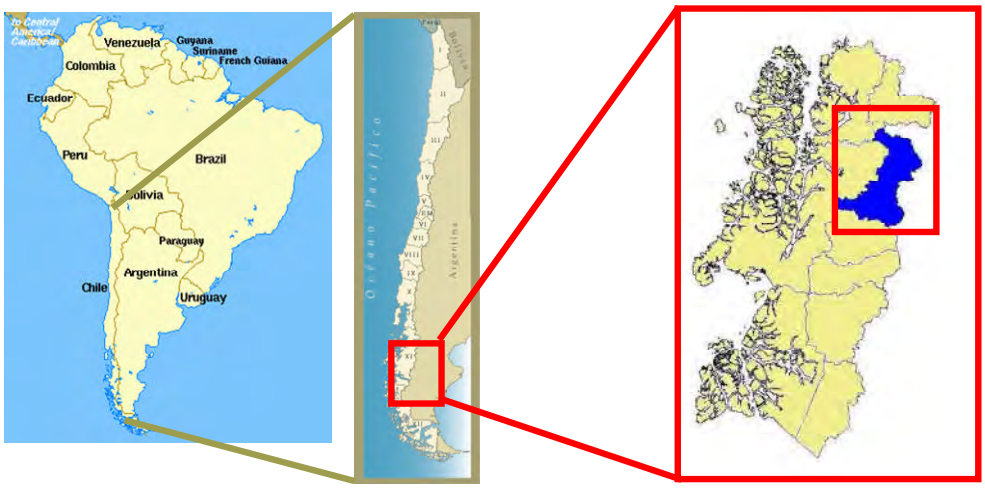


Figure A.4.1 – Location of Coyhaique commune

A.4.2 Detailed geographic delineation of the project boundary, including information allowing the unique identification(s) of the proposed A/R CDM project activity:

>>

Total area of 489.52 ha is consisting of 8 land parcels ranging from 474 m to 1025 m in altitude.

Figure A.4.2.- Eight land parcels of the project boundary

A.5. Technical description of the A/R CDM project activity:

A.5.1. Description of the present environmental conditions of the area planned for the proposed A/R CDM project activity, including a concise description of climate, hydrology, soils, ecosystems (including land use):

>>

The total surface of the project can be characterized with 3 eco-regions (SAG, 1999): Cold Moist Boreal with 359,16 ha, corresponding to 73% of the overall surface, Intermediate Moist temperate and Tundra. Cold Moist Boreal eco-region corresponds to sites of higher altitudes, from the beginning of dominant deciduous forest of lenga (*Nothofagus pumilio*) to the tree line. The area receives even rainfalls throughout the year, in winter mainly as snow. July is the coldest month with temperatures near 3°C below zero, the warmest season can surpass 10°C in summer.

Intermediate Moist temperate is mainly found in valley, and characterized as temperately rainy with short, dry summers and hard winters with snow and frost. The Tundra domain is characterized by slow growing bush vegetation, the formation of muddy peat-bogs, wetlands and moor. However, the sectors lying within the project area are in a transition zone between the Tundra and cold moist boreal domain, presenting less severe environmental conditions than the Tundra domain as such.

A.5.2. Description of the presence, if any, of rare or endangered species and their habitats:

>>

No rare or endangered plant or animal species lives within the project boundary, as this is a non-natural environment destroyed by human activity and cattle grazing.

A.5.3. Species and varieties selected for the proposed A/R CDM project activity:

>>

Pinus ponderosa Douglas ex Lawson & C. Lawson var. *ponderosa.*

A.5.4. Technology to be employed by the proposed A/R CDM project activity:

>>

Present situation of forestation

In the year 2006 the commune presented 23.767 ha of plantations. In the commune 59% correspond to *Pinus ponderosa*, 21% to *Pinus contorta* and 20% to other species (INFOR, 2008). Annual plantation areas of *Pinus ponderosa* and other species are shown in Figure A.5.1.

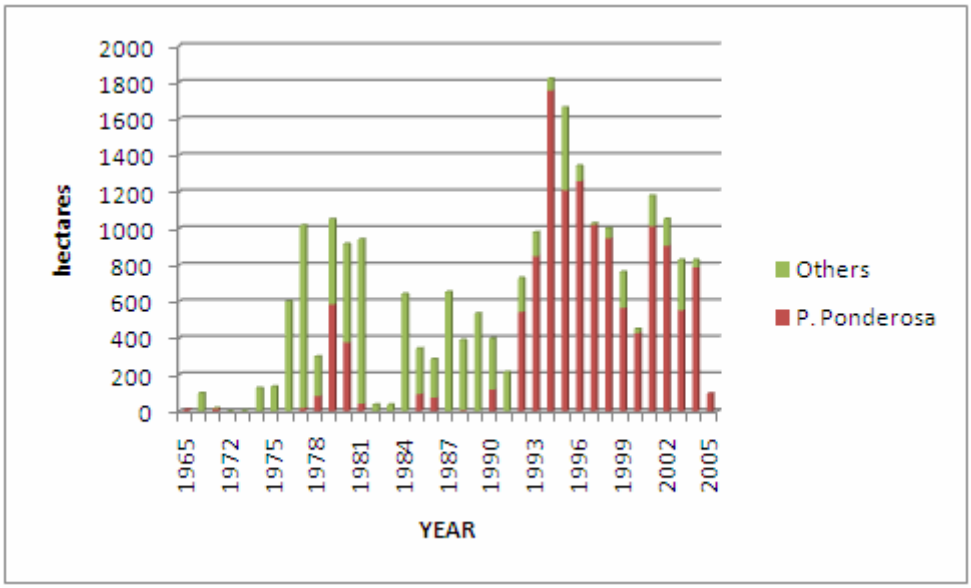


Figure A.5.1.- Plantations in the commune of Coyhaique according to species

Aysen Region had 8 nurseries in the year 2004, with a total production of 5.355.000 seedlings. Forestal MININCO has sufficient capacity for seedling supply to the project

Damages by insects and disease have not been reported until now.

Forest management standard

The project area is located in a cool temperature zone. So the project in Region XI is not good for short rotation wood production and pulp wood production commonly seen in Regions VIII and IX. Long rotation wood production is suitable for Region XI.

The management standard of the *Pinus ponderosa* is shown in Table A.5.2.

Table A.5.2.- Management standard of *P. ponderosa* for timber production

Age (Year)	Activity	Details
0	Planting	1,250 trees/ha
1-40	Management	Patrol
12-22	Pruning	Pruning1:12-year-old stand 1,250 trees/ha Pruning1: 22-year-old stand 500 trees/ha
22	Thinning	400 trees/ha for thinning
40	Final harvest	40 cm in diameter at breast height (850 trees/ha)

Thinning will be conducted at the same time as the second pruning. Tree selection for thinning needs experience and technique, therefore training should be held under CONAF supervision.

Forest protection

Fire belts are set up in and around the plantation area to prevent the spread of forest fires, whereas forest fires rarely occurred in the commune. Damage from grazing can be prevented by fencing the planted site. In Coyhaique commune from the first pruning to canopy closure, grazing will be introduced considering the local peoples' livelihood.

A.6. Description of legal title to the land, current land tenure and rights to tCERs / lCERs issued for the proposed A/R CDM project activity:

>>

PULMAFUE is responsible to carry out the forestation and is in charge of the project and holds the rights of the certificates (tCERs).

A.7. Assessment of the eligibility of the land:

>>

CDM EB 35-Annex 18 "PROCEDURES TO DEMONSTRATE THE ELIGIBILITY OF LANDS FOR AFFORESTATION AND REFORESTATION CDM PROJECT ACTIVITIES" (Version 01) was applied.

The Chilean DNA (CONAMA) defines the threshold values of forest for afforestation and reforestation project activities under the Kyoto Protocol as follows;

- A single minimum land area value : 0.5 ha
- A single minimum tree height value : 5 m
- A single minimum tree crown cover value : 25%

As described above, the subject lands to be planted in the proposed A/R CDM project activity are currently grassland. In all cases the land is not subject to forest regeneration due to the ongoing grazing activity and climate conditions. Even the surrounding native forests can not extend their territory to those subject lands due to the severe climate conditions and cattle grazing. Although there are some trees and shrub growing at the edges of the project boundaries, they do not qualify as forest according to the definition of forest stated above. Therefore the lands of the proposed A/R CDM project activity comply with the definition for reforestation in 16/CMP.1 and 5/CMP.1.

To demonstrate land eligibility, two different approaches, namely large scale approach

and project scale approach, are applied. In large scale approach, multi-temporal classifications (1984 and 2005) using Landsat/TM satellite images covering whole Coyhaique commune were compared in order to detect land cover evolution and therefore the targeted study area. In project scale approach, analysis of orthophoto obtained in 1996 and field survey were conducted to ensure there was no plantation between 1984 and 2005. All area which was extracted as eligible land by large scale approach was confirmed its eligibility by project scale approach.

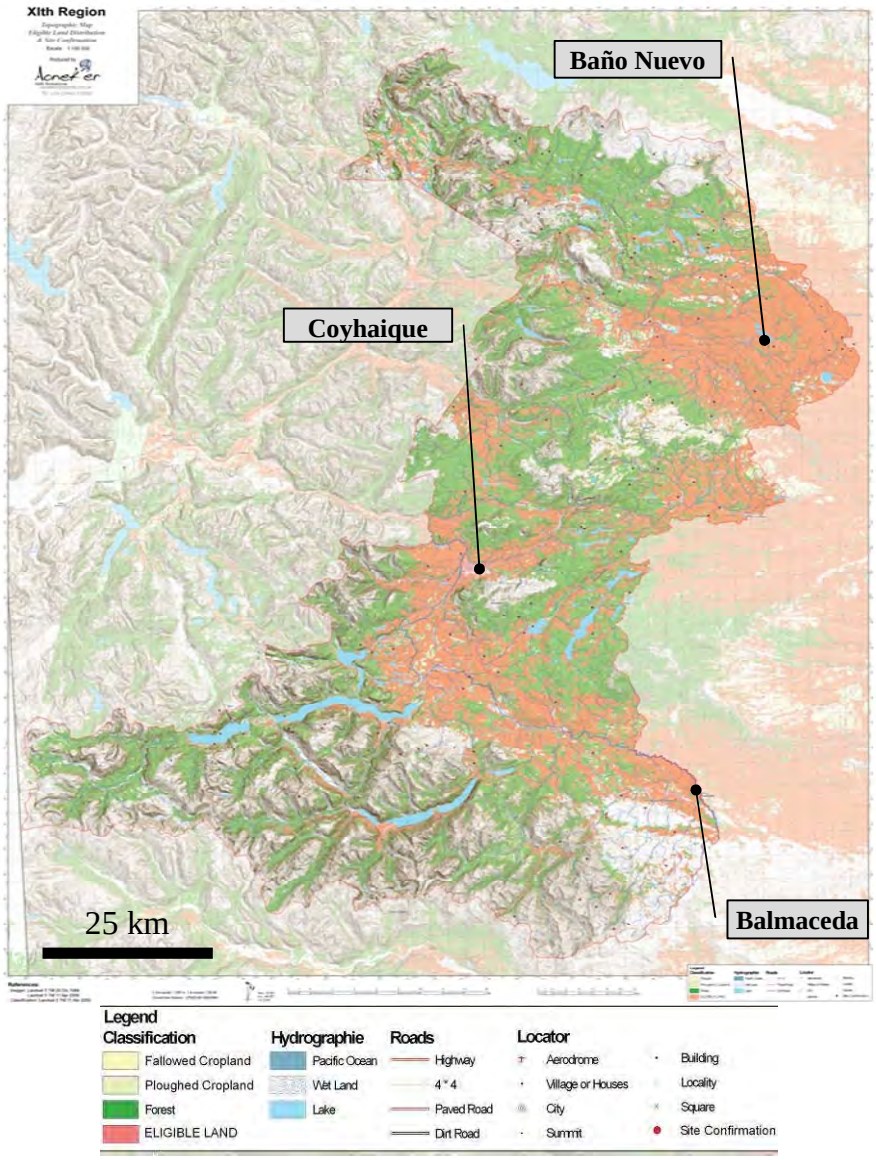


Figure A.7.1- Eligible Land Distribution map （large scale approach）

A.8. Approach for addressing non-permanence:

>>

tCER was selected.

A.9. Estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period:

>>

The net anthropogenic GHG removals by sinks as a result of the proposed A/R CDM project activity is anticipated to be over 243,136.8 tons of CO_2 equivalent during the crediting period.

Summary of results obtained in Sections C.7., D.1., and D.2.				
Year	**Estimation of baseline net GHG removals by sinks (tons of CO_2 e)**	**Estimation of actual net GHG removals by sinks (tons of CO_2 e)**	**Estimation of leakage (tons of CO_2 e)**	**Estimation of net anthropogenic GHG removals by sinks (tons of CO_2 e)**
2009	44.6	-27,040.8	0.0	-27,085.5
2010	63.7	0.0	0.0	-63.7
2011	85.5	0.0	0.0	-85.5
2012	109.8	0.0	0.0	-109.8
2013	136.5	0.0	0.0	-136.5
2014	159.0	0.0	0.0	-159.0
2015	169.4	0.0	0.0	-169.4
2016	192.5	0.0	0.0	-192.5
2017	216.4	0.0	0.0	-216.4
2018	241.1	259.5	0.0	18.4
2019	263.7	3,622.9	0.0	3,359.2
2020	277.3	4,800.1	0.0	4,522.8
2021	191.8	3,455.5	0.0	3,263.8
2022	169.6	8,269.8	0.0	8,100.2
2023	162.7	10,846.1	0.0	10,683.4
2024	155.8	13,104.5	0.0	12,948.7
2025	149.2	15,495.5	0.0	15,346.3
2026	143.1	17,256.0	0.0	17,112.9
2027	135.5	19,053.0	0.0	18,917.5
2028	128.0	21,017.3	0.0	20,889.3
2029	124.0	22,019.6	0.0	21,895.5
2030	112.4	21,720.7	0.0	21,608.4
2031	72.7	-2,209.5	0.0	-2,282.2
2032	65.2	17,151.6	0.0	17,086.4
2033	43.3	17,020.7	0.0	16,977.4
2034	36.2	16,819.2	0.0	16,783.0
2035	29.9	16,561.3	0.0	16,531.4
2036	24.4	16,222.9	0.0	16,198.5
2037	19.8	15,911.1	0.0	15,891.3
2038	15.9	15,518.8	0.0	15,502.9
Total (tons of CO_2 e)	3,739.1	246,875.9	0.00	243,136.8

A.10. Public funding of the proposed A/R CDM project activity:

>>

75% of forestation costs standardized by CONAF will be subsidized. Part of formulation, validation and registration costs of this A/R CDM Project are funded by Chilean Economic Development Agency (CORFO) under a scheme which assists the formulation of this kind of projects.

Although the project is supported by Japanese ODA project "Capacity Development and Promotion of A/R-CDM in the Republic of Chile (2005 – 2008)" during the preparation phase, Chilean government understands it does not result into diversion of ODA.

SECTION B. Duration of the project activity / crediting period

B.1 Starting date of the proposed A/R CDM project activity and of the crediting period:

>>

Starting date of project activities for the project is the 1st of August 2008. At this date the preparation of the first lands within the project boundary for plantation began.

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

>>

40 years

B.3 Choice of crediting period:

B.3.1. Length of the renewable crediting period (in years and months), if selected:

>>

B.3.2. Length of the fixed crediting period (in years and months), if selected:

>>

30 years

SECTION C. Application of an approved baseline and monitoring methodology

C.1. Title and reference of the approved baseline and monitoring methodology applied to the proposed A/R CDM project activity:

>>

Approved consolidated afforestation and reforestation baseline and monitoring methodology AR-ACM0001 "Afforestation and reforestation of degraded land" (Version 02), hereafter AR-ACM0001, is applied.

C.2. Assessment of the applicability of the selected approved methodology to the proposed A/R CDM project activity and justification of the choice of the methodology:

>>

The proposed A/R CDM project activity complies with the applicability conditions of the selected methodology. See Appendix 7 for details.

C.3. Assessment of the selected carbon pools and emission sources of the approved methodology to the proposed CDM project activity:

>>

Above and below ground living biomass pools have been selected, and deadwood, litter and soil organic carbon pools were excluded. See Appendix 7 for the assessment.

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

>>

Step 1: Stratification according to pre-existing conditions and baseline projections:

The ex ante stratification was conducted using the following factors:

- Eco-regions developed by SAG

- Altitude (600 m)

Table C.4.1.- Strata identified use *ex-ante* stratification

Stratum	altitude	Sub-Stratum by eco-region	Code	ha
1	< 600	Intermediate moist temperate	32	7.43
		Cold Moist Boreal	12	28.67
2	> 600	Cold Moist Boreal	11	330.49
		Intermediate moist temperate	31	34.23
		Tundra domain	41	88.70

C.5. Identification of the baseline scenario:

>>

A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) was used, and the results were shown in section C.6 .

C.6. Assessment and demonstration of additionality:

>>

A/R Methodological tool "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01) was used.

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

The proposed AR CDM project will start in 2008 planning on land surfaces which are currently non-forested and which are eligible according to Section C.1

In the year 2005 a study had been carried out by the Regional Government of the region of Aysén to assess the potential lands for a CDM project. The incentive from the planned sale of CERs was seriously considered in the decision to proceed with the project activity.

Step 1. Identification of alternative land use scenarios to the proposed A/R CDM project activity
Sub-step 1a. Identify credible alternative land use scenarios to the proposed CDM project activity:

Four credible alternative land uses can be identified:

1) Extensive bovine cattle farming
2) Extensive ovine cattle farming
3) Extensive bovine cattle farming on rented land
4) Forestation with exotic species with DL 701 and without A/R CDM

Sub-step 1b. Consistency of credible land use scenarios with enforced mandatory applicable laws and regulations:

In Chile, there is no legislation which regulates land use by land owners. The government has developed decrees as DL 701 to promote sustainable land use by defining soil type. The application of these decrees however is not mandatory. Therefore, no alternative land use scenarios identified in sub-step 1a is excluded.

Step 2. Barrier analysis

Sub-step 2a. Identification of barriers that would prevent the implementation of at least one alternative land use scenarios:

a) Investment barriers
One of the greater economic problems that landowners face is the lack of intermediate income in the case of forest activities, due to the climate and the other environmental condition of this region, the growth of tree is slow and the periods of rotation should be very long. The cost of opportunity of the land is very high so that they have to wait for a long time to receive benefits.

b) Institutional Barriers
In order to implement forestation, the project participant should apply the subsidy under DL701 (for forestation). The other hand, the subsidy under DL889 (for employment) is very useful for grazing activities and common for cattle grazing farmers in this region. However, these laws are not permitted to apply by same person or organization. Major proponents of the project have already applied the law and need to keep it ongoing for employment maintenance of this region.

c) Barriers related to local tradition
The local traditions as to the type of production are rather strong, from the decade of the 60s on the main economic activity is extensive cattle farming, where great extensions of land are used to produce bovine and ovine cattle mainly. The incorporation of forest activities is relatively new, where thanks to the incentives of the government new plantations mainly of exotic species have evolved. Nevertheless this type of activity is marginal in this region due to the lack of formal markets and knowledge of this activity.

The traditional activities are transmitted from generation to generation without major changes in the present land use.

d) Barriers due to Markets Risks
At the moment a formal forest market in this region does not exist, which causes that the investment alternatives pushed aside by other opportunities with greater security in the investment of capital. The wood production of fast growing species is concentrated with a great forest company and few small landowners, but the market of this type of wood still is not developed. The reason for this is that the plantations were mainly established between the 1990s and the present day, and the shortest rotation period for *Pinus Ponderosa* is 40 years.

e) Barriers due to local ecological conditions
See Section C.2. Different research has shown that the wind and sun dry out the soil and make it impossible for native species such as lenga to come up in open spaces like degraded grasslands. Some sectors in the Commune suffer from rabbits damaging the established trees, biting off the shoots.

Sub-step 2b. Elimination of land use scenarios that are prevented by the identified barriers:

Forestation with DL 701 and without A/R CDM is prevented by above mentioned barriers. Land use scenarios which are not prevented by any barriers are:

1) Extensive bovine cattle farming
2) Extensive ovine cattle farming
3) Extensive bovine cattle farming on rented land

Sub-step 2c. Determination of baseline scenario

The land use scenarios identified in barrier analysis can be summarized as extensive grazing activity, which is a continuation of current land use. Under such condition, carbon stocks in non-tree vegetation are conservatively expected to decrease, and therefore baseline GHG removals by sinks are determined as growth of existing tree vegetations. This has been done in section C.7 based on the field survey.

Financial analysis was conducted for credible alternative land use scenario identified in **Sub-step 1a**, although it is not required under "Combined tool to identify the baseline scenario and demonstrate additionality in A/R CDM project activities" (Version 01).

Exchange rate was set to 620 CLP/USD, and the following parameters were used for the analysis:

1. Bovine cattle farming

Information from the Project "Support studies for farm management and agricultural production in Region XI" carried out by Consultora Agraria Los Lagos, committed by the Corporation for Production Promotion including a financial analysis for the year 2002. Only production costs for a small scale exploitation system of 114 hectares are considered.

Table C.6.1.- Bovine cattle farming gross margin

Income	USD/ha	Costs	USD/ha
Cow sales	1.70	Feed	1.51
Calf sales	12.58	Veterinary products	0.95
Milk sales	8.67	Depreciation	11.18
Cheese sales	0.83	Total	13.64
Total	23.78		
		Gross Margin	15.25

2. Sheep farming

The data source is the same as that for bovine cattle firming.

Table C.6.2.- Sheep farming gross margin

Income	USD /ha	Costs	USD /ha
Lamb sales	7.70	Workforce sheering	0.33
Sheep sales	0.68	Depreciation	5.87
Wool sales	1.36	Total	6.20
Leather sales	0.51		
Total	10.24		
		Gross Margin	4.05

3. Grazing on rented lands

The data were collected through direct interview to landowners and professionals. Administration costs are considered as 0.

Table C.6.3.- Grazing on rented lands gross margin

Surface for grazing (ha)	114
Animal load per ha (animal/ha)	0.30
Income from rent/month (USD)	5.65
Months per year for grazing (month)	8

Income per year (USD)	1,544.52
Income per year and ha (USD)	13.55

4. Forestation

The statistical data of Region X were used for the cost estimations of harvest and transport, because currently there is no plantation activity in Region XI. These costs are from a study in radiate pine in Region X (INFOR 2002).

Table C.6.4.- Costs for forestation activities

For plantation and management	USD/ha
Plants	209.68
Plantation and preparation	209.68
Fencing (USD/km)	2.58
Administration and Maintenance	42.00
Pruning	248.00
Thinning	480.00
For harvest and transportation	USD/m3
Felling and handling for pulp wood	5.00
Felling and handling for saw logs	7.00
Roads	1.50
Loading	1.00
Transportation	6.00

Table C.6.5.- Prices of wood and renting the land for grazing,

Income			
	USD/m3		USD /ha/year
Pulpwood	19.48	Animal grazing	19.35
Standing tree	23.72		

Table C.6.6.-Subsidy

	USD/project
Forestation	715.01
Fence	0.63

Table C.6.7.- Costs relating to CDM

	USD/project
Registration	3,850,000
Verification	11,000,000

Validation cost was not included because Chilean government is assumed to bear the expense.

Net present values (NPV) were estimated for each of credible alternative land use scenarios and CDM forestation (Table 19). The discount rate, price of tCER, project year, and project area were set to 8.5%, 4 USD, 40 years, and 489.52 ha, respectively. Though the project year was set to 40 years, which equals to assumed rotation year, to enable to compare the scenarios, sales of CER was not assumed after 30 th year.

Table C.6.8.- Net present value.

Scenario	NPV (USD)
Cattle farming	56,186
Sheep farming	47,743
Rent for grazing	75,040
Non-CDM Forestation	-116,490

CDM forestation	88,144

CDM forestation was identified as the most financially attractive scenario. In addition, it should be recognized that the data source used for analysis on cattle farming and sheep farming was obtained from actual land uses, which are considered as overgrazing, in this region, and therefore that the grazing scenarios would not be sustainable. Actual incomes in the future under the grazing scenarios could be smaller than the calculated incomes here.

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

>>

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Step 1 Field measurements were conducted to identify the areas of lands with growing trees, and numbers of trees of each species on these lands. Sparsely distributed trees of Nothofagus pumilio (lenga) and Nothofagus antartica (ñirre), large shrubs of Berberis buxifolia (calafate), Embothrium coccineum (ciruelillo), Ribes magellanicum (zarzaparilla), and small shrubs of *Senecio sp. (senecio), Pernettya sp. (chaura), Maytenus disticha (racoma)* were found.

Step 2 Trunk diameter for each year throughout the project period was estimated.

Step 3 Carbon stock in above- and below-ground biomass for the stratum with growing trees, for each species, at each time was estimated using stock change method and algometric equation.

Due to the existing competition between the shrubs, a function of maximum number of shrubs per hectare was developed applying Dtc as independent variable.

Baseline net GHG removal by sinks for 30 years was estimated as 3,739 tons CO_2.

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

>>

Name of persons/entity determining the baseline:
Dr.(c) Carlos Bahamondes/ INFOR
Dra.(c) Marjorie Martin/ INFOR
Ing. For. Paulo Moreno/ INFOR
Ing. For. Enrique Villalobos/INFOR
Dr. Hozuma Sekine/ MRI
Dra. Aya Uraguchi/ MRI

SECTION D. Estimation of *ex ante* actual net GHG removals by sinks, leakage and estimated amount of net anthropogenic GHG removals by sinks over the chosen crediting period

D.1. Estimate of the *ex ante* actual net GHG removals by sinks:

>>

Tree Biomass

The merchantable volume was calculated using locally derived equations by INFOR (2006). The project area in Coyhaique commune is presumed to have site indexes from 8 to 10 m and precipitation from 700mm to 1,000mm. The estimating condition in question assumes the lowest one of 8 m as a conservative choice. Carbon stocks in above-ground and below-ground biomass pools were estimated by following equations (15) to (18) and (22) of AR-ACM0001.

Step 1: Estimating the diameter at breast height (DBH, at 1.3 m above ground) and height using the following model.

DBH: (Periodic – 5 year- increment model)

$$i_{d5} = 4.6 - 0.22 * d - 32.03 * d^{-1} + 9.54 * (d / T) - 0.02 * GL - 0.76 * Ln(G) + 0.06 * H_{100}$$

where:

i_{d5}= 5 year periodic increment of DBH(cm)
d= DBH over bark(cm)
G= Stand basal area (m^2/ha)
GL= Basal area over bark of the trees bigger than subject tree (m^2/ha)
SI= Site index (base age=20th year)
T= age (year)

Height:

$$HT = 30.34983 * \left[1 - \left\{1 - (SI / 30.34983)^{0.664}\right\}^{(t+0.298)/(20+0.298)}\right]^{1/0.664}$$

where:

HT= dominant height (m)
t= age (year)
SI=site index (base age=20th year)

SI=8, which is minimum in this region was applied in ex-ante calculation, because no site-specific data was available.

Step 2: Estimating the volume of the merchantable volume based on the following locally derived equations.

Stand Basal area:

$$Ln(G_2) = 7.49 - 13.76 * (1/HT - 1.3) - 87.78 * 1/\sqrt{N_1} + 233.32 * (1/HT - 1.3) * 1/\sqrt{N_1}$$

where:

G_2= stand basal area in period 2 (m^2/ha)
HT= dominant height (m)
N_1= Number of trees in period 1 (trees/ha)

In the project, 1250 trees/ha were planted, and 400 trees/ha will be thinned in the 22nd year.

Stand Volume (per ha):

$$Ln(V) = 1.736 + 0.057 * S - 23.712 * (1/E) + 1.060 * Ln(G)$$

where

$Ln(V)$= Natural logarithm of merchantable volume (m^3)
G= basal area (m^2/ha)
S= Site index (base age= 20th yea)
E= Age(year)

Step 3 Calculating above-ground biomass and below-ground biomass

To calculate above-ground and below-ground biomass from the merchantable volume, locally derived parameters were collected and applied (Table D.1.1.).

Table D.1.1.- Data set of D, BEF2, root-shoot ratio

Planting spp.	D tons d.m./m^3	BEF_2	Root-Shoot Ratio	CF tonne $d.m.^{-1}$
Pinus ponderosa	0.36	2.70	0.331	0.5

Source: Gayoso, J., Guerra, J.,Alarcón, D. 2002. Contenido de carbono y funciones de biomasa en especies nativas y exóticas. Proyecto FONDEF D98I1076. Medición de la Capacidad de Captura de Carbono en Bosques de Chile y Promoción en el Mercado Mundial. Universidad Austral de Chile (UACH). Valdivia. Chile.

BEF_2, however, was adjusted due to pruning conducted in 12th and 22nd year of the stand age by sampling trees. The adjusted BEF_2 for each year is shown in Table D.1.2.

Table D.1.2.- BEF2j

Stand age	BEF2j
year	Dimensionless
10	2.70
11	2.70
12	1.92
13	1.97
14	2.03
15	2.08
16	2.14
17	2.19
18	2.24
19	2.30
20	2.35
21	2.41
22	2.56
23~39	2.56

Note: j = *Pinus ponderosa*

Existing biomass

A/R Methodological Tool "Estimation of GHG emissions from clearing, burning and decay of existing vegetation due to implementation of a CDM A/R project activity" (Version 02) was used to estimate the increase in GHG due to live vegetation existing within the project boundary at the time an A/R project commences ($E_{BiomassLoss}$). A SIMPLIFIED DEFAULT APPROACH TO ESTIMATION OF EMISSIONS DUE TO SITE PREPARATION was applied.

In the proposed project, slash and burn is not conducted, and site preparation is restricted to partial clearance of non-tree vegetation. Therefore, clearance of existing tree biomass is not to be accounted. Since loss of existing herbaceous biomass is not required to be included in the tool, only that of existing shrub biomass was calculated. and the increase in CO_2 emissions from loss of biomass in existing vegetation can be calculated by applying the following equations:

Average above-ground biomass stock was obtained for small shrub and large shrub through field survey (Table D.1.3.).

Table D.1.3.- Above-ground biomass stock of shrub vegetation in the project boundary

($B_{AB,shrub}$)

Strata	$B_{AB,shrub}$ (t d.m. ha^{-1})
11	15.43
12	46.00
32	25.45
31	25.45
41	30.89

By applying IPCC default value for root: shoot ratio and carbon fraction, which are 0,473 and 0,49, respectively, CO_2 emissions from loss of biomass was calculated as 27.040 ton CO_2.

GHG emissions within the project boundary

The only possible source of GHG emission in this project is use of chain saws for thinning. Pruning will be done using saws, no biomass burn will be conducted, no fertilizer will be applied, and transportation within the project boundary will be done with horses. A GHG emission from burning of fossil fuels was estimated using direct method in "Estimation of GHG emissions related to fossil fuel combustion in A/R project activities" (version 01).

In year of 22nd and 23rd, 279 and 3506 litters of gasoline will be combusted. By applied CO_2 emission factor 3.10 kg CO_2 per litter of gasoline, 0.87 and 10.87 tons CO_2 were calculated to be emitted in year 22nd and 23rd, respectively.

This amount of GHG emission was tested its significance using "Tool for testing significance of GHG emissions in A/R CDM project activities" ver.01. It was demonstrated the GHG emission by f burning of fossil fuels within the project boundary is insignificant and therefore negligible.

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

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The possible sources of leakage are 1) leakage due to activity displacement and 2) leakage due to increased use of wood posts for fencing.

1) Estimation of leakage due to activity displacement, $LK_{ActivityDisplacement}$

The lands to be reforested are currently used as grazing lands, and therefore displacement of grazing activities outside of project boundary may result in leakage due to conversion of land to grazing land, $LK_{conversion}$, if conversion of non-grazing land to grazing land will be occurred. $LK_{conversion}$ was examined using the A/R methodological tool: "Estimation of GHG emissions related to displacement of grazing activities in A/R CDM project activity" (version 02).

In the proposed project, animals are displaced to identified existing grassland. Therefore, the examination started from Step 4 of the tool. El Pichi Blanco, EL Quemado and Los Coigues were excluded from this analysis, because animals currently in the project boundary will be sold, and no displacement will occur.

The necessary data were collected through interviews landowners and land managers and local study (SAG, 1999). As a result of calculation, it was shown that no overgrazing wil be

expected to occur.

2) Estimation of leakage due to increased use of wood posts for fencing

Perimeters of the area to be fenced were estimated as 21,558 m in total. Some parts of the area have already fenced, and some do not need fencing because they face to river. If the posts are 3 m apart, 7,186 posts will be used with an average weight of 40 kilos. Leakage due to increased use of wood posts for fencing was calculated as 386 ton CO_2.

The amounts of GHG emissions were tested using "Tool for testing significance of GHG emissions in A/R CDM project activities" (version 01), and was demonstrated that it is insignificant and therefore negligible.

SECTION E. Monitoring plan

E.1. Monitoring of the project implementation:

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E.1.1. Monitoring of forest establishment and management:

>>

Project implementation will be monitored through monitoring of the project boundary, forest establishment, and forest management.

E.1.2. If required by the selected approved methodology, describe or provide reference to, SOPs and quality control/quality assurance (QA/QC) procedures applied.

>>

To ensure the net anthropogenic GHG removals by sinks to be measured and monitored precisely, credibly, verifiably and transparently, a quality assurance and quality control (QA/QC) procedure will be implemented.

a) Quality assurance of field measurements
b) Verification of field data collection
c) Verification of data entry and analysis
d) Data maintenance and archiving

E.2. Sampling design and stratification

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Sample size

To realize the precision level of 10% and 95% confidence level, sample size was estimated to be 124 by using available data for *Pinus ponderosa* in Coyhaique. For stratum 1 and 2, 25 and 99 sample plots will be allocated.

Sample plot size

Square shaped plots of 25 m x 25 m, which are commonly used in planted forests in Region XI will be employed.

Plot location

To avoid subjective choice of plot locations, the permanent sample plots will be located systematically with a random start, which is considered good practice in IPCC GPG-LULUCF.

Monitoring frequency

The first monitoring period will be determined by examining the growth of planted trees. After the first monitoring, monitoring will be conducted every 5 years until the end of the crediting period.

E.3. Monitoring of the baseline net GHG removals by sinks, if required by the selected approved methodology:

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No monitoring of the baseline net GHG removals by sinks will be conducted.

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

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

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The diameter at breast height (DBH, at 1.3 m above ground) and preferably height of all the trees in the permanent sample plots above a minimum DBH (5 cm) will be measured.

E.4.2. Data to be collected in order to monitor the GHG emissions by the sources, measured in units of CO_2 equivalent, that are increased as a result of the implementation of the proposed A/R CDM project activity within the project boundary:

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It has been demonstrated that the only possible source of GHG emission is insignificantly small. Therefore, no monitoring will be conducted for the GHG emissions by the sources.

E.5. Leakage:

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Number of animals displaced to and existing in a parcel of grazing land outside of the boundary and area of the parcel will be recorded.

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

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PULMAHUE will make contract with the private firms, and the private firm will be responsible for measuring and monitoring of the actual GHG removals by sinks and any leakage generated by the proposed A/R CDM project activity.

INFOR will provide technical instruction on reforestation and forest management, and conduct the specific supervision of the implementation of the proposed A/R CDM project activity.

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

>>

Dr.(c) Carlos Bahamondes/ INFOR
Dra.(c) Marjorie Martin/ INFOR

Ing. For. Paulo Moreno/ INFOR
Ing. For. Enrique Villalobos/ INFOR
Dr. Hozuma Sekine/ MRI
Dra. Aya Uraguchi/ MRI

SECTION F. Environmental impacts of the proposed A/R CDM project activity:

F.1. Documentation on the analysis of the environmental impacts, including impacts on biodiversity and natural ecosystems, and impacts outside the project boundary of the proposed A/R CDM project activity:

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The environmental impacts on air quality, water quality, protected areas, and local ecosystems were analyzed, and environmental legislations were examined. No negative impact is expected.

Pinus ponderosa is on the invasive species list provided by IUCN, but not on that of Chile. Moreover, no invasive feature has been observed in existing plantation forest with mature trees.

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

G.1. Documentation on the analysis of the major socio-economic impacts, including impacts outside the project boundary of the proposed A/R CDM project activity:

>>

Socio-economic analysis was conducted through analysis of existing information and results of interviews for 30 persons. The results of interview regarding to effects of the project implementation can be divided into the following four groups.

Small scale farmers and settlers of older age groups

■ Large and medium-size livestock farmers
They consider that this Project is necessary and complementary to their livestock activities, as livestock protection (forest shelter) and erosion control. Moreover they see forestation as a business with good profits in the future.

■ Community Leaders
They are positive about the Project, considering it as a source of labor and income by operating nurseries and plantation, forest management and harvesting.

■ Young people with higher education living in cities of Coyhaique
Company or governmental organization employed person and NGO staff are fell in this group. They tend to point out negative impacts as forestation conducted under this project is not natural and the only positive effect of the project they admitted is air purification.

■ Small farmers
This group includes older aged person who has been working on small scale livestock operation or firewood production for long. They have a positive attitude towards the project as it makes forests burned in the past regenerate. They also expect increases in labor and incomes.

SECTION H. Stakeholders' comments:

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

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Comments from local stakeholders were invited by means of interviews to local officers, organization for agriculture, operador, and landowners, workshops (4 times), seminars (twice), and farmers' workshop.

3.4 Lessons learned and issues remained

A/R CDM project has been successfully formulated for Region XI. Many things were learned from this success and there are still issues for the future.

3.4.1 Cooperation for regional governments and establishment of committees at regional government level

Cooperation for A/R CDM capacity building has been emphasized for central governments in general, and gaps in term of levels of knowledge and awareness between the central government and the regional governments were recognized also in Chile. In case of Region XI, CONAF has a person who studied about A/R CDM in his master degree, and it would be one of the reasons of effective supports of CONAF which was essential for the formulation of the pilot project. However, this situation is not expected in other places. Capacity building for regional government level is required.

To promote formulation of A/R CDM project, continuous supports for project developers should be provided throughout the project life time, particularly in early stage of project formulation. Establishments of regional committees and working group are important to share and update relevant knowledge, to bridge central government and to support project formulation from technical side and administrative side. In case of Region XI, the relevant governmental organizations have their offices in one place, and also the INFOR counterpart kept close contact with them. These conditions, which cannot be expected always, would enable communicate and share common understanding among them, and perform their roles effectively.

3.4.2 Key roles and players

Through this study, the following roles and players have been recognized to be essential for formulation of A/R CDM project.

- Project manager to control schedule, especially in preparation phase,
- CDM/carbon expert to make a project not only approvable but also advantageous with updated knowledge on international trend,
- Lawyer to support making legally rigorous documents,
- Promoter to get understanding and trust from landowners/farmers with various backgrounds,
- Helpdesk in regional CONAF as link to relevant experts and organization including central government,
- Forester to make forestation plan and manage a planted forest.

3.4.3 Difficulty as a leading challenge

This study started when A/R CDM itself was still under development stage, and therefore we faced to many problems which would clarified later by UNFCCC as guidelines, tools and methodologies. At the same time, we also had to follow rapid changes of rules, e.g. PDD format. Now, variety of methodologies, which have been sophisticated through version up, are available and they cover most situations. Although there are still changes in rules, guidelines, tools and methodologies, formulation of project can be realized more efficiently than before in

general. In Chile, moreover, it is expected that the outcomes of this study will promote following project formulations.

3.4.4 Issues to recruiting project participants

Because of current low prices of carbon credits from A/R CDM project, i.e. tCER and lCER, additional benefit from A/R CDM project is not large. It is necessary to add financial benefit by taking into account other ecological services and/or including silvopastral system to bring continuous incomes.

3.4.5 Project scale

Establishment of organization with many members is more difficult than that with fewer members. In case of Region XI pilot project, one of the members left the organization at the final stage of its establishment, and it required additional time for finalization of the establishment. In case new organization is established as a project participant, small organization should be considered. Therefore, in such case, application of program CDM would be an effective way.

4. Region X project

4.1 Overview of the original plan

In 2005 CONAF of Region X started a forestation program for small landowners (5-10 ha) and for farmers who are not registered. The pilot project of Region X is embedded in the National Strategy Study for CDM and corresponds to a type 1 CDM forestation Project (small scale landowners with a low income) and has the following objectives:

- Efficient land-use and recovery of productivity to improve small landowners' quality of life.
- Establishment of high quality timber production model and technology transfer
- Rural poverty reduction by employment and technical training
- Reduction of CO_2 in the atmosphere and income generation through CER sale.

The following table gives a summary of initial plan of the pilot project:

Table 10 Initial plan of Region X pilot project

	Region X
Project area	6000 ha in 4 communes of Osorno, La Unión, San Pablo & San Juan de La Costa (Initial plan)
Landwoners	Small landowners
Implementing authorities	Joint implementation by INFOR, FIA, INDAP & CONAF in progress
Planting tree	*Eucalyptus Nitens*
Management method	Harvesting period 20 years
Implementation system	Institutionalization of small farmers

4.2 Basic concept of the project

During the period from the first to the third mission, basic concept of the project was elaborated as follows.

4.2.1 Basic concept of the pilot project

In the first and the second mission, JICA study team collected information and data necessary for the PDD development and analyzed problems. Many issues concerning institutionalizing farmers, additionality and methodology to be solved for implementation of Region X pilot project were pointed out. So, JICA Study Team conducted a critical analysis shown below at the beginning of this second mission and presented this analysis to Chilean counterparts.

Critical Analysis of Region X Pilot Project

JICA Study Team
14 July, 2006

INFOR provided JICA Study Team with studies made by INFOR on the CDM pilot project in Region X, namely "PROGRAMA DE FORESTACIÓN Y CAPTURA DE CARBONO EN EL MECANISMO DE DESARROLLO LIMPIO (MDL) PARA PEQUEÑOS PROPIETARIOS DE LA REGIÓN DE LOS LAGOS" part I, II and III.

Followings are our observations based on the field surveys carried out during our first mission and careful examination of the above studies.

1. Organization

- ✓ The total superficies of the pilot project is planned to be 6,000ha based on the INFOR study[4]. If we assume 3ha per each household according to the past statistics for CONAF-INDAP program in Region X, 6,000ha means 2,000 households to be organized as one project. If we assume 15 ha per household, ceiling for 90% subsidy and very challenging target, 6,000ha means 400 households. On the other hand, the past experience of the INDAP shows the maximum number of households organized as a legal entity was 30 to 50. This suggests organizing 2,000 or 400 households is not a realistic option. In addition, according to the INDAP headquarters, organizing people spreading into different communes and including indigenous people is a difficult task based on their past experiences.

2. Additionality

- ✓ In order to demonstrate additionality, the pilot project should not include those areas where the CONAF-INDAP program will be likely to be applied without additional incentive provided by CDM. It seems to be difficult to distinguish those areas from the eligible land for CDM.

[4] Section 2.2.2 "PROGRAMA DE FORESTACIÓN Y CAPTURA DE CARBONO EN EL MECANISMO DE DESARROLLO LIMPIO (MDL) PARA PEQUEÑOS PROPIETARIOS DE LA REGIÓN DE LOS LAGOS PART I" INDAP, CONAF, INFOR

3. Methodology and Leakage

- ✓ INFOR has tried to develop a new methodology in which historical rate of forestation is assumed to be a baseline carbon sequestration[5]. Since this concept is quite new compared with the approved methodologies, it is likely to take a long time for the methodology to be approved by the CDM EB.
- ✓ Even if we assume to apply the approved methodology, it is uncertain to be able to apply ARAM0001 and ARAM0002 to the pilot project in Region X due to the possible leakage from cattle grazing activities. In the meantime, if approved methodology ARAM0003 is to be applied in order to take into account the leakages from cattle grazing, it will require a lot of work for monitoring and the monitoring cost will likely to become very high which leads to the pilot project economically unfeasible.
- ✓ It might be difficult to say the pilot project area is degraded land. If it is the case, soil organic carbon pool should be taken into account and the baseline should be monitored.

4. Others

- ✓ Some of the potential lands have not been properly registered to the authority and the proper land title has not been given to the land owners. Without proper land title, it is difficult to develop a CDM project.

5. Future course of actions

- ✓ Given this scenario for the Region X, it is recommended by the JICA Study Team to further analyze possible course of actions regarding the CDM pilot project for this region.
- ✓ It is also recommended that possible course of actions be analyzed by the Workshop in Region X and Steering Committee meeting which are scheduled to be organized during the JICA Study Team's current second mission (from July 3rd to August 3rd, 2006).

END

Chilean counterpart decided to make the pilot project small scale A/R CDM project based on the critical analysis. The outline of the project is as follows.

Participant farmers : 30～50 households
Forestation area : Approx. 120 ha
Methodology : small scale AR/CDM（AR-AMS0001）

[5] MECANISMO DE DESARROLLO LIMPIO PROPUESTA DE NUEVA METODOLOGIA PARA ACTIVIDADES DE FORESTACION/REFORESTACION: LINEA DE BASE (MDL- F/R-NMB) "PROGRAMA DE FORESTACIÓN Y CAPTURA DE CARBONO EN EL MECANISMO DE DESARROLLO LIMPIO (MDL) PARA PEQUEÑOS PROPIETARIOS DE LA REGIÓN DE LOS LAGOS PART III" INDAP, CONAF, INFOR

4.2.2 Relevant organizations and their roles

To plan and implement AR CDM projects, active participation and cooperation of relevant organization are essential, since the projects have diverse aspects and various influences in local and national level.

The expected roles of the relevant organizations in Region X pilot project are shown in Figure 12.

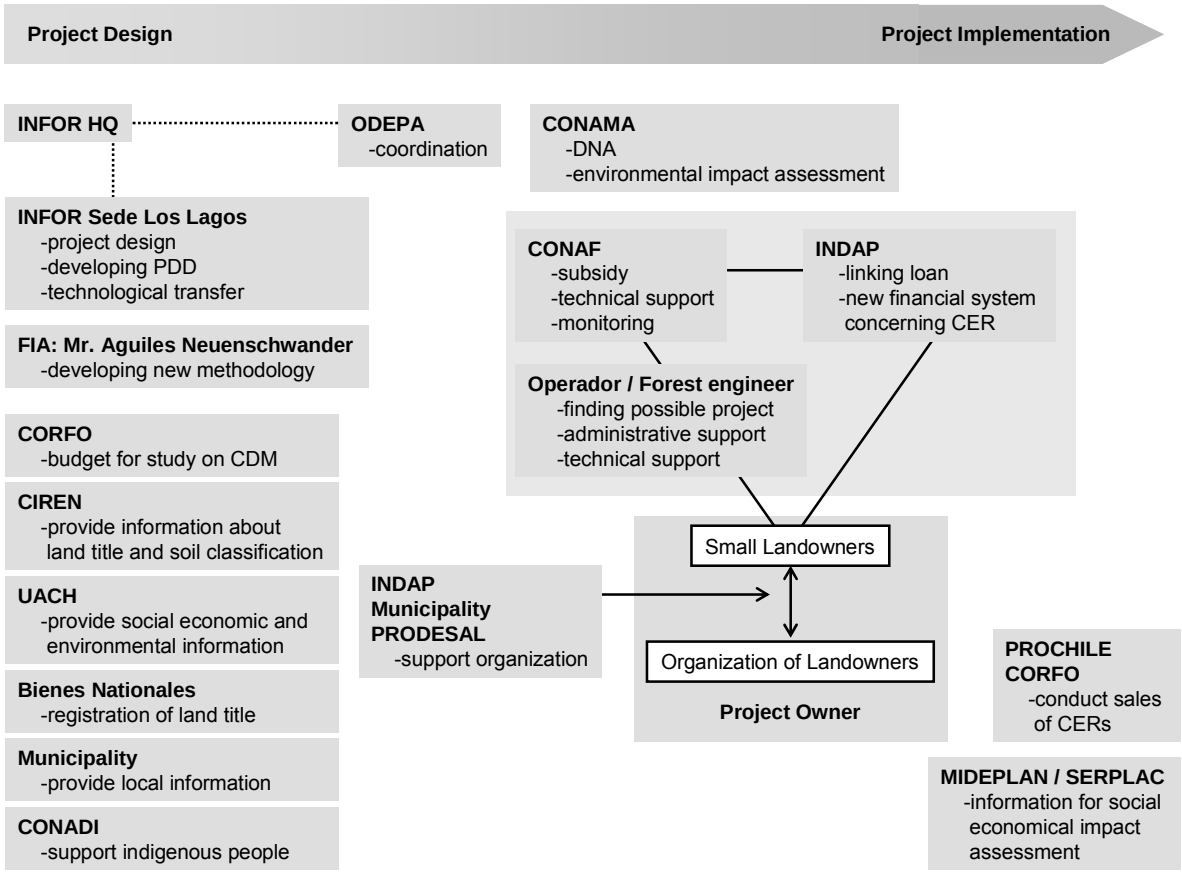


Figure 12 Roles of relevant organizations in Region X

4.2.3 Selection of eligible land

In the meantime, JICA Study Team contracted out a land eligibility study. According to this study, 29.2% of the total study area 624,000 ha, which is 153,000 ha, is appeared to be an eligible land for A/R CDM project (see Appendix 5 for detail)

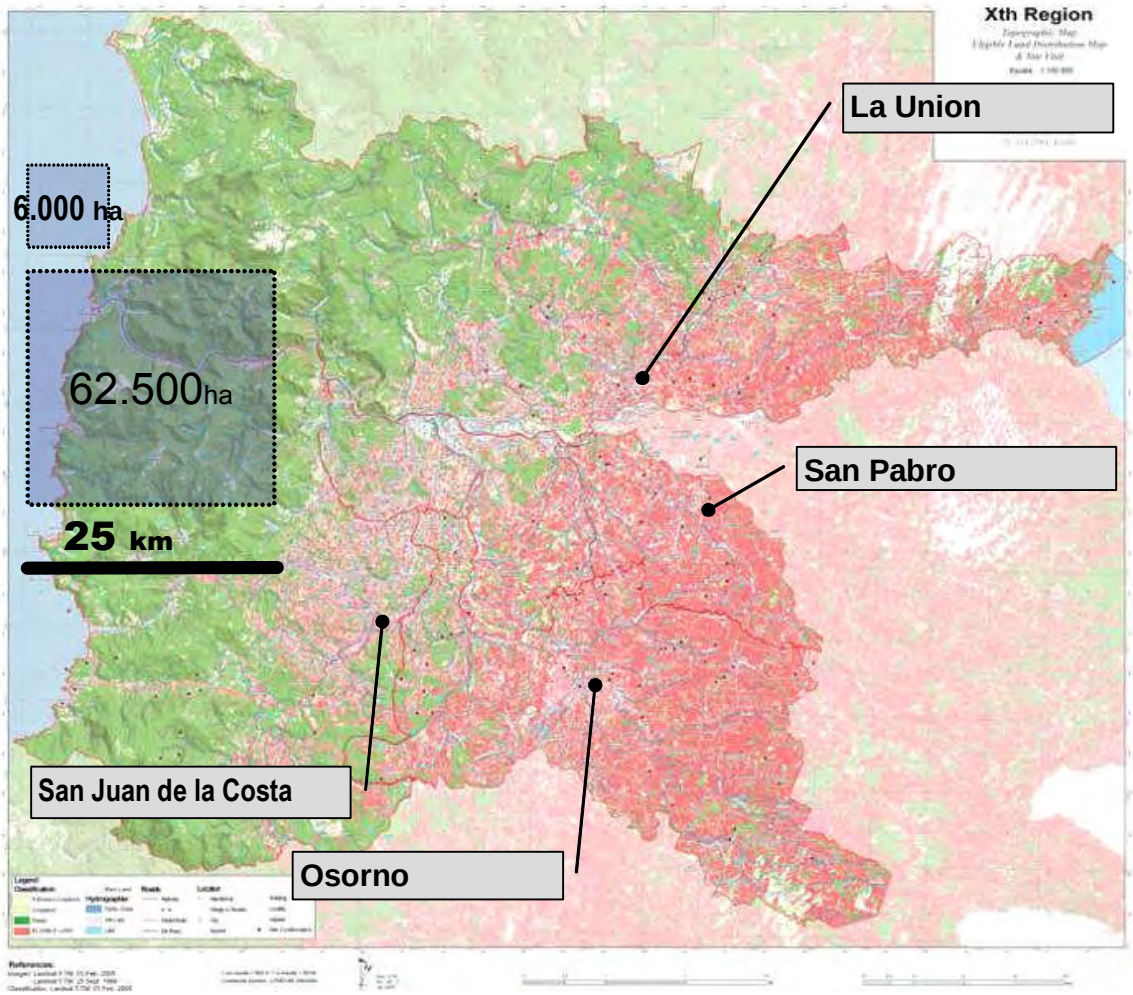


Figure 13 Distribution of eligible land in Region X

4.2.4 Selection of species and estimation of carbon sequestration

During the first and the third mission, JICA Study Team selected *Eucalyptus Nitens* as plantation species based on the discussion with C/P and also collected information and data regarding seedling production, plantation technology, forest management method, cost etc. (see Appendix 4 for more detail). Based on these data, JICA Study Team estimated the amount of carbon sequestration by this pilot project.

4.2.5 Consideration on major items of PDD

Considerations on major items of PDD were conducted prior to critical analysis. The results of considerations are as below.

1) Defining the boundary/selection of project site

The project area has to fulfill the required conditions to be an AR CDM project and a CONAF-INDAP program. The following steps 1 to 5 must be examined with reliable data in the process of drawing the project boundary. Step 6 is strategy of the project to decrease conflict between land uses by eliminating productive or unsuitable land for forestation. In addition, step 7, which concerns poverty level, may be used for selecting participants among candidates by mean of defining priorities of landowners to receive benefit from CDM implementation. The information obtained, possible sources, and / or remaining issues are shown in boxes.

Step 1. *Land was not forested on 31 December 1989 and is not at the moment the project starts. This step is part of "Procedures to define the eligibility of lands for afforestation and reforestation project activities" required in PDD (EB 22).*

Step 2. *Land was not forested on 1974. This is one of the conditions to obtain CONAF subsidy defined in the law 701.*

Step 3. *Land area owned by the landowner is less than 12 hectares with basic irrigation. It is the definition of small farmer by the Law No.701 and a part of definition of a small landowner and a small-scale agricultural producer by CONAF and INDAP, respectively. In the case of Region X, owners less than 200 ha are applicable.*

Step 4. *Soil condition (Superficie por capacidad de uso) is classified as class V, VI, or VII which is characterized as unsuitable soil for cultivation and preferable soil for forestation. This is requirement for CONAF subsidy.*

In Estudio tecnico de calification de terrenos de aptidud preferentemente forestal, it is required to show the land subject for application of subsidy is classified as the preferable soil for forestations. CIREN, Natural Resources Information Center, provides the soil classification data. In case the applicants want to change the classification, they need to show the evidences, such as soil depth, content of rocks, and slope of land.

Step 5. *Landowners have registered land titles. They have to show descriptions of their land titles in Estudio tecnico de calification de terrenos de aptidud preferentemente forestal. This is not only for CONAF-INDAP forestation program but also essential to realize the pilot project.*

The database of land titles may be recently updated and managed in CIREN. Further information will be collected in the following missions.

Step 6. *Slope of land is greater than 15% and less than 60%. Both low gradient land with high productivity and high gradient land difficult to forest are excluded through this step.*

Step 7. *Landowners do not have property greater than the equivalent of 3.500 UF, and earn income mainly from agricultural activities on their land. This is part of definition of a small-scale agricultural producer by INDAP Organization Law 18.910.*

INDAP has their own database but for internal use only. They suggested us to give them a list of candidates for participating landowners and ask them to make a comparison between their database and the list to check whether these candidates can fulfill the conditions for INDAP loan. Further information and discussion will be needed for seeking an efficient way.

Step 8. Poverty level of a landowner is severe. As mentioned above, this step may be added for the sake of defining priority for the selection of participants.

Step 9. Landowners agree to make organization and to formulate AR CDM project.

Ficha CAS2 / familia used in prioritization of subsidy provision may be useful.

2) Additionality

To identify barriers that would prevent the implementation of the type of proposed project activity, first, we listed possible barriers, and next we looked for existing mechanisms which possibly overcome these barriers. If there are already sufficient mechanisms, this type of project will be implemented without CDM registration. This process was taken, because Chilean government has intensive and problem-oriented programs to promote and support forestations.

a. Investment barriers
   - Small landowners may not have access to market of forestry products, and not shift their land use for forestation, though they can use loan and subsidy from INDAP and CONAF, respectively, for investment for forestation.

INDAP has technical assistant program that support small farmers to make good accesses to markets, but in many cases it does not cover forestry sector.

b. Market risks
   - Fluctuation of market prices of timber products will be critical for the small scale land owners who do not have savings, and need continuous income.

c. Technological barriers
   - Access to high quality seedlings might be limited for small land owners.

d. Barriers due to prevailing practice
   - Traditional land uses of small land owners are not forestation, and their knowledge for forestation, such as knowledge about higher value timber products other than fuel wood, is lacking.

At this moment, the only organization which has program to promote forestation is CONAF. CONAF is carrying out forestation campaign using various means, for example, radio programs or news papers. PRODESAL is also possible organization for this purpose, if land use change for forest plantation is beneficial for farmers. When CDM project's benefit is proven, PRODESAL forestation activity will be scaled up and consecuentively positive effects of CDM registration may prevail.

e. Barriers due to local ecological conditions

- The soil has been degraded by intensive agricultural activity.

Evidences to support the soil degradation in the pilot project areas have not been found until now. Study made by municipality to make Plan of Community Development, PLADECO, may provide the useful information. Also, university may have such information. These sources will be checked.

- Damages from unfavorable climate events, such as frost, or forest fires may be significantly decrease income from yield.

Recently, INDAP requires to their clients to buy private insurance covering such accidents, and it works quite well. In addition, the degree of decrease of income when compensated by insurance should be studied via collecting detailed information on actual compensation amounts.

f. Barriers due to social conditions

- Well-qualified labors are lacking.

As required by CONAF, operators give technical training for small landowners who receive subsidy. In general, the program consists of a half-day lecture about plantation and management techniques and one-day field trip for planting forest. Also, CONAF visits these landowners regularly to check their activities and give technical support for them (CONAF Valdivia). These technical supports need to be verified their effects. Especially in producing new high quality timers, technical supports are essential through the project period.

- Organization of landowners is limited in family-scale. In case organization should include different groups, such as indigenous peoples, who are common in this region, this process may be especially difficult.

- Pension system is not sufficient, and the small landowners need to earn continuous incomes. Since land use changes for forestation can accompany decreases in area of agricultural land, it is difficult for people needing continuous incomes to start forestation which requires long years until first harvesting.

g. Barriers relating land tenure, ownership, inheritance, and property rights

- Database of present ownership of land titles is not updated after dividing process of inheritance.

To divide their land title, as in case of inheritance to several sons, two steps have to be taken: registration and defining borders. The latter one is expensive process, and therefore whole registration processes have not been completed often. According to an operador in La Union, this is still big problem. Status of land registration needs to be checked with the latest database available

- Farmers without land titles may not apply for the land registration because of illiteracy and / or lack of support.

During 1992 – 1998, Chilean government had massive campaign to promote registration of land titles. The government gave financial support for making

technical report needed for the registration, and landowners obtained land titles freely during that period. After this campaign, landowners now have to apply a subsidy for preparing the technical report. Since this period was big chance to obtain land titles, peoples who still do not have land titles may have some reasons, and it may be a possible barrier. Detailed information about land title and its registration will be asked to Bienes Nationales. Nowadays, farmers are provided a subsidy and register their land.

As shown above, some of assumed barriers may be overcome with the existing mechanisms, though we need further survey and analysis. The remaining barriers are market risks, problems in land title, difficulty in making organization, and conflict between land uses.

4.2.6 Economic analysis

1) Basic assumptions

Type of credit and price

Carbon credit market has been rapidly growing and the price of credits by CDM projects (CERs) also has been rising. According to WB report[6], CER price in 2005 was 4 – 24 USD per 1ton with average of 8 USD. On the contrary, few information is available about credits by A/R CDM projects, which are tCER and lCER. In reality, WB BioCarbon Fund has been the only buyer[7] who bought them and the price at which WB BioCarbon Fund had bought is the only price index for now. Theoretically, tCER equals 14 -38% of CER price value and lCER, with lesser risk than tCER can be expected to sell at almost same price as CER[8].

Based on such information, the implementing committee held prior to the third mission decided to use tCER for the economic analysis. And the price is assumed as following table[9].

Table 11 Assumption of tCER price (USD/ tCO_2e)

	negative scenario (Low)	average scenario (Average)	positive scenario (High)
tCER	3	4	5

Credit period

There are two types of credit period that is 20-years maximum and can be extended up to twice (i.e. 60 years maximum) and 30 years with no extension available. The latter was used for this analysis as it had less risk concerning baseline revision.

Transaction costs

Project participants need to pay transaction costs of CDM project. These include

[6] STATE AND TRENDS OF THE CARBON MARKET 2006, The World Bank
[7] "Sourcebook for land use, land-use change and forestry projects", the World Bank
[8] "Value and Risks of Expiring Carbon Credits from CDM Afforestation and Reforestation", Mickael Dutschke et.al.
[9] We assume that replacement of these temporally credits will be under the buyers' responsibility.

validation cost to DOE and UNFCCC, registration cost, verification cost and certification cost. The following assumptions were used in the economic analysis for costs that would be managed by project participants.

Table 12 Assumption of transaction costs

	USD/project
Validation	20,000
Registration	5,000
Monitoring	1,761
Verification	15,000

Costs and income for forestation and forest management

Costs and income of forestation and subsequent forest management were assumed as follows based on studies conducted by INFOR.

Table 13 Forestation cost and income

cost		income	
	USD/ha		USDm3
preparation and plantation	693	pulp	22
technical advice	56	timber	37
maintenance	34	high quality timber	65
harvesting/ transpotation	17		
pruning	77		
trimming	17		

Discount Rate

Discount rate was set at 8.5% by the steering committee's decision.

2) Result of economic analysis

Results of the economic analysis conducted based on the previous assumption for Region X are as follows. The standard case (tCER/ton=4 USD) increased to16.8% with CDM comparing 15.4% without CDM. Low price case (3 USD) was 15.8% and high price case (5 USD) was 17.6%.

Table 14 Results of financial analysis

tCER/ton	with CDM			without CDM
	3 USD	standard case 4 USD	5 USD	
IRR	15.8%	16.8%	17.6%	15.4%
B/C	140%	146%	153%	132%
NPV	254,230	295,923	337,617	187.132

4.3 Formulation of pilot project

Based on the aforementioned basic examination, JICA Study Team started to identify project site as well as project participants from the forth mission.

4.3.1 Project site and participants

At the forth mission, JICA study team actively supported INFO and held workshops for recruiting project participants. As a result of these workshops, the following three communities were identified as possible participants.

- Native community of San Juan de la Costa（recommended by Mr. Miguel Leal, PRODESAL in Osorno）
- Community of Quilacahuin, Mission de la Costa and Cuinco where Fundación Mission de la Costa of Osorno operates
- Native community of Puaucho

Farmers showed many concerns about Eucalyptus plantation and it became clear that prospects of Eucalyptus plantation including its market value in the future should be explained in a clear manner in order to gain consensus from farmers and stakeholder organizations.

Subsequently, Mr. Enrique and Mr. Louis and other INFOR staff conducted small workshop and home visits from July to October 2007 for recruiting participants.

At the end of October, the number of participants was 18 households, approx. 40ha. These participating farmers were classified in the following three groups according to their degree of agreements.

(1) Farmers who gave consent in writing to join the project and identified the area for the project
   - 10 farmers/15ha

(2) Farmers who gave consent in writing to join the project but not identified the area for the project
   - 3 farmers（One of them is " San Pablo Mission in Quilacahuin," where JICA team held a workshop in the previous mission. They plan to offer 10ha. The other farmers are also related to the mission but not identified area）

(3) Farmers who agreed to join the project by oral consent.
   - 5 farmers (not identified the land yet)

Considering the progress of the recruitment, Steering Committee in October 24 in 2007 made the following decisions.

- Continuation of the pilot project of the 10th province
- Reassessment of the following issues
  - Feasibility on plantation of non eucalyptus species
  - Applicability of program CDM
  - Possibility of the support (including budget) from government institutions concerned

Following the decision of S/C, JICA team decided to continuously support INFOR toward the implementation of pilot project of the 10th province.

4.3.2 Re-selection of species

Major impediment to the recruitment of participants is the monoculture plantation of *eucalyptus nitens*. Many participants expressed some concerns about the market uncertainty and environmental impact of *eucalyptus nitens*. Farmers prefer to plant the following species.

- Native species : environmental protection
- Castagno: continuous revenues
- *Radiata pine* : stable market

According to INFOR, the plantation of native species is difficult because it grows very slow and they only have very limited growth data. Meanwhile, INFOR has some growth data for Castagno so that it can be included. *Radiata pine* is identified a disease outbreak, so government decision is required.

JICA team shared common perceptions with Chilean counterparts that it is quite important to have flexibility of selecting species. However, it requires fundamental revisions of the project plan. JICA team agreed with INFOR that the practical option is that *Eucalyptus nitens* remains to be major species for the plantation but Radiata pine and Castagno can be also included depending on farmers' needs. And INFOR continues to assess the feasibility study for plantation of native species such as two step plantation.

4.3.3 Applicability of Program CDM

Prior to the 5th mission, JICA Outside Experts Assistance Committee was held on August 24th 2007. During the committee, one committee member recommended to consider applying a program CDM to the pilot project of the 10th province. In addition, during the INFOR workshop in Santiago, the idea of a program CDM was introduced in the presentation, and INFOR Director Ms.Martha and other members expressed their interest in the idea. During the meeting with CONAMA, it also mentioned that Chilean government has intention to support to apply program CDM to the pilot project of the 10th province.

The following is the summary of the critical analysis.

<Advantage>
- In program CDM, it is allowed that project developers can request for the registration of programme of activities (PoA) if they identifies at least one CDM program activity (CPA). This gives the flexibility for the schedule.
- Project sites can be located in an extended region such as a whole province under one PoA. This gives possibility to conduct PoA as a continuous program by government and thus reduce transaction cost.

<Disadvantage>
- As of now there is no example of program CDM applying to AR/CDM. This requires more time to prepare documents.

4.3.4 Subsequent situation

Subsequently, at the end of 2007, Region X INDAP secured some budget for recruiting more project participant for January to March 2008 in order to solve the problem that number of participants was not sufficient. However, it was reported from the Chilean counterpart at the Steering Committee on February 29th, 2008 that a serious drought had happened in the north of Chile and there had been no rain since last September in Region X and land owners were quite negative for forestation activities which makes it very difficult to convince them to participate to the pilot project. With this situation, it was agreed at the steering committee to suspend Region X pilot project and Chilean counterpart will continue the project after JICA's cooperation. It was also decided that this conclusion will be informed to Japanese side through ODEPA, Chilean official focal point.

4.4 Lessons learned and issues remained

Regarding Region X, the result, unfortunately, has turned out not in a way that we had expected. Although all required preparation for the pilot project formation had been in place, sufficient commitments from project participants were not gained. Two purposes of CDM are to prevent global warming and to develop developing countries in sustainable way. A/R CDM, especially small scale one, among other CDM project types, has a potential to mitigate poverty around native citizens and small farmers. Therefore the World Bank's BioCarbon Fund has been active in supporting these projects.

Meanwhile, A/R CDM project bears some disadvantages. Its credit is cheaper than the one of standard CDM project and timber prices are generally hard to precisely predict in advance. Small scale A/R CDM also has negative features that its benefits are likely to be too small to cover transaction costs for validation etc. although it requires simpler methodology and no efforts to organize many project participants.

Native citizens and small farmers are the most vulnerable people against risks of long-term investment. So it might be very difficult for them to bear multiple risks of A/R CDM project's uncertainty. This foreseen burden is considered to be the biggest reason that prevented all of us from realizing the pilot project in Region X.

To utilize A/R CDM project for true benefits of natives and small farmers, we believe it is essential to introduce certain mechanism under which governmental agencies including INDAP and CONAF, on behalf of them, bear risks of project formation/realization.

5. Capacity building through this project

5.1 Workshops and seminars

5.1.1 Workshops

Many workshops were held during the project period. The purposes of these workshops were to share knowledge of A/R CDM and outlines of each pilot projects with counterpart organizations' staff and to enhance multiplied effects of works conducted under the project. 12 workshops in total were held during the period from the first mission to the fifth mission.

■First Mission

(1) First Workshop

During the first mission, JICA study team and INFOR co-held the first workshops in Santiago, Valdivia and Coyhaique.

Table 15 Summary of 1st workshop

City	Santiago	Valdivia	Coyhaique
Date	9:00-13:00 Mar. 3, 2006	9:00-13:00 Mar. 7, 2006	9:00-13:00 Mar. 17, 2006
Presentation	• Current status of CDM and A/R CDM(JICA study team) • Approval process of CDM project and current status of CDM project development in Chile (CONAMA) • Outline of A/R CDM project development in Chile (INFOR) • Outline of the Development Study (JICA study team)	• Current status of CDM and A/R CDM(JICA study team) • Approval process of CDM project and current status of CDM project development in Chile (CONAMA) • Outline of A/R CDM project development in Chile (INFOR) • Outline of the Development Study (JICA study team)	• Current status of CDM and A/R CDM(JICA study team) • Approval process of CDM project and current status of CDM project development in Chile (CONAMA) • Outline of A/R CDM project development in Chile (INFOR) • Outline of the Development Study (JICA study team)

(2) Second workshop

Second workshops were held in Santiago, Valdivia and Coyhaique by JICA study team and INFOR.

Table 16 Summary of workshop

City	Santiago	Valdivia	Coyhaique
Date	10:00-13:00 Apr. 5, 2006	9:00-13:00 Mar. 29, 2006	9:00-13:00 Apr. 3, 2006
Presentation	• Visions and efforts toward A/R CDM in Chile (INFOR) • Land eligibility for A/R CDM project (JICA	• Visions and efforts toward A/R CDM in Chile (INFOR) • Land eligibility for A/R CDM project (JICA	• Visions and efforts toward A/R CDM in Chile (INFOR) • Land eligibility for A/R CDM project (JICA

City	Santiago	Valdivia	Coyhaique
	Study team) • Existing mechanism regarding socio-economic impacts of A/R CDM project (INFOR)	Study team) • Possible participants and their institutionalization for A/R CDM project (INDAP) • Existing mechanism regarding socio-economic impacts of A/R CDM project (INFOR)	Study team) • Regional development plan (SERPLAC) • Existing mechanism regarding socio-economic impacts of A/R CDM project (INFOR)

■Second Mission

JICA study team and INFOR held seminars in Santiago, Valdivia and Coyhaique as follows during the second mission.

Table 17 Summary of workshop

City	Santiago	Valdivia	Coyhaique
Date	15:00-16:00 Aug. 2, 2006	10:00-13:00 Jul. 25, 2006	10:00-13:00 Jul. 28, 2006
Presentation	• Methodology to be applied • Forest Management • Carbon sink estimates • Possible project sites and additionality • Institutionalization of farmers	• Land eligibility • Forest Management • Carbon sink estimates • Possible project sites and additionality • Institutionalization of farmers	• Methodology to be applied • Forest Management • Carbon sink estimates • Possible project sites and additionality • Institutionalization of farmers

■Third Mission

During the third mission the implementing committee decided not to hold a seminar in Region X as well as workshops, so JICA study team co-held with INFOR seminars in Santiago and Coyhaique.

Table 18 Summary of seminars

City	Santiago	Valdivia	Coyhaique
Date	9:00-12:00 Dec. 19, 2006	None	9:00-12:00 Dec. 7, 2006
Presentation	• Results of land eligibility study • Results of pilot projects' economic analysis • Steps toward	None	• Results of land eligibility study • Results of pilot projects' economic analysis • Steps toward

■Fifth Mission

During the fifth mission, on Oct. 1, 2007, A workshop was held in Region X with the participation of two experts from Uruguay. Current status of Xth pilot project, especially regarding participant farmers and project candidate sites were shared and discussed in this workshop.

5.1.2 Seminars

Many seminars were held during the project period. These seminars placed their focuses on sharing the latest information of A/R CDM with forest engineers, academics, government officials and NGOs as well as counterparts' staff and enhancing multiplied effects of works conducted under the project. Eight seminars in total were held during the period from the second mission to the seventh mission.

■Second Mission

Apart from the workshop, JICA study team and INFOR held seminars in Santiago, Valdivia and Coyhaique as follows during the second mission.

Table 19 Summary of seminars

City	Santiago	Valdivia	Coyhaique
Date	9:30-13:00 Aug. 1, 2006	15:00-17:00 Jul. 25, 2006	15:00-18:00 Jul. 28, 2006
Presentation	• Current status of CDM • Case study: A/R CDM project in Madagascar • Outlines of approved methodologies and PDDs • Prospective for pilot project development	• Current status of CDM • Case study: A/R CDM project in Madagascar • Outlines of approved methodologies and PDDs • About environmental service project	• Current status of CDM • Case study: A/R CDM project in Madagascar • Outlines of approved methodologies and PDDs • About environmental service project

■Third Mission

During the third mission the implementing committee decided not to hold a seminar in Region X as well as workshops, so JICA study team co-held with INFOR workshops in Santiago and Coyhaique.

Table 20 Summary of seminars

City	Santiago	Valdivia	Coyhaique
Date	12:30-13:30 Dec. 19, 2006	None	12:30-13:30 Dec. 7, 2006
Presentation	• Current status of Carbon market and emission trading • Current status of CDM and A/R CDM	None	• Current status of Carbon market and emission trading • Current status of CDM and A/R CDM

■ Seventh mission

The final seminars for the project were held on March 2009 in Santiago and Coyhaique.

Figure 14 Picture taken at Workshops and Seminars

5.1.3 Farmers Workshop

In addition to workshops and seminars mentioned above, farmers workshops were held in the course of the project. These farmers workshops were for farmers who were potential participants of the pilot projects and offered explanations of project outlines in order to call for their participation to the projects. In the third mission and the fourth mission, several farmers workshops were held both in Region X and Region XI.

■Third Mission

During the third mission, the first workshop for farmers in Region XI was held. CONAF/ODEPA Counterparts also participated in this workshop from Santiago.

Table 21 Summary of farmers workshop

City	Santiago	Valdivia	Coyhaique
Date	None	None	9:00-13:00 Dec. 14, 2006
Presentation	None	None	• JICA study and Japanese Cooperation • Kyoto Mechanism, CDM and Carbon market • Pilot project in Coyhaique • Costs, benefits and duties of participants

■Forth mission

The following two farmers workshops were held in Region X during the fourth mission.

Table 22 Summary of farmers workshop

City	Santiago	Valdivia	Coyhaique
Date	None	May 31, 2007（San Juan de La Costa） June 8, 2007（Quilacahuin）	None
Presentation	None	• Basic concept of the pilot project	None

(1) San Juan de la Costa

In San Juan de la Costa the first farmers workshop was held on May 31, 2007, coordinated by Mr. Miguel Leal from PRODESAL Osorno. In this workshop 16 farmers, all of them members of indigenous communities of San Juan de la Costa, participated. Approximately half of them were community leaders.

Mr. Enrique Villalobos of INFOR made a presentation explaining the basic idea of the Project, Mr. Richard Hueitra, forestry engineer of CONAF, and Mrs. Javiera Vargas, forestry engineer of INDAP, also gave additional explanations of the project, demonstrating the close cooperation between CONAF & INDAP, INFOR and the JICA Team.

Many participants expressed their concerns about the uncertain market for *eucalyptus nitens*, mainly for two reasons. First, plantations of *eucalyptus nitens* are not common in the area, so there is limited experience and farmers are skeptical. Second, the current market for *eucalyptus nitens* is rather unfavorable. This part of Region X is far away from the pulp industry, which is mainly located in Regions VII & VIII, and the price for *eucalyptus nitens* as pulp wood is low in this area, so farmers sell *eucalyptus nitens* as firewood rather than pulp wood. Moreover the Project considers the production and commercialization of *eucalyptus nitens* as

high quality timber, for which there is no market at the moment.

However, after thorough explanations and favorable comments from CONAF & INDAP, the participants showed certain interests on the project at the end of this workshop.

(2) Quilacahuín

The workshop in Quilacahuín was held on June 8, 2007 by coordination of INFOR, CONAF & INDAP. 17 farmers participated, all of them parents of students of the school run by the Foundation of the Missions. Last-year students (equivalent to Japanese high school 3rd grades) and teachers were also present in the workshop, adding up to 60 participants altogether.

Same as the previous workshop, Enrique Villalobos of INFOR made a presentation explaining the basic idea of the project. Richard Hueitra, forestry engineer of CONAF, and Javiera Vargas, forestry engineer of INDAP, also gave additional explanations of the project, thus manifesting the close cooperation between CONAF, INDAP, INFOR & JICA.

Just like in the workshop in San Juan de la Costa the participants expressed their concerns about the lack of market for high quality timber from *eucalyptus nitens* at the discussion held after the workshop. Several farmers fear a negative impact of eucalyptus onto water resource and biodiversity. In CDM project implementation, decisions should be made with consideration of these concerns. Other topics including issues of operators and land ownership were discussed.

at Quilacahuín

CP explaining pilot project

Figure 15 Picture taken at farmers workshops

5.2 Steering Committee and Project Implementing Committee

Under this development study, the steering committee and the project implementing committee were repeatedly held (see Annex 1). Both committees were main decision-making bodies for the study and, at a same time, became places at where projects results were shared among major Chilean counterpart organizations.

Table 23 Records of steering committee

Date	City	Major agenda
March 2, 2006	Santiago	- about Inception Report
April 6, 2006	Santiago	- about Progress Report (1)
August 2, 2006	Santiago	- about Progress Report (2)
December 18, 2007	Santiago	- about the third mission
June 1, 2007	Santiago	- about Interim report - about Joint implementation plan for the third year - about the status of pilot projects in Region X and Region XI
October 24, 2007	Santiago	- about the status of pilot projects in Region X and Region XI
February 29, 2008	Santiago	- about Progress Report (4)
June 24, 2008	Santiago	- about Joint implementation plan for the fourth year - about the status of pilot projects in Region X and Region XI

Table 24 Records of project implementation committee

Date	City	Major agenda
March 2, 2006	Santiago	- about Joint implementation plan for the first year
July 4, 2006	Santiago	- about Joint implementation plan for the second year
November 27, 2006	Santiago	- about premises for economic analysis and its results

5.3 In-Japan Training

Two staffs from Chilean counterpart organizations were invited and received In-Japan training on A/R CDM from October 30 to November 10. The “Training Course on Study for Capacity Development and Promotion of A/R CDM in the Republic of Chile”, arranged by the JICA study team, offered series of lectures regarding A/R CDM: their topics covered climate change policies, understandings of A/R CDM and actual project examples.

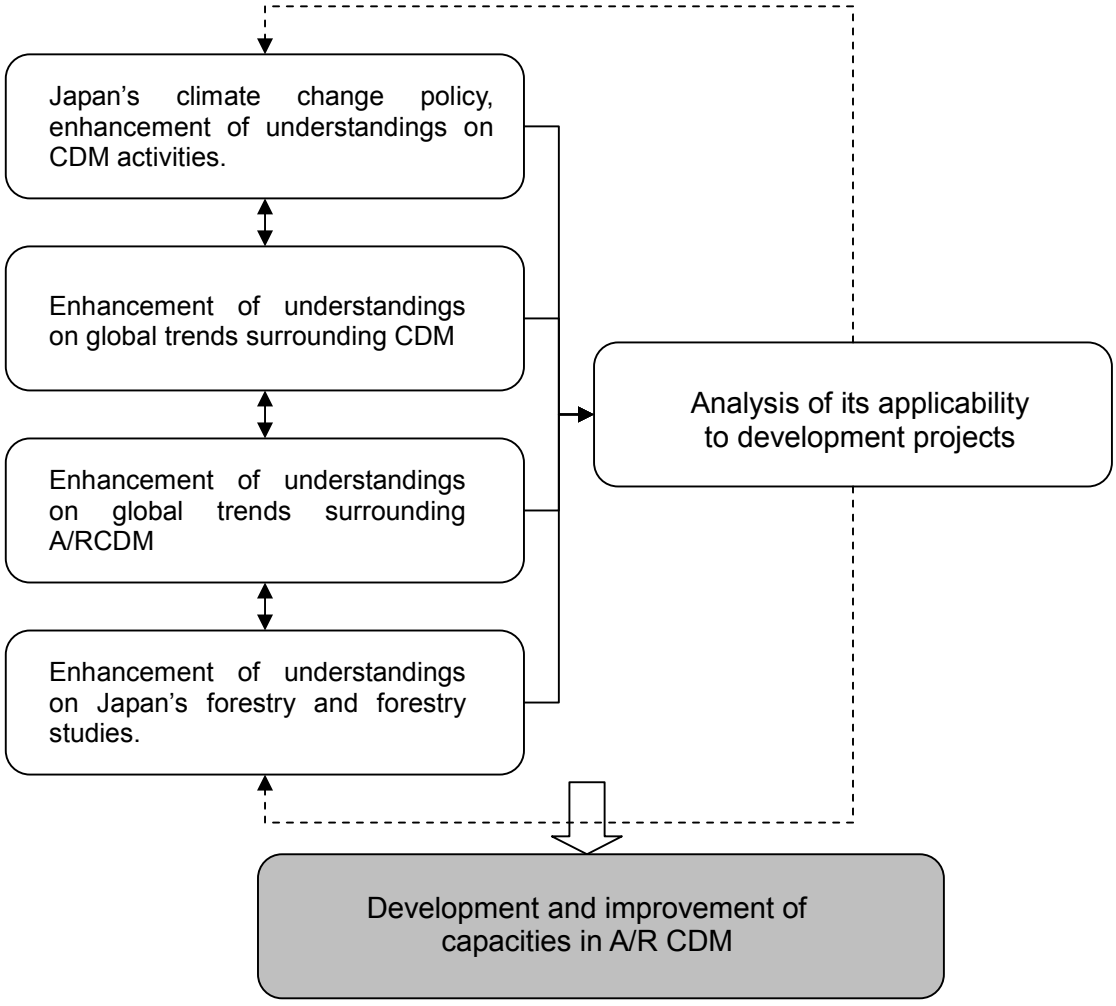


Figure 16 In-Japan Training schematic diagram

5.4 Website

As a part of the Project activity, we established, with INFOR Valdivia's cooperation, a website to disseminate the pilot projects information to as many as possible credit buyers. Manual section also had been revised and updated during the work period.

URL : http://www.infor.cl/AR-CDM-project/

Figure 17 Website

5.5 Manual[10]

5.5.1 Purpose of preparation and its policy

An A/R CDM manual has been made based on the results and experiences of the project. This manual assumes individuals or organizations have intentions to plan/implement A/R CDM in Chile as leaders and helps their understandings, even if they don't have enough knowledge, by offering beneficial information for such project planning/implementation. As many CDM references including manuals and guidebooks have been published so far by international organizations, private institutions and several nations, this manual follows a policy that focuses information required for A/R CDM implementation in Chile and general discussion regarding CDM or A/R CDM is minimized as possible. The results of the pilot project are mainly based on the Xth pilot project as Xth pilot project had not been realized in the project period. However, some consideration are paid to reflect encountered problems, issues and perspectives for feasible solutions in order to also utilize this negative experience for future project planning/implementation. The manual were made jointly by JICA study team and Chilean counterparts with the support and advices of Mr. Jose Eduardo Sanhueza, the first chairman of UNFCCC A/R CDM working group.

5.5.2 Contents

The manual is divided into two parts; the first part consists of generation information on A/R CDM and the second part consists of information and data required to implement A/R CDM project in Chile. The second part especially contains useful guidance for future A/R CDM project planning/formation in Chile by reflecting knowledge and experience obtained from the pilot projects in Region X and Region XI by JICA study team and Chilean counterparts. Contents of each chapters of Part I and Part II are summarized below.

(1) Part I General information

Part I includes the background of Kyoto Protocol, progress of international negotiation and basic information on Kyoto Mechanism(flexible mechanism) including CDM in order to offer general information regarding A/R CDM. Chapter 1, placed after the preface, summarizes social/economic/ecological effects caused by climate change issues by referring IPCC assessment report 's climate change forecasts. Outline of UNFCCC, the secretariat for United Nations Framework Convention on Climate Change, is also described with the history of 1997's Kyoto Protocol adaptation. In addition, emission trading and joint implementation (JI) as Kyoto Mechanism (flexible mechanism) and how to handle forest as carbon sinks' under Clean Development Mechanism (CDM) and Kyoto Protocol are explained.

Chapter 2 describes each steps required for project formation as well as summarizing CDM position and conditions under Kyoto Protocol to offer basic knowledge of CDM. In chapter 3, which focuses on A/R CDM, clarification of types of forestry eligible for CDM and explanation of carbon pool that can be a subject for carbon credits are available. In addition, as elements needed for A/R CDM project design, project participants, eligibility, additionality, social/economic effect etc. are summarized with considerations to PDD contents. Also,

[10] See appendix 6

accounting of carbon credits (tCER/lCER) obligation of compensation are explained and accompanied by the list of approved methodology including consolidated ones. Approved methodology, only one up to now, is mentioned in the end of this chapter. As Part II includes detailed information for A/R CDM project design to implementation with the pilot projects' experiences, information written in this chapter covers only general information required as basic knowledge. Chapter 4, the last chapter of Part I, takes up carbon credit market. CDM projects are implemented under the Kyoto Protocol and credits are issued for the compliance to achieve quantified objectives. However, there is no market for A/R CDM-originated carbon credits (tCER/lCER) today and dealing of carbon credits is limited. For forestry-related area, formation of forestation or forest preservation projects which aims to obtain voluntary credits has became active and it is growing its existences as a carbon market. Such voluntary carbon credits market can't be ignored so information of these markets is included in this manual.

(2) Part II A/R CDM project in Chile

Part II offers information and data required in the implementation of A/R CDM project based on the results of the pilots projects. Chapter 1 summarizes policies on climate change and Kyoto Protocol, the overview of national forest and related measures and definition of forests as the Government of Chile's policy on A/R CDM. Three types of CDM forestation project categorized by CDM National Strategy Study (NSS); 1) forestation of community where many native citizens live and coordinated jointly with CONAF or small scale land, 2)joint forestation implemented by small farmers and forest company through contracts or other tools for participation, 3) forestation of dissected/devastated land, within which Region XI pilot project fell under 3) are described. Chapter 2 gives guidance systems and stakeholder organizations required in implementing A/R CDM project in Chile. This manual lists CONAF, INFOR, INIA, ODEPA and FIA as well as CONAMA, Chilean DNA, as important governmental organizations with respective roles. Relevant international organizations and South American institutes are also introduced. In chapter 3, from the viewpoint what differences exists between normal forestation activity and CDM forestation, theories, things to consider and other things to confirm needed in implementing A/R CDM project are explained. The concept of "Additionality" is especially important for CDM, so actual cases that are likely to be CDM projects are taken up and cost-effectiveness estimated by economic analysis are discussed. Chapter 4 introduces relevant laws and regulatory schemes including forestry/forestation laws/regulation such as DL701 and environmental regulations, taxation law. These laws and regulations need to be considered in designing/implementing project. In addition, subsidy system available to project participants is introduced in Chapter 5. The government of Chile offers a subsidy system through CORFO under which 50% of project implementation costs are supported at the project validation phase. This system has become available to the participants of Region XI pilot project. So, taking the pilot project and others as actual examples, procedures, information and documents required for the subsidy application are explained. Chapter 6 describes series of process in detail from project design through its implementation by utilizing knowledge and experience gained from two pilot projects (See fig 18). Initially, Xth pilot project was planned as small scale project, but , as already mentioned, it didn't realized. So, Region XI pilot project, normal A/R CDM project not small scale one, is taken as the major case and descriptions are mainly for normal A/R CDM project. However, encountered problems and issues are also studied in order to give some suggestions for future projects' opportunities. Chapter 7 offers information needed in selecting appropriate methodology among from approved methodologies. Although chapter 3 of Part I also mentioned about methodologies, this chapter places its focus on how to select methodology that is suitable for a project each readers is considering. The last chapter, Chapter 8 describes useful information and data for preparing project design documents (PDD) and offers where to find them. Various information and data are essential for PDD preparation and it is important for project formation to utilize existing

information effectively. In this view, we listed information and data we used for the pilot projects and other information that can be useful in future project formation in this chapter.

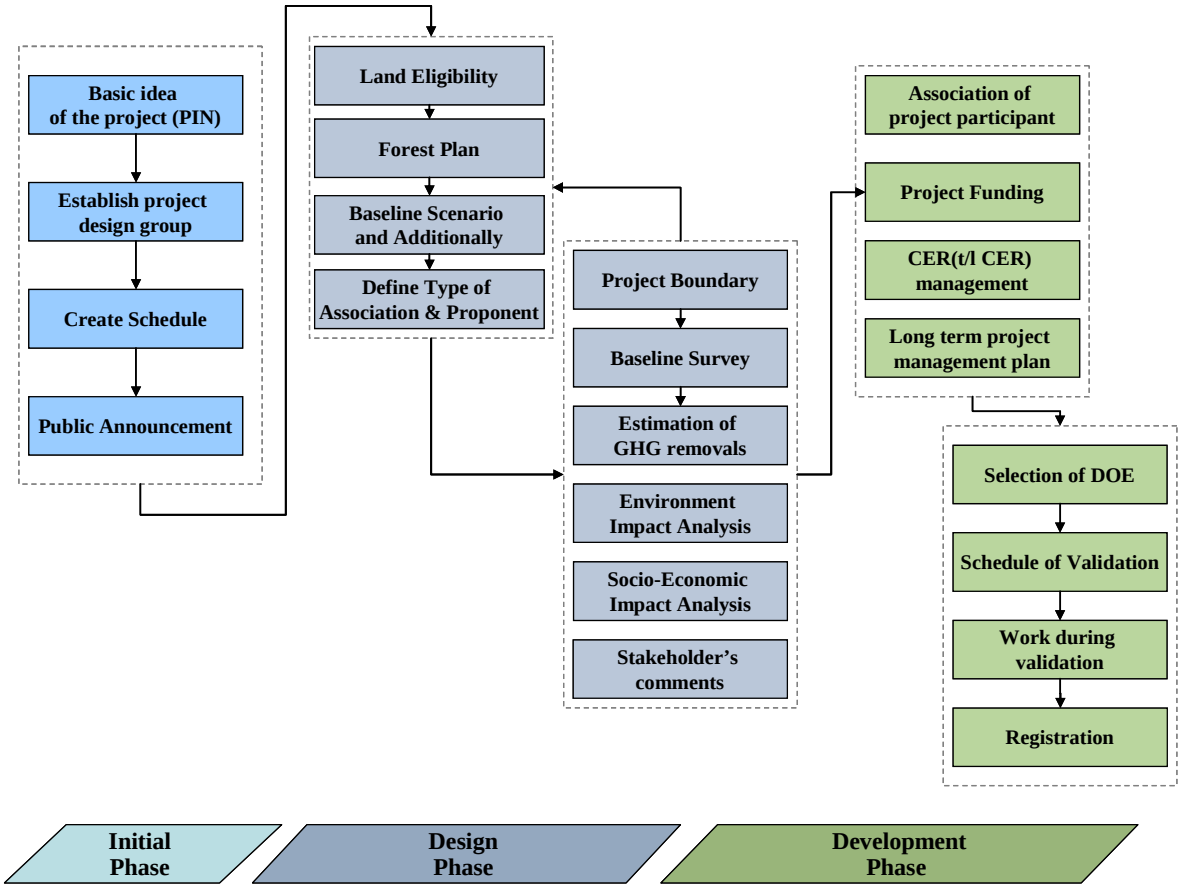


Figure 18 Procedures from project design to implementation of A/R CDM project

5.6 Hosting experts from neighboring countries

As a part of hosting experts from neighboring countries activities, we invited Mr. Walter Oyahantcabal, unit coordinator of forest/agriculture climate change project unit, agri-pastoral planning and policy department, Ministerio de Ganadería, Agricultura y Pesca and Mr. Tatsuya Watanabe, JICA long-term experts dispatched to the unit. On September 29 and 30, we visited the small scale CDM pilot project site in Region X and had meetings with Mr. Carlos Bahamondez the project manager and other INFOR staff. On the following day, we hosted the workshop held at INFOR Valdivia. In addition, they participated in INFOR seminars on September 28 and October 2-3 in Santiago and La Selena. They offered precise opinions based on their own views at the discussion and workshop on the pilot project in Region X held in Valdivia. These opinions contributed greatly in the pilot project formation.

Figure 19　INFOR Workshop (La Selana, September 28, 2007)

5.7 Support for credit disposal

5.7.1 Consultation with WB BioCarbon Fund

In order to explore possible credit buyers for the pilot project, we held a consultation with WB BioCarbon Fund, the most prospective buyer for the moment, on May 15, 2007. The fund has started the second tranche and would recruit new investors and projects. As one of its main objectives is poverty eradication, we received the impression that it would be possible to sell credits obtained from Region X pilot project to the fund.

5.7.2 Promotion activity at Chilean chambers of commerce

In order to explore further opportunities to look for potential buyers of carbon credit to be produced from the pilot project, an introduction of the pilot project in Region XI was made at a meeting of Chilean chamber of commerce of Japanese enterprises in December 2008.

6. Outcome of the Project and Issues toward future

6.1 Outcome of the Project

An A/R CDM project has been successfully formulated in Region XI through present cooperation project. In Region X, although project formulation could not be attained, various aspects of small scale CDM project as well as of program CDM have been explored. Through these experiences, including training program in Japan, Chilean counterparts have obtained a certain level of capability to formulate and implement by themselves A/R CDM projects.

It is also quite obvious that, through steering committee meetings, seminars and workshops, many people from counterpart institutions, other related ministries, universities, forest companies and NGOs have gained latest information about A/R CDM as well as about experiences on pilot projects. This information dissemination must have contributed to the capacity reinforcement of those who might have some concerns with A/R CDM projects in the future.

6.2 Important Issues for the promoting A/R CDM in Chile and some suggestions

One of the objectives of this project was to realize a good coordination scheme among various Chilean institutions concerned with A/R CDM.

As mentioned above, on various occasions, namely those of steering committee held at least once or two times during the visit of JICA Study Team in Chile, not only JICA's counterpart institutions such as ODEPA (Oficina de Estudio y Politicas Agrarias, Ministerio de Agricultura), INFOR (Instituto Forestal), CONAF (Corporacion Nacional Forestal), INDAP (Instituto de Desarollo Agropecuario), FIA (Fundacion para la Innovacion Agraria) but also other institutions like CONAMA (Comision Nacional del Medio Ambiente), CORFO (Corporacion de Fomento de la Produccion), PROCHILE, AGCI (Agencia de Cooperacion Intenacional de Chile), MIDEPLAN (Ministerio de Planificacion) have participated and have had fruitful discussions. It is also the same in Region X and Region XI that, in addition to the regional representatives of above-mentioned institutions, farmers' associations or other groups like foundation have participated to seminars and workshops organized by INFOR and JICA Study Team on the subject of promoting pilot projects in these regions. It is without saying that many official or unofficial meetings have been also organized among institutions concerned in order to discuss and find our solutions on specific topics of pilot projects.

Based on these experiences, several points described below may be identified as important issues for promoting A/R CDM projects in Chile in the future, as well as some suggestions may be made for the government of Chile, if it intends to define A/R CDM projects as one of major policy issues in Chile.

(1) Ceration of coordinating mechanism at the central government level

The related ministries of the central government of Chile have deepened their concerns on A/R CDM and the related officials also have increased their interests. Therefore, it is

desirable that;

a) An establishment of regular meetings, under the chairmanship of ODEPA, inviting CONAF, INDAP, CORFO, PROCHILE, INFOR and other agencies concerned. Such meetings will examine fundamental policy issues in order to promote A/R CDM projects. Urgent agenda among others to be addressed are;
   1) Policy framework to assist technically project formulation, including feasibility study and PDD elaboration,
   2) Policy framework to assist financially and organizationally project preparation,
   3) Policy framework to provide advices on administrative procedures, very particular to A/R CDM project, such as validation, registration etc.
   4) Policy framework to promote sales of CER or VER produced under A/R CDM projects.

b) Creation of needed mechanism to respond to above policy frameworks;
   1) A mechanism, composed of INFOR, CONAF, INDAP etc. to address technical issues of 1) above,
   2) A mechanism, composed of CORFO, CONAF, INDAP, FIA etc. to address financial and organizational issues of 2) above,
   3) A mechanism, not excluding an establishment of specialized independent company, composed of INFOR, CONAF, INDAP etc. to address, under the CONAMA's advices, administrative issues of 3) above,
   4) A mechanism, composed of PROCHILE and other agencies concerned, to address external sales issues of 4) above.

(2) Creation of specialized groups in CONAF and INDAP

According to our experiences of pilot projects in Region X and Region XI, we can say that;

a) It is quite difficult to organize large-medium scale farmers together with small scale farmers, in particular indigenous people, in only one organization which is aimed to promote and to implement an A/R CDM project.
b) CONAF has an advantage to promote relatively large and medium scale forestation projects in degraded area.
c) INDAP has, on the other hand, is a suitable institution to organize small scale farmers including those of indigenous people.

Therefore, with a purpose of efficiently promoting A/R CDM projects, it is desirable;

d) To establish a specialized group in CONAF in charge of promoting relatively large and medium scale A/R CDM projects mainly in degraded area.
e) To establish a specialized group in INDAP in charge of promoting small scale A/R CDM projects, as one of policy measures of poverty eradication in rural areas.

(3) Extension of LD (Ley-Decreto) 701

The LD 701 has been contributing a lot since its initial adoption in 1974 and its modification in 1996 to the forestation in Chile by providing currently subsidies covering up to 75% of the forestation cost (for degraded land but only for landowners of less than 200ha of non-degraded land). At the end of year 2009 it comes to its end of application, but it is our understanding that the extension of LD 701 after the year 2010 is under consideration by relevant authorities of the government of Chile. Such extension seems to us a prerequisite for

the promotion of A/R CDM projects which do not bring, in general, a high financial rate of return.

(4) Special considerations for small-scale A/R CDM

With the purpose of promoting small scale A/R CDM projects and by taking into account their characteristics, following issues are expected to be examined by respective Chilean authorities.

a) INDAP will carry out an overall survey to find out in different regions potential areas suitable for small scale A/R CDM projects.
b) Since the formulation of a small scale A/R CDM project at each time is not very efficient, the possibility to seek for a program CDM will be investigated. Indeed, during this JICA project, interest for program CDM was shown by Chilean counterpart in relation to the X Region pilot project. It could be efficient to provide necessary assistance based on the experience of the pilot project in order to build capacity for program CDM in Chile.
c) In case small scale A/R CDM projects are to be implemented in the framework of poverty eradication policy, applicability of all kinds of existing subsidies as well as creation of new necessary subsidy (subsidies) will be examined.
d) In case where indigenous people are involved, INDAP will examine the possibility to become by itself an implementing agency, or to create another form of organization under its control, since it is not an easy task to organize these people as an implementing body of their project.
e) It is also not realistic and advisable to request indigenous people to share financial burdens necessary for the creation and operation of implementing organization. Such cost will be examined as part of above-mentioned subsidies. It is rather recommended to ask indigenous people only for the permission to utilize their land for forestation and to provide them, from the view point sustainability, with short-term tailored incomes (in stead of only one income every five years from the sales of CER) such as remuneration for their labor works in planting, pruning, etc. or divided yearly anticipated payment of their income from sales of CER, in five installments for example. All other measures to facilitate their participation should be also explored.

(5) Transfer of know-how in project formulation

It is not the duty of the central government or regional authorities to formulate all A/R CDM projects forever. It is rather desirable in a long-run that the project formulation of A/R CDM will be carried out by private companies, consultants, academic people, operadores etc. It is therefore quite important to transfer to these people the experiences and know-how gained by INFOR, CONAF, INDAP or other institutions through our pilot projects. Continuous renewing of web-site, continuous activities inviting these people to seminars or workshops like those which have been organized during our study period, or all other relevant activities are key factors to this transfer of know-how.

(6) Function of operadores

At present, operadores are working in the field to give advice to farmers and to formulate eventually forestation projects under CONAF or CONAF/INDAP program. Their knowledge about the current situation of each individual farmer is very accurate and they are to some extent complementing the work of CONAF or INDAP. Therefore, even in case of A/R CDM project formulation their function seems to be indispensable. Under such situation, it is

recommended to review their functions at policy level including their remuneration system and to take necessary measures, if needed, with a view to utilize their capacity at maximum.

(7) Contribution to discussions in the world forum regarding A/R CDM

The fact that, as of December 2008, there exists only one A/R CDM project in the world which has been registered at UNFCCC, shows clearly the necessity to improve some part of the procedures or requirements of A/R CDM projects. We understand also that the recent scale-up of maximum ceiling of CER for small scale CDM from 8tons to 16 tons per year was the result of valuable efforts by Chilean delegation. We therefore believe that it is the utmost contribution of the present project, if, based on experiences and difficulties our counterparts have encountered, some improvements of A/R CDM are identified and proposed to the international forum by the Government of Chile. Follwings are some of the further suggestions;

- Rules and regulations of A/R CDM are very complex and person with sufficient knowledge on these rules usually in the central government. However, implementations of projects take place not in the capital but in rural areas. In this JICA pilot project, JICA Study Team tried to build capacity in local and regional level. In order to promote A/R CDM projects, more efforts on capacity building and knowledge sharing for local and regional level human resources are necessary.
- One of the most serious obstacles in promoting A/R CDM projects is the replacement obligation of tCER and lCER and this replacement obligation hampers creation of credit market for A/R CDM. If we want to promote A/R CDM project, it is time to consider easing or abolishing this obligation.
- During this JICA cooperation project, several baseline and monitoring methodologies and some useful tools were approved. Yet, it requires an advanced knowledge and skills to develop a PDD. Development of more simple methodologies and tools are necessary.

Appendix

Appendix 1. Framework for implementation

(1) Organizational framework

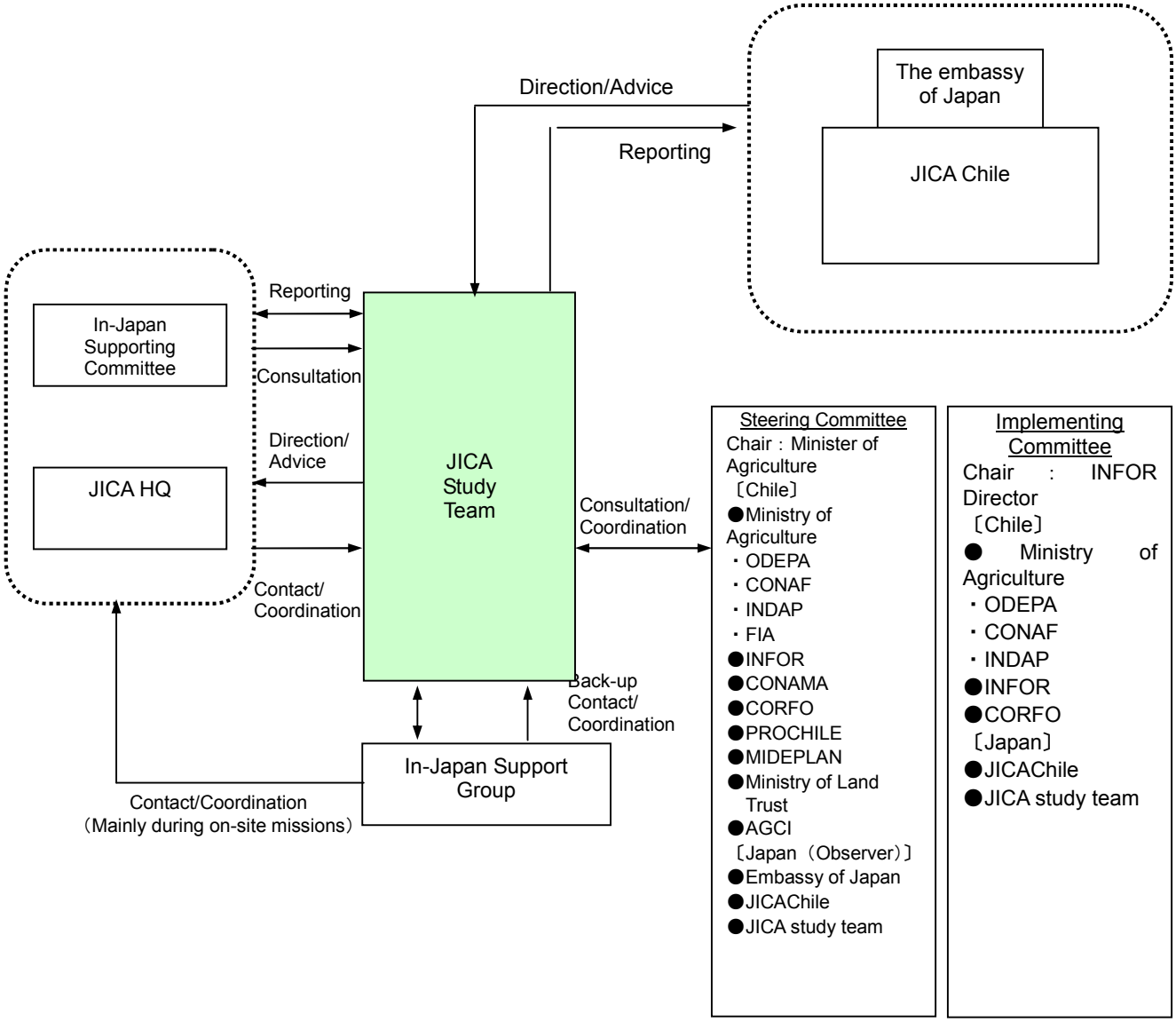


Fig. Cooperation between JICA study team and stakeholder organizations

(2) Team members and their tasks

Name	Role	Tasks
Kunio HATANAKA	Team Leader ／CDM	JICA Study Team Leader — report and explain essential information on the project progresses as a representative of the study team and coordinate with JICA on issues important for the project implementation. — consult with the government of Chile , explain contents of reports to SC, formulate joint implementation plan and coordinate with C/P during missions as a representative of the study team. — consult with other stakeholders and NGOs if necessary.
Atsushi HISAMICHI	Forest Management（Forest planning）	Conduct studies concerning forest planning. — collect, organize and analyze documents for forest planning. — analyze and make forest plan based on on-site surveys. — explain matters regarding forest planning at workshops/seminars.
Shuichi MIYABE	Forest Management（Forest Measurement）	Conduct studies concerning forest measurement — collect, organize and analyze various essential data for baseline setting, identifying additionality and establishing methodologies. — explain matters regarding forest measurement at workshops/seminars.
Naoya FURUTA	CDM Project Planning（Project Formation and Capacity Building）	Act as team leader's proxy when he is not available — Region X project formation, especially socio-economic study in the second year, environment impact analysis, economic analysis and establishing implementing framework. Same for Region XI, in principle. — Organizing workshops and seminars for capacity buildings of C/P, farmers workshop for supporting CDM project formation.
Hozuma SEKINE	CDM Project Planning（A/R CDM1）	Leader of A/R CDM experts — Establish baseline, additionality and methodology based on the CDM EB's direction regarding A/R CDM. — Prepare draft PDD in cooperation with Chilean side as well as baseline setting, identifying additionality and leakage. — Explain PDD part at workshops and seminars. — Prepare draft basic manual for A/R CDM project formation and hold workshops for stakeholders.
Shuta MANO	CDM Project Planning（A/R CDM2）	Sub-leader of A/R CDM experts — Support Sekine in principle, and conduct the same tasks. When Sekine is not available, act as his proxy. — Explain general matters on CDM at workshops and seminars.
Aya URAGUCHI	CDM Project Planning（A/R CDM3）	A/R CDM expert — In addition supporting other A/R CDM experts' tasks, collect and organize data required for baseline setting, identifying additionality, establishing methodology and preparation of draft PDD — Follow up A/R CDM trends in the world including CDM EB's direction.

(3) Chilean staff and organization

Chilean staff and their tasks

Name	Affiliation	tasks
Carlos Bahamondez	Branch head, INFOR Los Lagos	Project Leader
Santiago Barros	In charge of International relations, INFOR	Project sub-leader
Paulo Moreno	Branch head, INFOR La Patagonia	Region XI project coordinator
Enrique Villalobos Volpi	Forest engineer, INFOR Los Lagos	INFOR counterpart for Aysen and Los Lagos
Andrè Laroze	Agriculture polocy dept., ODEPA	Coordination among Chilean organizations Steering committee chairman Implementing committee chairman
Eduardo Gàndara	Manager, InternationalRelations Dept., CONAF	Steering committee member Implementing committee member
Marcela Main	International relations dept., CONAMA	Steering committee member
Javier García	Manager, Commerce development dept., CORFO	Steering committee member Implementing committee member
Aquiles Neuenschwander	FIA	Steering committee member Implementing committee member National project counselor
David Aracena	Development dept., INDAP	Steering committee member Implementing committee member
Oscar Saavedra	MIDEPLAN	Steering committee member
Paola Conca	Manager, Environment Dept.,PROCHILE	Steering committee member
Patricia Montaldo	INDAP Los Lagos	INDAP Los Lagos Counterpart
Delfín Hidalgo	CONAF Los Lagos	CONAF Los Lagos Counterpart
Germàn Krause	CONAMA Los Lagos	CONAMA Los Lagos Counterpart
Sergio Sanhueza	CONAMA Aysen	CONAMA Aysen Counterpart
Mauricio Cordero	CORFO Aysen	CORFO Aysen Counterpart
Alejandro Henriquez	INDAP Aysen	INDAP Aysen Counterpart
Manuel Henriquez	CONAF Aysen	CONAF Aysen Counterpart

Appendix 2. M/M (actual)

	Assigned task	Name	Organization	grade	FY 2005					FY 2006										FY 2007										FY 2008										M/M									
					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	FY 2005		FY 2006		FY 2007		FY 2008		Total	
					Dec.05	Jan.06	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	In Chile	In Japan	In Chile	In Japan	In Chile	In Japan	In Chile	In Japan	In Chile	In Japan
Work in Chile	Director / CDM	Kunio HATANAKA	Mitsubishi Research Institute, Inc.	2			2days	9days			35days					35days					26days				10days			12days					13days						8days			8days	1.00		2.33		1.60		0.97		5.90	
	Forest Administration (Forest planning)	Atsushi HISAMICHI	Japan Forest Technology Association	3			44days				35days					35days					27days																						1.47		2.33		0.90		0.00		4.70	
	Forest Administration (Forest measurement)	Shuichi MIYABE	Japan Forest Technology Association	3			44days				35days					35days					27days																						1.47		2.33		0.90		0.00		4.70	
	CDM Planning (Capacity building)	Naoya FURUTA	Mitsubishi Research Institute, Inc.	4				30days			35days					35days					23days				8days			7days					7days					13days			7days	1.00		2.33		1.27		0.90		5.50	
	CDM Planning (A/R CDM1)	Hozuma SEKINE	Mitsubishi Research Institute, Inc.	3			18days				21days					23days					26days				11days			7days					7days			8days				7days		0.60		1.47		1.47		0.73		4.27	
	CDM Planning (A/R CDM2)	Shuta MANO	Mitsubishi Research Institute, Inc.	5							16days					19days					16days				6days																		0.00		1.17		0.73		0.00		1.90	
	CDM Planning (A/R CDM3)	Aya URAGUCHI	Mitsubishi Research Institute, Inc.	6				31days			35days					26days					21days													7days									1.03		2.03		0.70		0.23		3.99	
																																										Subtotal work in Chile		6.57		14.00		7.57		2.83		30.97	
Work in Japan	Director / CDM	Kunio HATANAKA	Mitsubishi Research Institute, Inc.	2	5days									5days				5days							2days				3days		2days							2days						0.17		0.33		0.23		0.07		0.80	
	Forest Administration (Forest planning)	Atsushi HISAMICHI	Japan Forest Technology Association	3	5days									3days				5days							1day				8days		1day													0.17		0.27		0.33		0.00		0.77	
	Forest Administration (Forest measurement)	Shuichi MIYABE	Japan Forest Technology Association	3	5days									3days				5days							1day				8days		1day													0.17		0.27		0.33		0.00		0.77	
	CDM Planning (Capacity building)	Naoya FURUTA	Mitsubishi Research Institute, Inc.	4	2days									3days				3days							1day				3days		5days							7days						0.07		0.20		0.30		0.07		0.64	
	CDM Planning (A/R CDM1)	Hozuma SEKINE	Mitsubishi Research Institute, Inc.	3	3days									3days				3days							1day				6days		1day							2days						0.10		0.20		0.37		0.07		0.74	
	CDM Planning (A/R CDM2)	Shuta MANO	Mitsubishi Research Institute, Inc.	5	1day									3days				3days											9days		1day													0.03		0.20		0.33		0.00		0.56	
	CDM Planning (A/R CDM3)	Aya URAGUCHI	Mitsubishi Research Institute, Inc.	6	3days									2days				2days											9days		1day							6days						0.10		0.13		0.33		0.20		0.76	
																																										Subtotal work in Japan		0.80		1.60		2.22		0.41		5.03	
Report	Delivery schedule				ICR				PR1			PR2							ITR				PR3								PR4								DFR			FR	FY 2005 Total (In Chile+In Japan)		FY 2006 Total (In Chile+In Japan)		FY 2007 Total (In Chile+In Japan)		FY 2008 Total (In Chile+In Japan)		FY 2005*2008 Total (In Chile+In Japan)	
	Work in Japan (Total M/M)				Preparation in Japan (0.8M/M)					1st Work in Japan (0.73M/M)								2nd Work in Japan (0.87M/M)				3rd Work in Japan (0.20M/M)				4th Work in Japan (1.53MM)			5th Work in Japan (0.4M/M)							6th work in Japan (0.4M/M)						Revised plan	7.37	Revised plan	15.60	Revised plan	9.79	Revised plan	3.24	Revised plan	36.00
	Stages						1st Mission					2nd Mission			3rd Mission								4th Mission				5th Mission			6th Mission								6th mission													

Leyenda : Work in Japan Work in Chile

Appendix 3. Workshop

(1) First Mission

Workshop (Santiago) Mar. 3, 2006

Time	Agenda	Speaker
9:00 AM	Opening Address and Participant introduction	Sr. Roberto IPINZA, Director Ejecutivo INFOR
9:15 AM	Current situation of CDM and A/R CDM projects	Sr. Hozuma SEKINE, JICA study team
10:15 AM	Coffee break	
10:30 AM	Approval process by the Designated National Authority (DNA) and flow of CDM projects in Chile	Sra. Marcela MAIN, CONAMA
11:00 AM	Development of A/R CDM project in Chile	Sr. Jorge URRUTIA, Gerente Regional Sede Valdivia, INFOR
11:30 AM	JICA project in Chile	Sr. Kunio HATANAKA, JICA study team
12:00 AM	Discussion	

Workshop (Valdivia) Mar. 7, 2006

Time	Agenda	Speaker
9:00 AM	Opening Address and Participant introduction	Sr. Roberto IPINZA, Director Ejecutivo INFOR
9:15 AM	Current situation of CDM and A/R CDM projects	Sr. Hozuma SEKINE, JICA study team
10:15 AM	Coffee break	
10:30 AM	Approval process by the Designated National Authority (DNA) and flow of CDM projects in Chile	Sr. Claudio NILO, CONAMA
11:00 AM	Development of A/R CDM project in Chile	Sr. Jorge URRUTIA, Gerente Regional Sede Valdivia, INFOR
11:30 AM	JICA project in Chile	Sr. Kunio HATANAKA, JICA study team
12:00 AM	Discussion	

Workshop (Coyhaique) Mar. 17, 2006

Time	Agenda	Speaker
9:00 AM	Opening Address and Participant introduction	Paulo More
9:15 AM	Current situation of CDM and A/R CDM projects	Sr. Naoya FURUTA, JICA study team
10:15 AM	Coffee break	
10:30 AM	Approval process by the Designated National Authority (DNA) and flow of CDM projects in Chile	Sr. Claudio NILO, CONAMA
11:00 AM	Development of A/R CDM project in Chile	Sr. Jorge URRUTIA, Gerente Regional Sede Valdivia, INFOR
11:30 AM	JICA project in Chile	Sr. Naoya FURUTA, JICA study team
12:00 AM	Discussion	

Workshop (Valdivia) Mar. 29, 2006

Time	Agenda	Speaker
10:00 AM	Opening Address and Participant introduction	Sr. Roberto IPINZA, Investigador, INFOR Sede Valdivia
10:15 AM	Overview of A/R CDM project initiatives in Chile	Sr. Roberto IPINZA, Investigador, INFOR Sede Valdivia
10:45 AM	Land eligibility for A/R CDM project	Sr. Shuichi MIYABE, JICA study team
11:15	Coffee break	
11:30 AM	Potential participants and organization for A/R CDM project	Srta. Javiera VARGAS, Ingeniero Forestal, INDAP
12:00 AM	Mechanism of socio-economic impact assessment of A/R CDM project	Sr. Enrique Villalobos Volpi, INFOR Valdivia
12:30 AM	Discussion	

Workshop (Coyhaique) Apr. 3, 2006

Time	Agenda	Speaker
14:45 PM	Opening Address and Participant introduction	Sr. Paulo MORENO, Gerente Regional Sede Coyhaique, INFOR
15:00 PM	Overview of A/R CDM project initiatives in Chile	Sr. Paulo MORENO, Gerente Regional Sede Coyhaique, INFOR
15:30 PM	Land eligibility for A/R CDM project	Sr. Shuichi MIYABE, JICA study team
16:00 PM	Coffee break	
16:15 PM	Regional Land Management Plan	Sr. Luis FUENTES L. SERPLAC, Coyhaique
16:45 PM	Mechanism of socio-economic impact assessment of A/R CDM project	Srta. Monica VERGARA SERPLAC, Coyhaique
17:15 PM	Discussion	

Workshop (Santiago) Apr. 6, 2006

Time	Agenda	Speaker
10:00 AM	Opening Address and Participant introduction	Sra. Marta ABALOS, Directora Ejecutiva INFOR
10:15 AM	Overview of A/R CDM project initiatives in Chile	Sr. Jorge URRUTIA, Coordinador Chilean counterpart
10:45 AM	Land eligibility for A/R CDM project	Sr. Shuichi MIYABE, JICA study team
11:15	Coffee break	
11:30 AM	Mechanism of socio-economic impact assessment of A/R CDM project	Sr. Jorge URRUTIA, Coordinador Chilean counterpart
12:00 AM	Discussion	

(2) Second mission

Workshop (Valdivia) Jul. 25, 2006

Time	Agenda	Speaker
10:00 AM	Opening Address and Participant introduction	Sr. Carlos BAHAMONDEZ, Gerente Regional Sede Valdivia, INFOR
10:20 AM	Land eligibility	Sr. Dante CORTI INFOR
10:40 AM	Forest management	Sr. Atsushi HISAMICHI, JICA study team
11:00 AM	Carbon sink estimates	Sr. Shuichi MIYABE, JICA study team
11:20 AM	Coffee break	
11:40 AM	Possible project sites and additionality	Sr. Naoya FURUTA, JICA study team
12:20 AM	Institutionalization of farmers	Sr. Carlos BARMONDEZ, Gerente Regional Sede Valdivia, INFOR
12:40 AM	Discussion	

Seminar (Valdivia)Jul. 25, 2006

Time	Agenda	Speaker
15:00 AM	Opening Address and Participant introduction	Sr. Carlos BARMONDEZ, Gerente Regional Sede Valdivia, INFOR
15:20 AM	Current status of CDM	Sr. Naoya FURUTA, JICA study team
15:50 AM	Case study: a CDM project in Madagascar	Dr. Hozuma SEKINE, JICA study team
16:15 AM	Coffee break	
16:30 AM	Summary of approved methodologies and PDDs	Dr. Aya URAGUCHI, JICA study team
16:45 AM	Environmental service project	Sr. Jorge CABRERA, INFOR
17:00 AM	Discussion	

Workshop (Coyhaique) Jul. 28, 2006

Time	Agenda	Speaker
9:30 AM	Opening Address and Participant introduction	Sr. Paulo MORENO, Gerente Regional Sede Valdivia, INFOR
9:45 AM	Methodogy applied	Dr. Aya URAGUCHI, JICA study team
10:20 AM	Forest management	Sr. Atsushi HISAMICHI, JICA study team
10:40 AM	Carbon sink estimates	Sr. Shuichi MIYABE, JICA study team
11:00 AM	Coffee break	
11:20 AM	Possible project sites and additionality	Sr. Naoya FURUTA, JICA study team Sr. Paulo MORENO, Gerente Regional Sede Valdivia, INFOR
12:00 AM	Institutionalization of farmers	Sr. Naoya FURUTA, JICA study team
12:40 AM	Discussion	

Seminar (Coyhaique)Jul. 28, 2006

Time	Agenda	Speaker
15:00 AM	Opening Address and Participant introduction	Sr. Paulo MORENO, Gerente Regional Sede Valdivia, INFOR
15:20 AM	Current status of CDM	Sr. Naoya FURUTA, JICA study team
15:50 AM	Case study: a CDM project in Madagascar	Dr. Hozuma SEKINE, JICA study team
16:15 AM	Coffee break	
16:30 AM	Summary of approved methodologies and PDDs	Dr. Aya URAGUCHI, JICA study team
16:45 AM	Prospective for developing pilot project	Sr. Enrique VILLALOBOS, INFOR
17:00 AM	Discussion	

Seminar(Santiago)Aug. 1, 2006

Time	Agenda	Speaker
9:30 AM	Opening Address and Participant introduction	Sra. Marta Abaros, Directora Ejecutiva, INFOR
10:00 AM	Current status of CDM	Sr. Naoya FURUTA, JICA study team
10:30 AM	Case study: a CDM project in Madagascar	Dr. Hozuma SEKINE, JICA study team
11:00 AM	Coffee break	
12:20 AM	Summary of approved methodologies and PDDs	Dr. Aya URAGUCHI, JICA study team
12:40 AM	Prospective for developing pilot project	Sr. Kunio HATANAKA, JICA study team
13:00 AM	Discussion	

(3) Third Mission

Workshop(Coyhaique) Dec. 8, 2006

Time	Agenda	Speaker
9:00 AM	Opening Address and Participant introduction	Sr. Paulo MORENO, Gerente Regional Sede Coyhaique, INFOR
9:10 AM	Results of land eligibility study	by Sr. Shuichi Miyabe y Mr. Paulo Moreno
9:50 AM	Results of pilot project's economic analysis	by Sr. Naoya Furuta y Sr. Enrique Villalobos
10:30AM	Steps toward	by Sr. Shuta Mano y Mr. Paulo Moreno
11:10 AM	Discussion	

Workshop (Santiago) Dec. 19, 2006

Time	Agenda	Speaker
9:00 AM	Opening Address and Participant introduction	Sr. Santiago BARROS, INFOR
9:10 AM	Results of land eligibility study	by Sr. Shuichi Miyabe
9:50 AM	Results of pilot project's economic analysis	by Sr. Naoya Furuta
10:30AM	Steps toward	by Sr. Hozuma Sekine
11:10 AM	Discussion	

Seminar (Coyhaique) Dec. 8, 2006

Time	Agenda	Speaker
12:30AM	Opening Address and Participant introduction	Sr. Paulo MORENO, Gerente Regional Sede Coihaique, INFOR
12:30PM	Current situation of Carbon market and emission trading	Sr. Shuta Mano, JICA study team
13:00PM	Current situation of CDM and A/R CDM	Sr. Naoya FURUTA, JICA study team
13:30 PM	Discussion	

Seminar(Santiago) Dec. 19, 2006

Time	Agenda	Speaker
12:30AM	Opening Address and Participant introduction	Sr. Santiago BARROS, INFOR
12:30PM	Current situation of Carbon market and emission trading	Sr. Shuta Mano, JICA study team
13:00PM	Current situation of CDM and A/R CDM	Sr. Naoya FURUTA, JICA study team
13:30 PM	Discussion	

Farmers Workshop (Coyhaique) Dec. 14, 2006

Time	Agenda	Speaker
9:30AM	Opening Address and Participant introduction	Sr. Andre Laroze de ODEPA
9:40AM	JICA Project and Japanese Cooperation	Sr. Kunio Hatanaka, JICA study team
9:55AM	Kyoto Mechanism, CDM and Carbon market	Sr. Hozuma Sekine, JICA study team
10:20AM	Pilot project in Coyhaique	Sr. Paulo Moreno de INFOR
10:40AM	Coffee break	
11:10AM	Cost, benefits and duties of participants	Sr. Paulo Moreno de INFOR
11:40AM	Discussion	

Appendix 4. Results of consideration on Forest planning

1.Region X

(1) Forestation condition

Forestation activity was conducted from 9,661ha to 12,620ha in the last five years (2000 to 2004 year) in Region X. That shows forestation was conducted about 10,000ha annually. In 2004 *Eucalyptus* spp., *Pinus radiata* , other species were planted 8,421ha (67%), 3,264ha(26%), 935ha(7%) respectively. Until 1992 *Pinus radiata* occupied important position of forestation. But after 1992 the forested area of *Eucalyptus* spp. is increasing gradually.

The forested area conducted by CONAF-INDAP forestation program was increasing from 2000 to 2004. But the forested area in 2005 decreased slightly. The forested area for small scale land owner was estimated about 3.0 ha by the calculation of forested area per household. If the project will be conducted in 6,000ha, about 2,000 small scale land owners are target for the A/R CDM project.

Table A-1 The condition of forested area of CONAF forestation program

Year	CONAF－INDAP		CONAF－FNDR		CONAF－BECH	
	Beneficiary	Area（ha）	Beneficiary	Area（ha）	Beneficiary	Area（ha）
2000	305	885				
2001	379	1,230			29	269
2002	503	1,249			86	763
2003	540	1,757			129	1,311
2004	526	1,791			129	1,783
2005	506	1,698	338	353	148	1,516
Total	2,759	8,610			521	5,642

Note：CONAF 2006, FNDR: Regional development national foundation,BECH: National Bank of Chile

According to comments of workshop in the first mission, the forestation by small scale landowner seems not to be always successful. The reason was pointed out as follows. Those points seem to be barrier for A/R CDM.

① Farmers who raise the cattle are not accustomed to forestation.
② Forestation requires many years to obtain the income.
③ Farmers cannot pay the planting cost because of their low incomes.

The forested area in each commune in 2004 is shown as follows. *Eucalyptus* spp. is planted more than *Pinus radiata* in every commune. The percentage of forested area of *Eucalyptus* spp. in San Pablo commune is higher than other commune. For the selection of site to be proposed for the A/R CDM, it needs to consider the forested area with the need of local people.

Table A4-2 Planted area in commune under the pilot project (ha)

species / commune	*Pinus radiata*	*Eucalyptus* spp.	Other species	計	amount of forested area until 2004
La Union	722.1	940.2	-	1,662.3	31,092.2
Osorno	71.2	113.1	2.7	187.0	2,479.6
San Juan de La Costa	197.1	352.7	45.2	595.0	10,858.4
San Pablo	29	115.2	7.8	152.0	2,989.6
Total	1,019.4	1,521.2	55.7	2,596.3	47,416.8
Region	3,264.3	8,420.6	934.7	12,619.6	208,824.8

Source：Estadisticas forestales 2004, Region X

CONAF in Region X has prepared the Strategy of the Forest Development Plan in 2005 and proposed the development plan in Region X. In this report the strategy is intended for 1)forest resources 2)forest product, 3) wood product and market 4)education and extension, 5)technology development.

In the strategy of the forest resources CONAF describes small and middle scale landowners, expansion of the subsides for the forestation, improvement of the land title, examination of the forestation cost in relating to the A/R CDM Project.

(2) Wood production

1) Wood production

In 2004 wood consumption was 4,367,832 ㎥ and wood production was 1,833,254 ㎥. Excepting pulp production, chip production is the biggest one as 740,212 ㎥. Timber production is 696,244 ㎥ and plywood production is 315,786 ㎥.

Since 2000 raw material for chips has changed from natural forest to man-made forest. Chip production of *Eucalyptus* spp. has exceeded *Pinus radiata* since 1998.

For tree species to be used for timber, *Pinus radiata*, local tree species, *Pseudotsuga menziesi*, *Eucalyptus* spp. were produced in 598,004 ㎥, 69,341 ㎥, 25,221 ㎥, 14 ㎥ respectively. *Pinus radiata* still holds a important position in Region X.

2) Wood market

Eucalyptus spp. mainly produces chips in Region X. The market of high value timber products of *Eucalyptus nitens* to be targeted for the pilot project has not been established yet.

Under these circumstances the counterpart has the following expectation of timber market in future.

① The demand of timber from the man-made forest is increasing for difficulty of the good quality timber production from the surrounding natural forest.

② A saw mill in Valdivia has produced the timber by using the *Eucalyptus nitens* in 12 years as test case and has exported 6000 ㎥ of the timber to the United States for two years.

③ Depending on the demand of timber from the foreign country, *Eucalyptus nitens* will have high expectation of timber market near future.

3) Wood price

According to INFOR, it is said that the timber price of *Eucalyptus nitens* is within the estimation at present because there is no experienced of timber production.

As concerns of pulp wood price, *Eucalyptus nitens* is cheaper than *Eucalyptus globules*. It is considered that local people who is willing to plant *Eucalyptus nitens*, will expect highly timber or high value timber products rather than pulp wood because of low price of *Eucalyptus globules* (refer to Annex).

According to INFOR, it is said that The timber price of *Eucalyptus nitens* was estimated in proportion with the timber price of *Pinus.radiata* as shown the following table. INFOR intends to estimate the timber price of *Eucalyptus nitens* on the basis of this idea for the A/R CDM project at present. It is necessary to use high accuracy estimation by market research.

Table A4-3 Estimation of prive of *Pinus radiata* and *Eucalyptus nitens*(market prince)

Use	*Pinus radiata*（$/㎥）	*Eucalyptus nitens* （$/㎥）
Pulp	8,710	12,903
Timber	17,000	25,184
Plywood	40,000	59,256

Source）*Eucalyptus nitens* en chile: economia y mercado INFOR 2003

According to the project document, wood price (market price) for the pulp and timber wood are estimated 23 US dolor per ㎥ and 38 US dolor per ㎥ respectively.

(3) Forestation technology

1) Tree species selection

In Region X, forestation of *Eucalyptus nitens* has been conducted from the 1990s.

In 2004 *Eucalyputus spp.* was planted in 8,412 ha including 2,614 ha of reforestation for these areas. *Eucalyptus nitens and Eucalyptus globulus* was planted in 4,582 ha and in 1,956.8 ha respectively. *Eucalyptus nitens* was planted widely rather than *Eucalyptus globulus.*

Eucalyptus nitens has high resistance in cold environment and show fast growth in the cold area. So *Eucalyptus nitens is suitable for cold temperature*.

Table A4-4 Site condition of *Eucalyptus nitens*

Environmental factors	contents	Environmental factors	Contents
Annual precipitation (mm/year)	800 – 3000 mm	Length of dry season	5 months
		Humidity	75% <
Annual mean temperature (oC)	10 - 15.5oC	Frost	50-150
		Soil texture	Medium, heavy
Minimum temperature (oC)	-10oC	Soil pH	5 – 6
Soil depth	Medium		
Drainage	Good ~ fair		

Note: INFOR :Information source is "*Eucalyptus nitens* en Chile: Primera Monografia"

Moreover, it is said that *Eucalyptus nitens* is shorter than *Eucalyptus globulus* and *Eucalyptus nitens* is hard to crack rather than *Eucalyptus globulus.*

From the view point of harvesting period, wood quality and adaptation of natural condition, even if the wood price is low, it could be concluded that *Eucalyptus nitens* is suitable for A/RCDM project.

Table A4-5 Comparison of *E.nitens* and *E.globlus* at the view point of the market, timber quality and adaptation to the natural condition

Tree species	Price of the pulp wood	Harvesting period for timbre production	Timber quality (occurrence of crack)	Adaptation to the natural condition (climate condition)
E.nitens	Cheap	Short	Difficult	High
E.globlus	Expensive	Long	Easy	Low

Source: Interview from INFOR

The plantation activity still has not carried out by using native species on a project

scale(see annex).

And considering the estimation of carbon sequestration and measurement of monitoring for A/R CDM, this project will not use local tree species not to be established technically. At the fourth mission, CONAF(in Osorno province) and Farmers in workshop has submitted the opinions that there is no market for *Eucalyptus nitens* at present, price as pulp materials is falling and *Pinus radiata* is for multiple usefulness. Comparing with characteristic of *Eucalyptus nitens* and *Pinus radiata* by INFOR, it is confirmed that *Eucalyptus nitens* is better characteristics in term of wood production income, conformity with natural condition, high quality materials in addition to CO_2 sequestration. After discussion of the selection of tree species among the official concerned, because of the diseases of *Pinus radiata*, *Eucalyptus nitens* was decided for tree species of A/R CDM project as before.

2) Nursery practice and seedling production

The number of nursery and seedling production in Region X is shown as following table. The nursery is located on 18 places in Region X. Among those nursery, Valdivia province and Osorno province, which is considered for pilot project area, are located on 10 place and 3 place respectively. Seedlings in Region X are produced 44,304,000seedling and 95% of the total seedlings (41,941,000seedling) are produced in Valdivia province. The seedling production of *Eucalyptus* spp. and *Pinus radiata* are 26,726,000 seedlings and 8,743,000 seedlings respectively in accordance with increasing forested area.

Table A4-6 Seedling production in Region X

Province	Number of nursery	Number of seedling (thousands seedlings)			
		Pinus radiata	*Eucalyptus* spp.	Other species	Total
Valdivia	10	8,430.0	26,421.0	7,098.1	41,949.1
Osorno	3	313.0	230.0	138.0	681.0
Total	13	8,743.0	26,651.0	7,236.1	42,630.1
Region	18	8,743.0	26,726.0	8,835.9	44,304.9

Source：Estadisticas Forestales 2004, Region X

From the beginning of project design in Region X, 6,000 ha will be planted in project area for 4 years. If 1, 500 ha of project area will be planted a year, 230 million seedlings will be needed. So it could be judged to procure the seedlings without problem from the present seedling production. Moreover, in the case of small-scale A/R CDM, 120 ha are estimated in the area to be forested. It is possible to plant trees by procurement of seedlings from the existing nursery in Region X. Under the large amount of the seedling production, the nursery practice technique has been established as bellow .

Table A4-7 Seedling practice of *Eucalyptus nitens*

Item	*Eucalyptus nitens*
Type of seedling	Bare root
Procurement of seeds	Self –support
Seed collection period	-
Pregermination treatment	25oC, 24 hours
Soils and container	Use of pine bark, Use of pot
Damage by disease and insect	Mould, chemical praying
Shading	Necessary
Nursing period	6 – 7 months: greenhouse (Dec-Feb, 4 months), field for hardening (Apr, 2 months)
Transplanting period	Apr-May (Winter)

Source）INFOR: *Eucalyptus nitens* en Chile: Primera Monografía and interviews

3) Planting and tending

Planting will be conducted on grass land with 15 to 60 % of inclination in the area which the suitable land classification is ranked for VII class. For this project planting density is 1,429 seedlings per ha.

Planting period is suitable from the middle of April to end of the May. It needs to prepare the planting stock in the nursery before starting planting. Land preparation only cut the grass surrounding the planted trees without machinery. After land preparation the planting hole will be made by hands, tree will be planted in it. Judging from the vegetation in the planting area, weeding will be conducted before and after planting. Fertilization also will be conducted before and after planting.

Fencing will be set up surrounding the planting area before tree planting to prevent planted trees from the cattle.

Table A4-8 Planting standard of *Eucalyptus nitens*

Item	*Eucalyptus nitens*
Site	Grass land, Inclination:15～60
Density	600～1,650seedling/ha
Period	Middle of April to end of May
Land preparation	Clearing the grass around the planting hole
Planting	Digging and planting by manual
Weeding and fertilizing	Weeding and fertilizing by manual before and after planting, the name of chemical spraying and fertilizer: unknown
Protection	Fencing for grazing, countermeasure for animal, countermeasure for insect, fungi etc.

Note：INFOR：*Eucalyptus nitens* in Chile: primera Monografia

Pruning will be conducted three times continuously from the third years after planting to produce the knotless wood in future, to keep the space for the forest activities and to conserve the ground vegetation.

Thinning will be conducted two times in five year and nine year after plating to help the growth of high quality trees and to conserve the ground vegetation. The trees to be thinned in second time will be produced for pulp wood.

According to the period of final pruning, Thing period is that first thinning will be conducted to the trees not to be pruned and second thinning will be conducted to the dominated trees to remain the main crop for good harvest.

(4) Forest protection

1) Forest fire

The most apprehension damage for forestation project is forest fire and is considered from the large risk of A/R CDM.

In Region X the largest damage and damaged area from 1991 to 2004 was 39,672ha in 1998. The forest fire of plantation in 1998 is the biggest one. And the planted area damaged in 2 to 39 ha by forest fire except large damage in 2001. In Region X the reason of forest fire is considered that 1) precipitation is high, 2) finding the fire is easy from the close farmland and grassland and 3) CONAF extend the fire prevention knowledge to the village.

According to the private forest company 1) the section concerned forest fire is set up in

the office 2) the staff of company patrol surrounding the plantation everyday and 3) the prevention work was carried our by the cooperation of the farmers surrounding the plantation.

CONAF has the forest fire department in each Regional forest office as well as headquarter. And provincial level also has forest fire section for the extension of forest fire to the local people.

The extension activities against forest fire are 1) extension to the land owners, 2) fire control of the national park and 3) fire control of the protected area.

Table A4-9 The number of staff concerned the forest fire in each provincial forest office

Region	Province	The number of staff concerned the forest fire
Region X	Valdivia	18
	Osorno	22

Note: Staff concerned the forest fire is employed during the summer season (Region X:December to February)

2) Disease and insect damage

According to the interview in the plantation in Region X there is no damage by the insect and disease in *E.nitens* plantation.

It is considered by INFOR that there is 11 species of disease and 11 species of insect which damage to *E.nitens* plantation. In the case of occurrence of the damage it is necessary to correspond to the countermeasure on the basis of the characteristic and contents of damage (see annex).

3) Grazing

It is said that the statistics data of damage by grazing is hard to receive. There is no report about damage for forest by grazing in Region X reportedly. According to the company the grazing is hard to prevent entering into plantation in spite of the fencing surrounding the plantation. For this reason they allow the grazing into the plantation after reaching to certain height of planting tree by collecting the entrance fee on the basis of contract.

In the case of introducing the grazing in the forest it is said to be important that the forestation project will be formulated taking into balance between advantage and disadvantage consideration on the basis of the examination of initial growing rate, tree species and management target.

4) Climate damage

The damage was observed at the plantation by the strong wind (a wind of 150 km per hour) from the Andes in Region X. The damaged trees represent about five percent of planting trees and all of them uprooted on the shallow soil condition. According to the manager tree uprooted is left in the forest until harvesting period. But it is necessary to care the uprooted tree in the plantation for incidence of disease.

From the above mention, there has been no big problem of the forest damage from the forest fire and others in the pilot project area. For this reason, the risk from the forest damage will be small for the A/RCDM project.

(5) Forest management

1) Forest management standard

The management of *Eucalyptus nitens* plans to conduct the pruning and thinning and harvesting in 20 years for realizing the production target as the High-valued timber production by conducting the intense management.

The reasons of the High-valued timber production are 1) the market of pulp wood is struggling, 2) timber production is high profit, 3) local people needs to plant.

According to INFOR, cutting period of *Eucalyptus nitens* is eighteen years in good site condition as San Juan province in Region X. But the cutting period in moderate site condition should be twenty years. The cutting period will be decided for twenty years to achieve certainly the goal of A/R CDM project even if the planting site is good for planting trees considering few experience of high value timber product by small-scale land owners.

Table A4-10 Management standard of *E.nitens*

Year	Activity	Contents
0	Land preparation, demarcation for planting area	Fence of boundary , diging, etc.
0	Planting	1,429 trees/ha (2m×3.5m) planting with shovel
0-1	Fertilization	Application in ditch
0-1-2	Weeding by chemical	Before and after planting, adjusted with maintenance and management (chemical spraying100%)
1~ final cutting	Routine intervention	Watching, protection, insurance
3-4-5	Pruning	Pruning 1：3 yr 700 trees/ha 2.7m Pruning 2：4 yr 500 trees/ha 4.5m Pruning 3：5 yr 300 trees/ha 7.5m
5-9	Thinning	Thinning 1：5 yr (Trees which are not pruned are subject.) Thinning 2：9 yr 350 trees/ha (trees which pruned are remained)
20	Final cutting	Cutting period

Note: INFOR, INDAP, CONAF, June 2005. A Forestation and Carbon Capture Programme within the Clean Development Mechanism (CDM) for Small-Scale Landowners in the Lake Region

2) Implementation plan for forestation

According to project document in Region X, the project period is set at 40 years for conventional forestation and 30 years for A/R CDM with rotation length of 20 years and two times of planting. Total planted area amounts to 6,000 ha which is completed by four years. But at the result of critical analysis conducted by INFOR in the third mission, normal scale A/R CDM have been changed to small-scale A/R CDM. So the planting area will be reduced from 6,000 ha to 120 ha and under this situation tree planting will be conducted with one year.

In the case of small-scale A/R CDM as well as normal scale A/R CDM taking consideration of planting experience and labor force from the surrounding village, labor procurement is considered not to be problem.

The farm roads to connect the stem roads and the small-scale landowners are considerably developed. They tend to be unpaved, but possible to be used for forestation road. According to the interview the road for forestation will not be constructed on the gentle slope from farm road to plantation site. On the contrary the road for forestation will be constructed on the steep slope.

(6) Technical guidance for forestation

To landowners such as small- scale landowners, the technical guidance is conducted at planting time, However, the forestation area conducted by CONAF subsidy system is still young and around 10 years old, The technical guidance for forest management remains from now on.

Technical guidance on forest management is conducted from CONAF to small-scale landowners through extension workers shown as bellow. The technical guidance was conducted for theory and practice in each forest activity by using manual and text.

At present the format of the inspection and record related to tending and protection according to the forest management has been preparing and stocking in CONAF. But the evaluation of forest management depends on the person in charge of inspection. So the preparation of standards for evaluation should be prepared to standardize the evaluation method for forest management.

PNTTF(Program Nacional Transparencia Technologia Forestal) was started since 2002 by CONAF. The technical guidance for forest management as pruning and thinning is conducted and the data base of inspection and evaluation for forest management will be arranged by this program. Using filing system to be prepared by PNTTF, it is important to read the records conducted any time for the participant of technical guidance to understand technical level.

nstitutional structure for instruction of the forestation technology

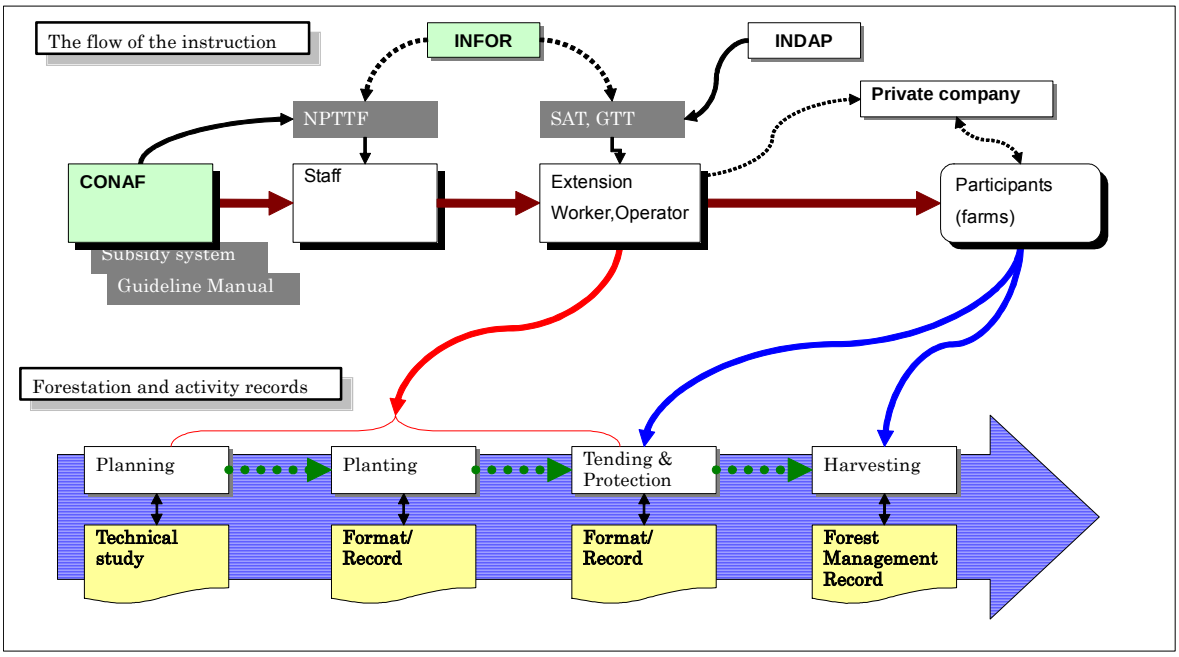


Figure A4-1 The flow of the technical guidance for forestry

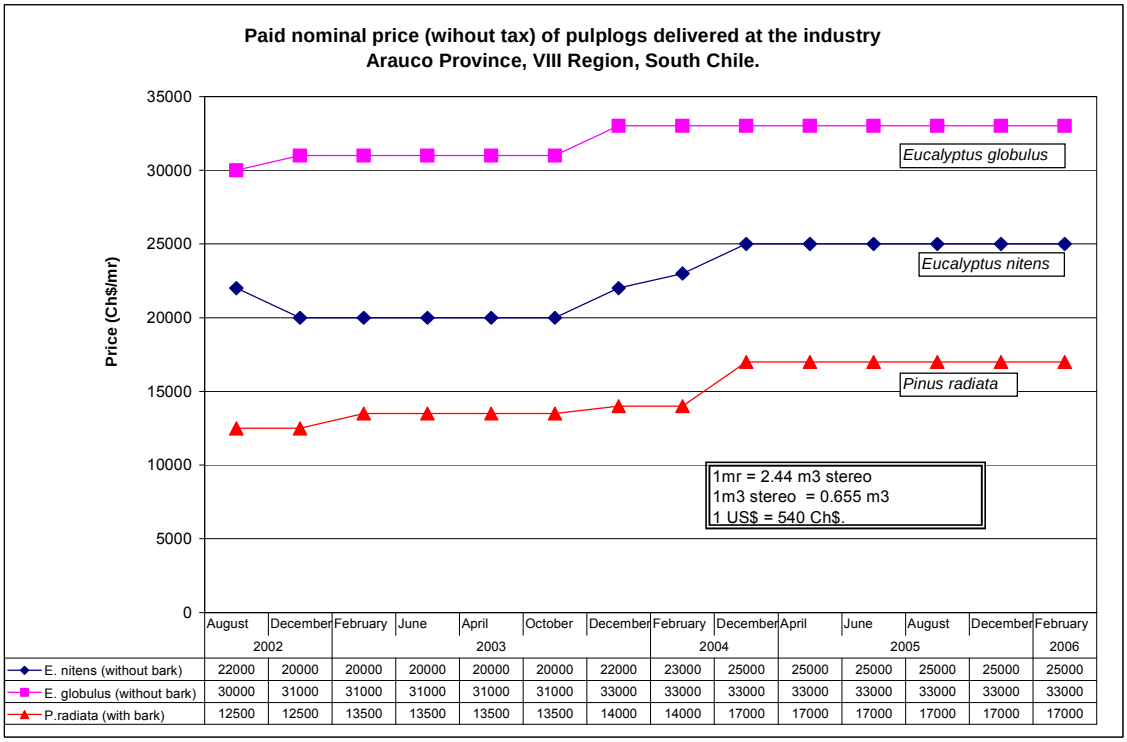
The cost of the technical guidance for forestry is normally including first pruning and thinning by subsidy of CONAF and INDAP program. But from second pruning and thinning the cost of management should be spend by the farmers For that reason implementation of technical guidance for forestry is important as enforcement of the sustainable project and income generation for the farmers with combination CONAF and INDAP program and technical support by INDAP and other agencies (Those program in detail refers to annex).

(7) Forestation cost

The planned planting cost, which gives base for economic assessment of A/R CDM, is properly calculated with sound unit price and process adapted to the local situation.

According to the project document in the Region X, forestation cost including land preparation, planting, weeding, fertilizing and fencing is estimated 693 us dolor per ha. Tending cost including fertilizing, weeding, pruning, thinning is estimated 608 us dolor per ha .and harvesting and transporting cost is estimated 17 us dolor per ha. Maintenance cost for regular watching for plantation to prevent forest fire, frost and wind damage is estimated 34 us dolor per ha annually.

Annex



	August	December	February	June	April	October	December	February	December	April	June	August	December	February
	2002		2003					2004		2005				2006
E. nitens (without bark)	22000	20000	20000	20000	20000	20000	22000	23000	25000	25000	25000	25000	25000	25000
E. globulus (without bark)	30000	31000	31000	31000	31000	31000	33000	33000	33000	33000	33000	33000	33000	33000
P.radiata (with bark)	12500	12500	13500	13500	13500	13500	14000	14000	17000	17000	17000	17000	17000	17000

Annex Figure1 Trend of the price of pulp wood

Annex Table 1 Produced seedling in Region X and Region XI

	symbol	common name	scientific name	local species	foretation X	foretation IX	coniferes	broad leaf	height(m)	DBH(m)	remark
1	Abe	Abedul									costal area
2	Al	Alerce	Fitzroya cupressoides	◎	◎		◎				
3	Ala	Alamo									
4	Ali	Aliso									
5	Ar	Araucaria	Araucaria araucana	◎		◎	◎				
6	Ara	Aromo aus									
7	Aro	Arumo									
8	Arr	Arrayan	Luma apiculata	◎				◎	15		
9	Ave	Avellano	Gevuina avellana	◎	◎			◎	20		
10	Be	Belloto	Beilschmiedia miersii	◎	◎			◎	20		
11	Bo	Boldo	Peumus boldus	◎				◎	20		
12	Ca	Castano									
13	Cc	Cipres dela coridillera	Austrocedrus chilensis	◎			◎				
14	Ci	Cupressus									
15	Cn	Canelo	Drimys winteri	◎	◎			◎	30	1	
16	Co	Coigue	Nothofagus dombeyi	◎	◎	◎		◎	50	4	
17	Ea	Ensina									
18	En	Especies nativas									
19	Eu	Eucalyptus sp									
20	Eg	E. globuls									
21	Eun	E.nitens									
22	Ex	Especies exoticos									
23	La	Laurel	Laurelia sempervirens	◎	◎			◎	40	2	
24	Le	Lenga	Nothofagus pumilo	◎		◎			15–30	1	
25	Li	Linge	Persea lingue	◎	◎			◎	30	1	
26	Ma	Manio	Saxegothaea conspicua	◎	◎		◎				
27	Mai	Maiten	Maytenus boaria	◎	◎			◎	20	1	
28	No	Nogal									
29	Nof	Nothofagus sp									
30	Ni	Nirre	Nothofagus antarctica	◎		◎		◎			
31	Ol	Olivillo									
32	Orn	Especies ornamentoles									
33	Pe	Peumo	Cryptocarya alba	◎	◎			◎	20	1	
34	Pi	Pino insique									
35	Po	Pino oregon									
36	Pp	Pino ponderosa									
37	Ra	Rauli	Nothofagus alpina	◎	◎			◎	30	1	
38	Ro	Roble	Nothofagus obliqua	◎	◎			◎			
39	Ti	Tineo	Weinmannia trichosperma	◎	◎			◎	15	1	
40	Ul	Ulmo	Eucryphia cordifolia	◎	◎			◎	40	2	

Annex Table2 List of disease and insect damage for *Eucalyptus nitens*

Item	Cause	Parts	Te name of disease damage and inset damage
Disease damage	Fungus	Leave	Odium spp
			Botryotinia fuckelinana
			Hainesia lythri
			Alulographis eucalypti
			Harknessia spp
			Mycosphaerella spp.
			Mycosphaerella molleriana
			Phaeoseptoria spp.
			Kirramyces eucalypti
		Stem	Botryospaeria spp.
			Endothia gyrosa
Insect pest		Damaged of leaf	Chrysophtharta spp.
			Paropsis spp.
			Paropsis spp.
			Paropsis charybdis
			Antheraea eucalypti
			Antheraea helena
		Sabsucking	Ctenarytaina eucalypti
			Eriococcus spp.
			Glycaspis brimblecombei
		Borer	Phoracantha semipunctata
			Chilecomandia valdiaiana

Source：Eucaluyptus nitens en chile: primera monografía,info. Tecnico no 165 valdivia July 2004

Annex Table3 Comparison between *Eucalyptus nitens* and Pinus radiata

Contents	*Pinus radiata*	*Eucalyptus nitens*	Remarks
Wood production	2004：598,004 ㎥ 2005：612,647 ㎥	2004：14 ㎥ 2005：4,87 ㎥	Statistics of INFOR
Forest management system	Aim：timber production Cutting period：22years Thinning ：2times	Aim ： high value timber production Cutting period：22years Thinning ：2times	
Yield	Main cutting：439 ㎥/ha Thinning：71 ㎥/ha(second thinning)	Main cutting：489 ㎥/ha Thinning：95 ㎥/ha(second thinning)	
CO_2 sequestration (after 20 years)	512 CO_2ton/ha	644 CO_2ton /ha	Refer to the chapter of forest measurement in detail
Financial analysis	11.2％（＝IRR）	12.8％％（＝IRR）	Estimation by INFOR
Fire wood quality	Low density	High density	
Climate condition (site condition)	Minmam temperature：－7□ Average temperature：17-30□	Minmam temperature：－10□ Average temperature：10-15□	
Insect damage	Sirex wasp（*Sirex noctilio Fabricus*）		Information by SAG

Annex Table 4 Assistance of technical guidance for forest management

Asístanse	General discription
PNFFT(Programa Nacional de Transfarecia Tecnica Forestal)	PNFFT (Programa Nacional de Transfarecia Tecnica Forestal) started since 2002 carried out technology transfer for planting and forest management on the basis of general idea for forestry extension at a whole country level. Forms on the present situation and evaluation of forest management are made, while a database is made in this program by region.
SAT（Servicio de Asesoria Tecnica）	SAT is a scheme of technical support by INDAP to enhance modernization and marketing of agriculture for small-scale landowners and to help the forest management mainly by farmers. Now this support scheme includes forestry, But it is not used in the forestry of Region X. This scheme is used as an opportunity for forest management or life improvement of participatory farmers, so that smooth enforcement of a pilot project is expected in future.
GTT（Groupo Transfarencia Tecnica）	GTT is a scheme of the technology support by INDAP. INFOR is going to utilize this scheme for natural forest management project for forest conservation and local farmers The purpose of GTT is to assist farmers groups consisting of ten to eleven as a group in terms of technical aspect of agriculture production In this system, farmers always open monthly meetings in a group and analyzes contents of work, and a shares the responsibility. In the same way of SAT, this system can be used for technical guidance for the second thinning which is not covered by subsidy.

Annex Table 5　Forestation cost for Region X (Planting density: 1,250 ~ 1,668 trees/ha)

Area: 15 ha

Large item	Item	Cost (US$)	Remarks
Alternative land use cost		250/ha	
Establishment	Land preparation	170/ha	light mechanized land preparation and pitting
	Planting	215/ha	The cost varies up to planting density.
	Weeding	154/ha	Chemical spraying
	Fertilization	77/ha	The application is pending.
	Fencing	57/ha	Propped by 3m and 4 rows of barbed wire.
Post-planting expense	Fertilization	77/ha	Applied in the 1st year after planting
	Weeding	154/ha	Conducted in the 1st and 2nd years after planting
Subsidy		- 622/ha	
Silvicultural intervention	1st pruning	77/ha	Silvicultural intervention will be reconfirmed using the material. Subside 76/ha
	1st thinning	56/ha	Subside 43/ha
	After 2nd pruning	77/ha	
	After 3rd pruning After 2nd thinning	77/ha 90/ha	
	Professional consulting	31/ha	Consulting fee (subsidized)
Maintenance, administration and protection		34/ha	Insurance for damages by frost, wind and forest fire
Harvesting and transport	Roads	1/m3	
	Logging(felling and stocking)	5/m3	
	Management	1.85/m3	
	Loading	1.15/m3	
	Transport	8/m3	

note) based on the project summary for Region X

2. Region XI

(1) Forestation condition

In Region XI the planted areas are 2,451ha in 2001, 2600ha in 2002, 2,929ha in 2003, and 3,595ha in 2004 respectively. The planted area has been increasing and increasing rate 25% from 2001 to 2004.

Since 1996 when the revised forestry promotion law No.701 has been started, the planted area of small scale land owner including CONAF-INDAP program is increasing annually same as other forested land area conducted by other program or agency. In 2004 the percentage of planted area by small scale land owner in total planted area in Region XI achieved at 74% and the planted area by small scale land owner become high percentage in Region XI.

The planted area per house hold in Coyhaique commune become belong to the Pilot project area shows 18.7ha to 27ha since 2001. Average of planted area per house hold is 22.8ha and it shows seven times as planted area in Region X.

Table A4-11 Plantation area for small scale land owner

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1.All plantation in Region 11	2059	860	1802	1658	1809	1474	2451	2600	2929	3595
2.Plantation for small land										
2.1 Region 11										
Household	45	62	52	43	51	45	62	53	64	95
Plantation area	214.7	265.3	245.6	316	472.8	468.6	1429.2	1533.9	1881.1	2654.4
Plantation area per household	4.8	4.3	4.7	7.3	9.3	10.4	23.1	28.9	29.4	27.9
2.2 Coyhaique province										
Household	17	33	27	21	31	21	38	19	20	28
Plantation area	75.9	130.6	124.4	155.6	209.4	178.5	710.5	523.6	435	645.9
Plantation area per household	4.5	4.0	4.6	7.4	6.8	8.5	18.7	27.6	21.8	23.1
Percentage of plantaion for small scale land owner and plantation	10.4	30.8	13.6	19.1	26.1	31.8	58.3	59.0	64.2	73.8

Source: Estadisticas forestales 2004 : Region XI

(2) Wood production

1) Wood production

In 2004 wood consumption is 50,792 ㎥(without bark) supplied from natural forest mainly. From the natural forest Lenga*(Nothofagus pumilio)*, Tepa*(Laureliiopsis philippiana)*, Coihue*(Nothofagus dombeyi)* are consumed 3,894 ㎥, 5,152 ㎥ and 3,208 ㎥ respectively. Lenga*(Nothofagus pumilio)* occupied 76.7% of wood consumption of all tree species.

Wood production is 23,544 ㎥ supplied from natural forest same as wood consumption. Wood production of Lenga*(Nothofagus pumilio)*, Tepa*(Laureliiopsis philippiana)*, Coihue*(Nothofagus dombeyi)* are 18,392 ㎥, 2,226 ㎥ and 1,362 ㎥ respectively. Lenga*(Nothofagus pumilio)* occupied 78.1% of wood production of all tree species.

2) Wood market

Among the wood production, those product will be produced 6,469 ㎥ for export and 17,075 ㎥ for domestic to use material for construction, furniture and packing.

Pinus ponderosa has no experience of timber production in Region XI and its market has not been established yet. So *Pinus ponderosa* has high expectation to produce the timber for replying the demand of the timber in Region XI.

3) Wood price

According to INFOR wood price of *Pinus ponderosa* still have not been established because of no existence of market. So that wood price *Pinus ponderosa* will be estimated by using Pinus radiata price in Region X.

In Chile wood business for forestation normally is conducted on standing tree in the forested land. Stumpage price to be obtained by deducting the harvest and transport cost should be used for wood business.

According to the project document, wood price for pulp and timber are estimated at 11 US dolor per m^3 and 38 US dolor per m^3 respectively.

(3) Forestation technology

1) Tree species selection

The project document in Region XI show that tree species will be selected by the following point; 1)to grow fast for getting carbon credit, 2)to have the planting knowledge based on research result and experience of planting, 3)to adapt the local environment.

In Region XI main tree species for planting trees are *Pinus ponderosa* (Ponderosa pine)、*Pseudotsuga menziesii* (Oregon pine) and *Pinus contorta* (Contorta pine). Those tree species are native to north America and planted totally 24,925ha from 1993 to 2004. In Region XI, the size-wise order of planted areas is: *Pinus ponderosa* (17,617ha)> *Pseudotsuga menziesii (*4,631ha) > *Pinus contorta(*1,980ha). *Pinus ponderosa* is major plantation in this Region. Cohyaique commune in project site has 500 to 2,000mm in annual precipitation and locate in cool temperature area in 4 ℃ of annual mean temperature.

Pinus ponderosa has no transformation of stems by drying from spring winds and has wide adaptation of environment. *Pinus ponderosa* has much result of the research as seeding, nursery practice and planting by INFOR. *Pseudotsuga menziesii* is suitable for humid area such as Aisen Province which annual precipitation has 2,000mm but is not for good for dry condition. *Pinus contorta* is suitable for dry condition, shallow depth soil and low precipitation as 500mm below in eastern part of Argentina.

Table A4-12 Site condition of *Pinus ponderosa*

Environmental factors	*Pinus ponderosa*	Environmental factors	*Pinus ponderosa*
Annual precipitation (mm/year)	250 – 760 mm	Length of dry season	4 months
		Humidity	-
Annual mean temperature (oC)	5.5 - 10oC	Frost	90-154
		Soil texture	light, heavy
Minimum temperature (oC)	-40oC	Soil pH	6 – 7
Soil depth	Shallow, Medium		
Drainage	Good ~ fair		

Note: INFOR：Pino ponderosa y pino oregon, confieras para el sur de Chile

Moreover comparing with those three species at the view point of wood quality, *Pseudotsuga menziesii* is highest quality rather than other two tree species. But planting site for *Pinus ponderosa* are restricted to small frequency of wind in Region XI because of occurrence

of wood torsion by the wind.

From the view point of adaptation for natural condition, large scale of plated area and good quality of wood, *Pinus ponderosa*is considered to be suitable for A/R CDM.

Table A4-13 Comparison of *P.ponderosa*, *Pseudotsuga menziesiiand, Pinus contorta* at the view point of the plantation scale and adaptation to the natural condition

Usage	Timber quality	Plantation area	Adaptation to the natural condition (climate condition)
P.ponderosa	Middle	Large	Strong against wind, dry and low temperature
Pseudotsuga menziesii	High	Middle	Occurrence of the torsion of stem by the wind, Weak against dry
Pinus contorta	Low	Small	Strong against dry. Suitable for thin depth soil

Source: Interview from the INFOR

Comparing with *Pseudotsuga menziesii* and *Pinus contorta, Pinus ponderosa* does not spread surrounding the natural vegetation and it considered not to be invasive species.

The seedling production technology of Lenga (*Nothofagus pumilo*) and Coigue (*Nothofagus dombeyi)* has been established (refer to annex). But INFOR said provenance test of Lenga(*Nothofagus pumilio*) has been conducted in the Reserva Nacional Cohyaique in Cohyaique commune since 2000 and planting and management technology has been yet established about light intensity control to the seedling and damage of here and rabbit. For the reason the A/R CDM project should be conservative about the introduction of the native species and it is necessary to examine again to introduce the native species for this A/R CDM project after accumulation of the research data in future.

2) Nursery practice and seedling production

The nursery has eight in Region XI. 6 nurseries belong to CONAF and 2 nursery managed by private company (Foretal Mininco、Soc.Vivero El Trapial Ltda). Seedlings were produced 5,355,000 seedlings of all of the region in 2004 and it considered that 70% of produced seedlings are *P.ponderosa*. from the forestation condition.

Table A4-14 Seedling production in Region XI（2004-2005）

Zone	Number of nursery	Produced Seedling (thousand)
Aysen	3	3,440
Coyhaique	3	1,770
General Carrera	1	15
Capitan Prat	1	130
Total	8	5,355

Source：Estadisticas Forestales 2004, Region XI

According to Forest Mininco, 2.4 million seedling was produced in 2005 and 3.3 million seedlings in 2006. Since 1991 Forestal Mininco has started forestation and until now has planted in 15,506ha (as of March, 2006). Recently plating has been conducted about 1,500ha per year. *Pinus ponderosa* occupied 70% above among planting trees in Region XI.

Seedling of *Pinus ponderosa* produced from the Forestal Mininco has been used in 50% for his plantation and remains have been sold to other plantation.

Seedling from Forestal Mininco to the pilot project can be supplied to 1,610,000 seedlings in 2007 and 2,050,000 seedlings in 2008. But seedling production in 2009 and 210 has not been planned. It is difficult to supply the seedling to the project in 2009 and 2010 by only 1, 650,000 seedlings to be produced in present 6 greenhouses only. If the planting will be conducted on schedule, it will need to construct green house additionally.

Table A4-15 Planed seedling of project and seedling to be supplied from Forestal Mininco

Year	2:0	1:1	total	A/RCDM project	Balance
2007	1,130,000	480,000	1,610,000	650,000	960,000
2008	400,000	1,650,000	2,050,000	1,250,000	800,000
2009	-	?		2,500,000	-2500,000
2010	-	?		3,125,000	-3,125,000
total	1530,000	2,130,000	3,660,000	7,525,000	-3,865,000

note） 2:0: seedling on the ground for 2 years, 1:1：seedling on the ground for 1 year and in greenhouse for more 1 year

The project participants has decided in fourth mission and planted area decrease from 6,000ha to about 500he and over. Following this situation planting period was reduced from 4 years to 2 years. So that the seedling from Forestal Mininco in not problem to supply to project because of reduction of planting scale and planting period.

The standard of quality control of nursery practice technique for *Pinus ponderosa* is said to possess belong to his own company because of majority of nursery business managed by private company in Chile. And Foestal Mininco purchase high quality seed certified US Agriculture Department and produce the high quality seedling according to ISO14001.

In the case of *P.ponderosa* in Region XI the rule about imported seed by SAG has changed from this year and by this role seedling production should be raised in the greenhouse at first one year and on the nursery bed at next one year within the nursing period to control the disease.

Table A4-16 The contents of seedling practice of *Pinus ponderosa*

Item	*Contends*
Type of seedling	Bare root
Procurement of seeds	Purchase(USA)
Seed collection period	Feb-Mar
Pregermination treatment	Water, 4oC, 24 hours
Soils and container	Use of pine bark, Use of pot
Damage by disease and insect	Mould, birds, insect, chemical praying
Shading	Unnecessary
Nursing period	2 years: greenhouse(one year), field (one year)
Transplanting period	Middle of Sep- Middle of Nov

Note: interview from INFOR

3) Planting and tending

Planting will be conducted on grass land which the suitable land classification is ranked for VII class in the presence of project participants. According to CONAF, the suitable area for plantation is high productivity soil with slope but steppe land, 950m and above in sea level, 100% of inclination of slope should be avoided.

For this project planting density is 1,250 seedlings per ha. The tree planting will be conducted from September to October in spring. The seedling should be prepared taking into consideration of timing and number of seedling because of raising period for 2 years in nursery. Land preparation cut the grass surrounding the planted trees without machinery.

From the site condition, the project will not be conducted for weeding and fertilizing. Fencing will be set up surrounding the planting area before tree planting to prevent planted trees from the cattle.

Table A4-17 Planning Standard of *Pinus ponderosa*

Item	Contents
Site	High productivity on slope area
Density	1,111～1250seedling/ha
Period	Middle of April to end of May、Middle of Aug to middle of Dec
Land preparation	Clearing the grass around the planting hole
Planting	Digging and planting by manual、planting hole of 40㎝×40㎝×35㎝
Weeding and fertilizing	Weeding and fertilizing by manual before and after planting, the name of chemical spraying and fertilizer: unknown
Protection	Fencing for grazing, countermeasure for animal, countermeasure for rabbit

Note：INFOR：Pino ponderosa y pino oregon, confieras para el sur de Chile

Pruning will be conducted two times after planting to produce the knotless wood in future, to keep the space for the forest activities, to conserve the ground vegetation and to introduce cattle grazing in planted area. First pruning will be conducted to until 1.5m in height of every tree because of the characteristic of *Pinus ponderosa* which grows well under part of branches in early stage of plating. Second pruning will be conducted to until 4.0m in height of 500 trees within the standing trees (850 trees per ha) after thinning. Branches to be pruned will be left in the planted area basically. Those branches will be accumulated along the contour line on the steep slope to conserve the soil erosion. And pruning should be conducted in dormant period from autumn to spring.

Thinning will be conducted one time after plating to help the growth of high quality trees and to conserve the ground vegetation. Thinning will be conducted before second pruning and number of thinning trees area 400 trees per ha to avoid the over release of canopy. The thinning will leave the strait and nontaperness of stem and cut dominated trees. Harling method of thinned trees should be considered which cattle or machinery will use depending on the forest condition.

4) Annual schedule for forestation

The planting period is restricted in project area for cool temperature and transportation of seedling and fencing is conducted as planting period. From the interview in the field annual forestation schedule is as follows.

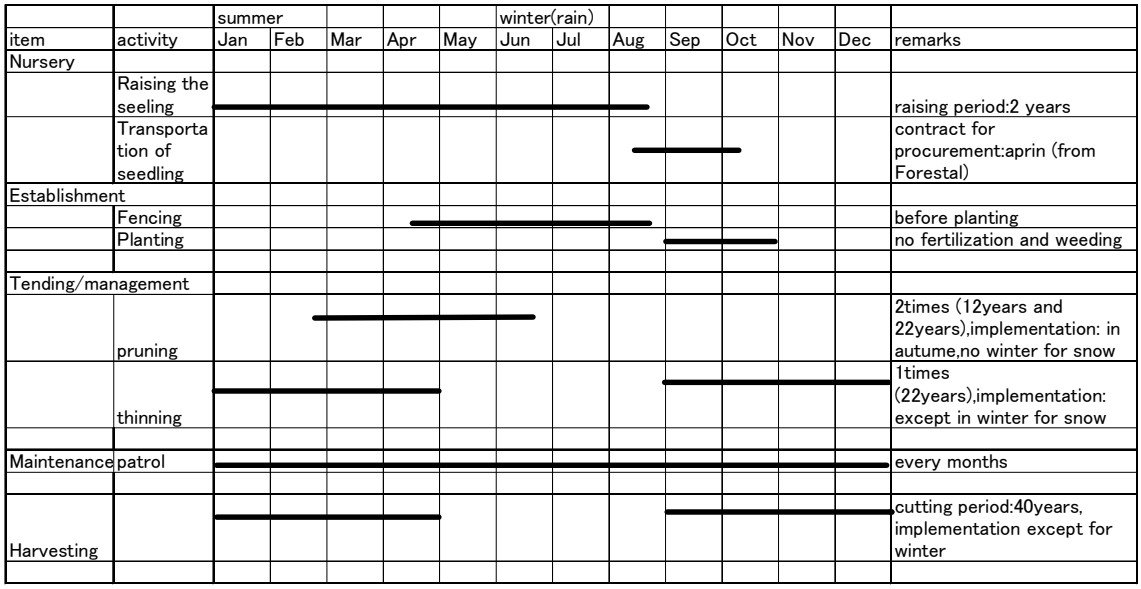


Figure A4-2 Annual schedule for forestation

(4) Forest protection

1) Forest fire

According to the scale of the occurrence of forest fire from 1989 to 2004 in Region XI it shows 30,196ha in 1997, 2,613ha in 1989, 944.6ha in 1995, 795ha in 2004. the damage in 1997 was the biggest one. Those damages mainly occurred in the natural vegetation (forest, bush, grassland). Actually there is little damage of plantation area. The reason for the small scale and little frequency of forest fire of man-made forest is considered as small number of population and no burning to forest. MININCO was set up the fire belt in and around the plantation area to prevent the forest fire.

In cooperation with CONAF and Border police, CONAF regional forest office has 70 fire fighters (including non permanent staff) in 5 provincial forest office and the border police in Region XI has 60 members for fire fighting.

2) Disease and insect damage

The damaged insect of *P.ponderosa* which is native to North America was reported 108 species and the damage of disease also was reported several species in North America. At the moment there is no information about those insect and disease in Chile. The plantation of *P.ponderosa* in Coyhaique National Reserve in Region XI is reported to find extraordinary defoliation by the competition among plantation trees and increasing of moisture in the high density forest which does not conduct any treatment and to need the maintenance for the good environmental condition by the pruning and thinning.

3) Grazing

As Region X, the damage of grazing was not reported in the statistics. As the result of field survey, the countermeasure for grazing has been introduced in planted area as fencing and it is considered that this method will mitigate the damage from grazing.

4) Climate damage

The damage of planted trees by drought, cold wind and low temperature was not reported, the damage by drought and low temperature was not found in the field. But the damage of cold wind and hare was found slightly in dry area at the eastern part of Cohyaique commune.

As mentioned above, there seems to have low risk of forest protection for A/R CDM because the damage of forest fire, insect and disease, grazing, climate etc. to *Pinus ponderosa* is considered as no problem.

(5) Forest management

1) Forest management standard

The forest management standard was proposed as pruning in 12 years, thinning in 22 years and final cutting in 30 years for timber production on project document in Region XI. But from the opinion of CONAF and Forestal Mininco, finally the forest management standard was prepared with 2 times pruning and 40 years for final cutting.

Table A4-18 Management standard of P.ponderosa

Year	Activity	Timber production
0	Planting	1,250 trees/ha
1-40	Management	Patrol
12-22	Pruning (Podas)	Pruning1:10-12 years 1,250 trees/ha Pruning1:22-24 years 500 trees/ha
22	Thinning (Raleos)	400 trees/ha for thinning
40	Final cutting	DAP 40cm (850 trees/ha)

Note: Information source is “project documents in Region XI ” by INFOR and interviews.

2) Implementation plan for forestation

The period of A/R CDM project in Region XI will be planned as A/R CDM in 30 years and normal forestation in 40 years. So planting will be conducted one time during 40 years. The total planting area are 6,000ha and will be divided into 4 years, 500ha in first year(2007), 1,000ha in second year(2008), 2,000ha in third year(2009) and 2,500ha in fourth year(2010) considering that the planting area is increasing in latter half of planting period.

3) Procedure for forestation

a. Explanation for forestation to the farmers

Operador mainly contact each local people and explain to prepare forestation for them. To obtain the agreement for forestation from local people it is said to take about one months since starting the extension activity.

b. Preparation for forestation plan

To conduct the plantation technical study should be submitted to CONAF. The technical study is prepared by operador normally.

c. Implementation and inspection for forestation

After proving the technical study (forestation plan), the planting will be started on farmer's land. Labor for forestation will be procured generally by operador.

Inspection method of forest establishment such as planting, fencing is established but inspection method of forest management such as pruning and thinning still have not been established yet because pruning and thinning will be started from now on to take 10 years after planting by CONAF-INDAP program. So the result of examination for inspection method will be expected.

d. Preparation for forest management

Reforestation should be conducted after final cutting according to the revised forest promotion raw No. 701 and the forest management and technical study should be prepared explaining before harvesting. The procedure of forestation in detail shows as annex.

As mentioned above, it is considered for exploiting the CONAF forestation program to be effective as conducting implementation of A/R CDM project from the view point of utilization of subsidy, comprehension of local people, support of operador and existence of established institute.

(6) Technical guidance for forestation

Actually, the guidance targets about forest management in Region XI are extension workers to supervise work instead of large-scale landowner. According to INFOR in Region XI, the technology transfer item for A/R CDM needs to be conducted for pruning, thinning and grazing control according to the result of PNFFT. It will be necessary to prepare the money by themselves or to be supported by the technical guidance such as farmer's tour from CONAF or private company.

Table A4-19 The contents related to forest management

Item	Contents	Period
Planting	Confirmation of situation of the planted trees	At the beginning of the planting
Maintenance	Understanding situation of pruning and thinning through the tour	8 to 10 years from the beginning of the project
Grazing management	Visiting the good practice for grazing control. Confirmation of place of damage	8 to 10 years from the beginning of the project
Monitoring	Confirmation of sampling for CO_2	8 to 10 years from the beginning of the project
Cutting and harvesting	Confirmation of the final cutting, cost, transportation	40 years from the beginning of the project

Because it is difficult to have a budget for forest management in Region XI under present subsidy system of CONAF. The material for forest instruction of forest management was prepared as pruning and thinning of *Pinus ponderosa* by INFOR.

(7) Forestation cost

According to the project document in the Region XI, forestation cost including land preparation, planting, and fencing is estimated 485 US dolor per ha. Tending cost including pruning in 2 times, thinning in 1 time is estimated 976 US dolor per ha, Maintenance cost for regular watching for plantation to prevent forest fire, frost and wind damage is estimated 43 US dolor per ha annually and harvesting cost is estimated 17 US dolor per m^3. The detail of forestation cost is shown in annex

The cost of procedure of forest management and technical study to be prepared for forestation, the forestation technical expense, is 55.98 US dolor per ha. And subsidy rate for participants is different from small-scale land owner and middle and large scale landowner, former is 90% and later is 75% respectively. For this project 75% of subsidy will be prepared.

(8) Fuel consumption related to forestation activity

Fuel consumption of vehicles for transportation of materials and labors is fundamental for estimation of emission and leakage occurred by project activity. Those data from INFOR and Forestal Mininco was referred

There is no fuel consumption for chain saw and track to harvest and transport inside the project boundary because the project period (30years) is shorter than cutting period (40 years). But the following activity for forestation will be estimate for fuel consumption as emission.

a. Transportation of seeding
b. Transportation of material for fencing
c. Tending of planting tree(pruning and thinning)
d. Maintenance (patrol of planted area)

Annex

Annex Table 1 Procedure for forestation

Item	Contents
Approach for farmers	The following three approach exists in the case of CONAF-INDAP program ① Operador contacts farmer individually to plant trees ② CONAF announced forestation plan by newspaper and after that operador contacts farmer to plant trees. ③ CONAF contacts farmer directly according to the forestation plan. The agreement from farmer needs to takes about 1 month at the beginning of extension activity.
Preparation and approval for plan a	To implement the forestation by CONAF-INDAP program, operador needs to prepare the related document, submit the technical study and receive the approval from the CONAF. And finally the farmer will be receive the subsidy from CONAF. ① Application of lands as preferably used for forests ② Submission of technical study based on lands as preferably used for forests ③ Certification of lands as preferably used for forests ④ Certification of land title ⑤ Approval for lands as preferably used for forests ⑥ Approval of subsidy The most workable issues for preparation of technical study is to select and decide the boundary with land owner. The preparation of application form needs to take one month and the review of application contents needs to take two months at the maximum.
Implementation and inspection	(1) Planting trees After planting the seedling, CONAF will inspect the condition of seedling in one year and three year. ① If 80% of planted seedlings will survive at the first inspection after one year of planting, subsidy will be given to the farmer. ② After three years of planting if the seedling survives below 80%, subsidy will be given in accordance with survival rate. The circle plot with a radius of 10 m in the planted area will be set up and number of trees in the circle plot will be counted for inspection in the field. (2) Pruning and thinning In general operador will prepare the technical study which contents of pruning and thinning was described. It needs to take three month to prepare the application form. The pruning and thinning in CONAF-INDAP program has been little experienced and the inspection method needs to be examined from the objective and practical viewpoint.
Preparation for forest management	Reforestation should be conducted after final cutting according to the revised forest promotion raw No. 701 and the forest management and technical study should be prepared explaining the contents of harvesting and replanting.

Annex Table 2 Forestation cost for Region X (Planting density: 1,250 ~ 1,668 trees/ha)

Large item	Item	Cost (US$)	Remarks
Establishment	Seedling	251/ha	Seedling :0.149 per seedling, transplantation:0.007 per seedling,
	Planting	177.52/ha	Manual planting and mechanical transporting
	Fencing	57/ha	Propped by 3m and 4 rows of barbed wire.
Silvicultural intervention	1st pruning	248/ha	12 years after planting
	1st thinning	480/ha	22 years after planting
Maintenance, administration and protection		43/ha	Insurance for damages by frost, wind and forest fire
Harvesting and transport	Transport	25/m3	

Annex Table 3 Fuel consumption by transportation of forestation

I Fuel consumption by transportation per 100ha

1. Plantation (camping)

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Truck	diesel	1	400	0.2	80	liter	5 ton, 200km*2 times
Bus	diesel	1	400	0.2	80	liter	30 persons,200km*2times
Pick Up	diesel	1	400	0.143	57	liter	4x4,200km*2times
				subtotal	217	liter	

1. Plantation (transportation) per 100ha

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Truck	diesel	1	400	0.2	80	liter	5 ton, 200km*2 times
Pick Up	diesel	1	400	0.143	57	liter	4x4,200km*2times
				subtotal	137	liter	
				total	354	liter	

2. Fensing per 100ha

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Truck	diesel	1	400	0.2	80	liter	5 ton, wire,200km*2times
Truck	diesel	1	180	0.2	36	liter	5 ton, pole, 20km*9times
				total	116	liter	

3. Patrol

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Pick Up	diesel	39	200	0.143	1,115	liter	1time/week*52weeks*9/12
				total	1,115	liter	

4. Pruning 1 per 100ha

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Truck	diesel	1	400	0.2	80	liter	5 ton, 200km*2 times
Bus	diesel	1	400	0.2	80	liter	30 persons
Pick Up	diesel	1	800	0.143	114	liter	4x4
				total	274	liter	

5. Pruning 2 and thinning

x	y	Nxyt	Kxyt	exyt	total	unit	remarks
Truck	diesel	1	400	0.2	80	liter	5 ton, 200km*2 times
Bus	diesel	1	800	0.2	160	liter	30 persons,200km*4 times
Pick Up	diesel	1	800	0.143	114	liter	4x4, 200km*4times
				total	354	liter	

The calculation was conducted on the following assumption. 1) The distance from Coyaique to project area is 200km, 2) the transportation of material is conducted by 5 ton track, 3) the labors is carried by bus hold 30 people, 4)the patrol for project site is used for pick up type vehicle with 4WD.

Appendix 5. Results of consideration on Forest Measurement

1. Region X

(1) Estimation of yield and living biomass

In the case of *Eucalyptus nitens* in Region X, the existing yield estimation model were applied. The parameters for conversion from merchantable volume to biomass are procured from locally available data as well as GPG-LULUCF's default values for *Eucalyptus nitens*.

1) Findings

The project description prepared in June 2006 assumes the high-value timber production by *Eucalyptus nitens* as the main part of the project activity.

MAI of *Eucalyptus nitens* is approximately estimated at 45 m^3/ha/yr on average. According to Barros (1993), MAI by provenance indicates 10～20m^3/ha/yr at 6-year-old stand, and 34～46 m^3/ha/yr at 12-year-old stand.

The estimation of growth is conducted mainly for commercial stem volume by the following models.

① EUCA3.3
② Regressive equation by INFOR
③ EUCASIM (by Chile Foundation)

The most practical one is said to be the EUCA3.3. The growth estimation requires the following parameters. The model has enough data on *Eucalyptus globulus* in Region 8 and 9. It allows developing functions for estimation of corresponding growth to forest intervention. However, in the case of *Eucalyptus nitens* in Region X, the development is still underway while the estimation is limited to the one without forest intervention.

Growth estimation was done by EUCA3.3. However the coefficients are confidential for INFOR. There is an old model, EUCA2.1, which is almost the same in equations and coefficients. In this report, those of EUCA2.1 is reported as follows.

Table A5-1 Growth and volume equations for *Eucalyptus nitens*

Eucalyptus nitens (Model for stands (EUCA) and Coefficients are of Version 2.1.)
Height: $H = a * \left\{1 - \left[1 - (s/a)^b\right]^{t/tc}\right\}^{1/b}$
Where
H= dominant height (m, 100 trees/ha)
Dominant height is defined as average height of the 100 biggest trees (in DBH) by hectare.
s= site index (at the age of 10 yr)
t= age of year
tc= base age (= 10th year)
a,b= coefficients *a*= 75.3, *b*=0.863
Mortality: $N_2 = N_1(t_2/t_1)^{b1} EXP\left[b_0(t_2 - t_1)\right]$
Where
N_2= tree number per ha at t_2
N_1= tree number per ha at t_1
t_2= stand age at 2nd time
t_1= stand age at 1st time

b_0, b_1= coefficients b_0= – 0.014, b_1=0.034, R^2=0.98

Basal area: $G = EXP[b_0 + b_1 Hm + b_2 Hm(1/E) + b_3 Nm(1/E)]$

Where
G= basal area (m^2/ha)
H= dominant height of 100 trees (m)
N= planting density (trees/ha)
Hm= 1/(*H* – 1.3)
Nm= $100/N^{1/2}$
E= age (year)
$b_0,\ldots,b_3$: coefficients b_0=4.989, b_1=–31.746, b_2=54.719, b_3= –1.724, R^2=0.86

Volume (per ha): $V = G[b_0 + b_1 H + b_2 (H / N^{1/2}) + b_3 (NH / G)]$

Where
V= volume (m^3) up to 5 cm of diameter
(Merchantable volume, volume until the tree reach 5cm in DBH)
G= basal area (m^2/ha)
H= dominant height of 100 trees (m)
N= planting density (trees/ha)
b_0,b_1,b_2,b_3= coefficients b_0=–0.261, b_1=0.323, b_2=0.215, b_3= –0.00013, R^2=0.98

Volume (per tree): （single-tree volume equation）

$$V = -0.00198 + 0.000026756 * D^2 * H$$

Where
V: Merchantable volume (m^3) up to top diameter of 5 cm
D: DBH (cm) H: total height (m)
r=0.98 Standard Error=0.0220

Source: INFOR (2000) Informe Tecnico N°148

For convenience, site conditions were divided into three classes of dominant heights: 27.2m, 31.7m and 35.0m. The lowest or most conservative estimation were conducted by the site condition of 27.2m for growth estimation.

Table A5-2 Applied parameters

Parameters for model estimation	Assumed values in provisional estimation
1) Planting species	*Eucalyptus nitens*
2) Dominant height (Dominant height is given from average height of the 100 largest trees (in DBH) per ha at 10-year-old stand.)	27.2 m
3) Basal area (m^2/ha)	15
4) Planting density (trees/ha)	1,429

Note: The assumed values for estimation are obtained from research plots deployed adjacently.
Source: INFOR Valdivia, March 2006

The reality of the coppice regeneration of *Eucalyptus nitens* seems difficult if the stand is harvested in the age of 13 years. Usually the harvested stand is replanted. Currently a research project on growth model development including forest intervention on *Eucalyptus nitens* is in operation and scheduled to finish in November 2007.

The used parameters to convert the merchantable volume to living biomass are as follows.

Table A5-3 Applied parameters

D	BEF	R		CF
Tonnes d.m./m^3	-	AGB(t/ha)	-	Tonne d.m.-1
0.457	**1.40**	<50	**0.450**	**0.5**
		50-150	**0.350**	
		>150	**0.200**	

Source: D: Informe Tecnico 165, INFOR BEF, R (Temperate broadleaf forest / plantation), CF: GPG-LULUCF

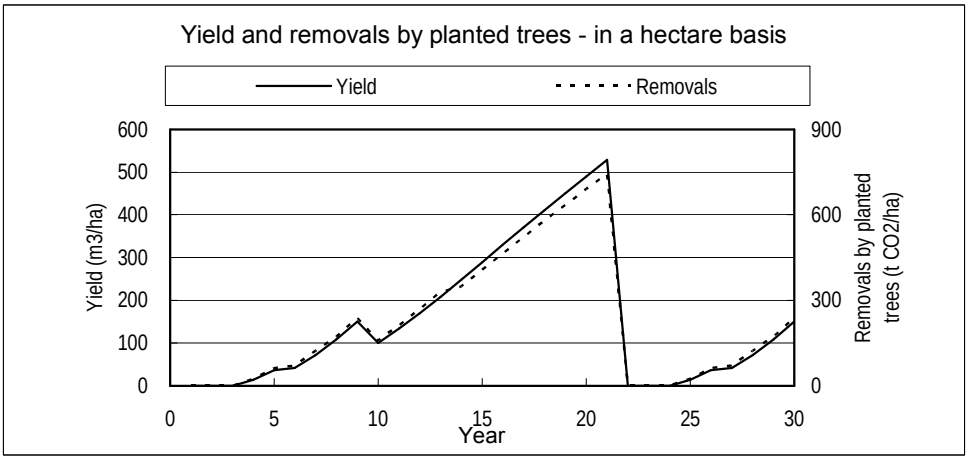
In this report the above values were provisionally applied to get estimation at a hectare basis by assuming the following forest management. Conversion factor from carbon to CO_2 is given at 3.667.

Table A5-4 Assumed forest management

Forest management	Timing (age)	Density (pl/ha)
Planting	0	1,429
1st thinning	5	700
2nd thinning	9	300
Pruning	3, 4, 5	700, 500, 300
Final cutting	20	300

Note: INFOR Valdivia (2006)

The results are as follows. (see Annex)

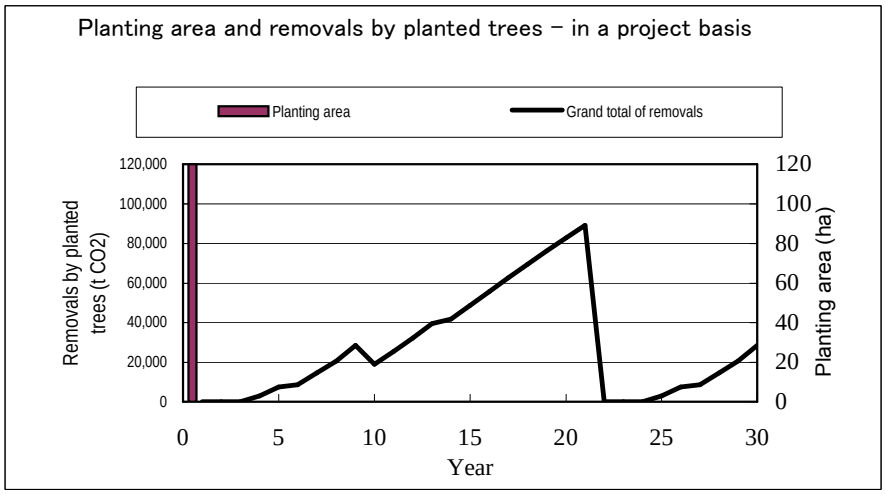


Note: The year refers to the project year (= stand age + 1).

Figure A5-1 *Estimation of yield and GHG removals by living biomass in Eucalyptus nitens stand in a hectare basis*

Based on the above data, annual values were estimated in t CO_2 as follows. (see Annex)

At the moment, the planting area is assumed to be 120 ha. The removals significantly decrease by thinning at the ages of 5 and 9 years and final cutting at 20 year old. This trend continues to be significant due to single planting year.



Note: The year refers to the project year (= stand age + 1).

Figure A5-2 *Estimation of GHG removals by living biomass in Eucalyptus nitens stand in a project basis*

2) Estimation of growth of Pinus radiata

In order to respond to local needs, *Eucalyptus nitens* and *Pinus radiata* were compared in yield and GHG removals by planted trees with available data in the early 4th mission.

The growth features for *Pinus radiata* were assumed to be two site indices in the 10th zone (or central part of Region X): Site Index (or SI) 22 and SI 31[11]. The management system and the relation with the present pilot project are as follows.

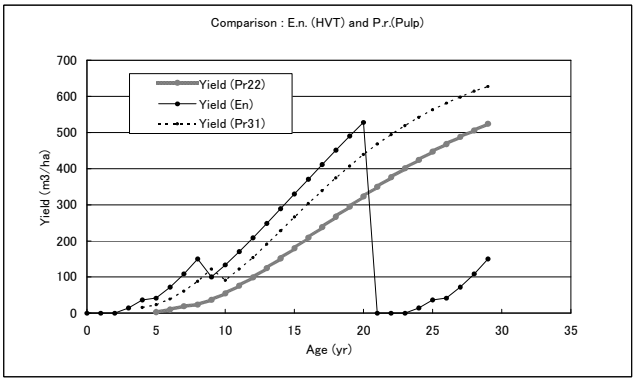
a. SI 22: The management system aims at pulpwood production including thinning at the age of 8 year old. The site productivity is relatively low and similar to the assumed one for the pilot project.
b. SI 31: The management system aims at timber wood production by intensive management including thinning at the ages of 5 and 10 year old. The site productivity is higher than the one assumed for the pilot project. The values are the maximum ones that can be expected for *Pinus radiata.*

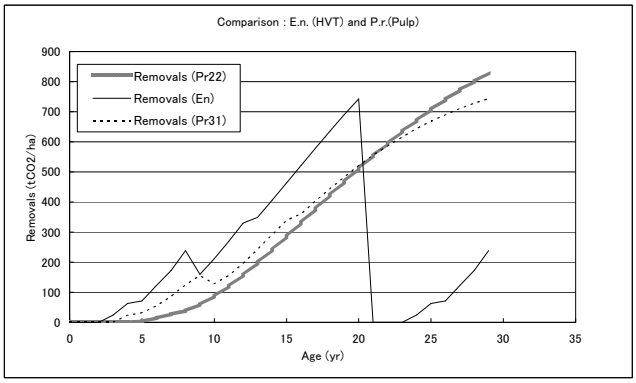
As a result of comparison, *Eucalyptus nitens* has higher growing speed in terms of both stem volume and GHG removals. *Eucalyptus nitens* can continue to show larger growing stock than *Pinus radiata* while it can provide 27 m^3/ha and 93 m^3/ha through two times of thinning conducted at the age of 5 and 9 year old. On the other hand, *Pinus radiata* can expectedly provide 7 m^3/ha at SI 22 and 79 m^3/ha at SI 31.

Accordingly the following conclusions are given. After all, *Eucalyptus nitens* can dominate *Pinus radiata* in terms of wood production and GHG removals except for the factor of value addition which is specific to respective tree species.

a. *Eucalyptus nitens* can provide more yield from thinning earlier with higher growing stock. (17 fold for SI 22 or 1.3 fold for SI 31 of *Pinus radiata*)
b. In terms of GHG removals, the growth is faster and the growing stock is larger continuously. Therefore, the growing stock at any time and even the difference can be expected to be more.

[11] Site index is given by the height at the age of 22 year old. The data source is:
FUNDACIONCHILE (2005) Annex tables for production of *Pinus radiata* (PROYECTO FONDEF D01/1021)





Note: Pr22: *Pinus radiata* (site index=22) Pr31: *Pinus radiata* (site index=31) En: *Eucalyptus nitens* (SI=27.2 (m height of 10-year-old stand))

Figure A5-3 Yield and GHG removals comparison between *Eucalyptus nitens* and Pinus radiata

The following parameters are used for estimating GHG removals.

Table A5-5 Parameters applied

D	BEF	CF	CO_2/C
0.405	1.30	0.5	3.667

Source: D: INFOR (1987) Manual No.15 Tables for Mechanical Conversion and Elaboration, BEF: GPG-LULUCF, Table 3A.1.10 (3.178p)

Table A5-6 Root-shoot ratio (R) for *Pinus radiata*

	AGB (t/ha)	Mean
Conifer	<50	0.46
forest/	50 - 150	0.32
Plantation	>150	0.23

Source: GPG-LULUCF, Table 3A.1.8 (3.168p)

In the late of 4th mission, the following parameters were obtained from UACH document. When Pinus radiata is selected for the project activity, the living biomass can be calculated through the following parameters and the existing growth estimation model.

Table A5-7 Parameters available for *Pinus radiata*

D	BEF	R
0.3846	1.56	0.2543

Source: Gayoso, J., Guerra, J., Alarcón, D. 2002. Contenido de carbono y funciones de biomasa en especies nativas y exóticas.Proyecto FONDEF D98I1076. Medición de la Capacidad de Captura de Carbono en Bosques de Chile y Promoción en el Mercado Mundial. Universidad Austral de Chile (UACH). Valdivia. Chile. (Referred to as UACH 2002)

(2) Sampling method

The principles for sampling method for planted trees can be referred to in the parts of forest measurement in Region XI.

At the time of the 1st work in Chile, the pilot project was assumed to have normal scale (6,000 ha). In this case, the size was found by standard deviations of carbon amount in two strata (coastal range and central valley) after converting the existing data on commercial stem

volume to aboveground biomass. By optimum allocation for stratification, the sampling size was estimated at 84 plots (precision level 13%) and 141 plots (precision level 10%) at confidence level of 95%. These values were expected to be improved by increasing strata for stand age, etc. The latter one was thought to be relevant for conservative estimation of emission by the plot survey.

At the time of the 4th work in Chile, the pilot project was assumed to have small-scale. The outline of the sampling method was as follows.

Outline of sampling method for small-scale A/R CDM project in Region X

a. Basically GPG-LULUCF (4.3.3.4) will be applied.
b. The precision target shall be not larger than ± 10% at a 95% confidence level for the mean.
c. BEF method (Option 2) will be applied for living biomass estimation.
d. SOPs are to be prepared by translating and modifying the INFOR's forest measurement manual (Field Operation Manual for Plantation (FOMP), 2004, INFOR, Status: Draft version) to fit the methodologies. (The contents of FOMP can be referred to in the part of forest measurement for Region XI.)
e. It is necessary to estimate the sampling size in the same way as the normal scale.

The maximum planting area for the small-scale A/R CDM project will be approximately 120 ha in the case of high-value timber production by *Eucalyptus nitens* in question.

The sampling size of permanent sample plots is expected to be 69 plots as follows. (see Annex)

Table A5-8 Number of permanent sample plots

Region	No. of plots	Calculation ground
X	69	a. The standard deviation is based on sampling population amounting to 12. b. Precision level 10% at confidence level of 95%

Source: Calculated by INFOR Valdivia (as of June 2007)

(3) Geographic information for demonstration of land eligibility

1) Geographic information available in INFOR

INFOR has the following geographic data obtained through preparation of the project outline for Region X.

Table A5-9 Used GIS data and the attribute

Data/Parameters	Descriptions	Vintage	Resolution	Sources
Present land use	"Establishment of Control and Monitoring System for the Present Situation and Conservation of Natural Vegetative Resources" 1997	1997	1: 50,000	CONAF
Administrative boundary, SNASPE, road, cities	"Establishment of Control and Monitoring System for the Present Situation and Conservation of Natural Vegetative Resources" 1997	1997	1: 50,000	CONAF
DEM	SRTM	2000	60 m	NASA
Landownership boundary, cities Land use capacity	CIREN Chilean Domestic Taxation Services	1992	1: 50,000	CIREN
Satellite images	Landsat 5 data	March 2005, 1995	30 m	NASA

Source: INFOR Valdivia

The selection criteria of subject area for planting are summarized as follows.

a. Land use capacity (for forestation)
b. Present land use (cropland and shrub)
c. Slope: 15 ~ 60%
d. Selection of small-scale landowners (5 ~ 200ha)
   (for selection of small-scale landowners, Law 18.910 of INDAP)

As a result, approximately 6,000 ha were estimated for the scale of project activity following that 60,730 ha was primarily selected. These lands can satisfy the minimum requirement for lands for A/R CDM if the land eligibility for A/R CDM is demonstrated.

The preparation of geographic information on eligible land distribution was sub-contracted.

2) Geographic information on eligible land

The preparation was finalized in the middle of December 2006. The following data were prepared.

a. Land cover map for 1989
b. Land cover map for now
c. Eligible land distribution map

The following issues were carefully considered to attain appropriate information to demonstrate the land eligibility.

a. The above land cover classification using satellite data identifies non-forested land in conformity with Chilean forest definition for A/R CDM, of which minimum values of area = 0.5 ha, tree crown cover=25% and tree height =5m. Accordingly, the results are consistent with the forest definition for A/R CDM in the country in question.
b. Field verification was conducted and the results showed high accuracy. Therefore the data is highly reliable.
c. The current forest was identified with available latest data taken in February 2005. The newer vintage of data can contribute to more precise detection of the subject lands. (Data: at the end of 1989 (Landsat 5 TM, 25 Sep 1986, NASA), at present (Landsat 5 TM, 1 Feb 2005, INFOR))

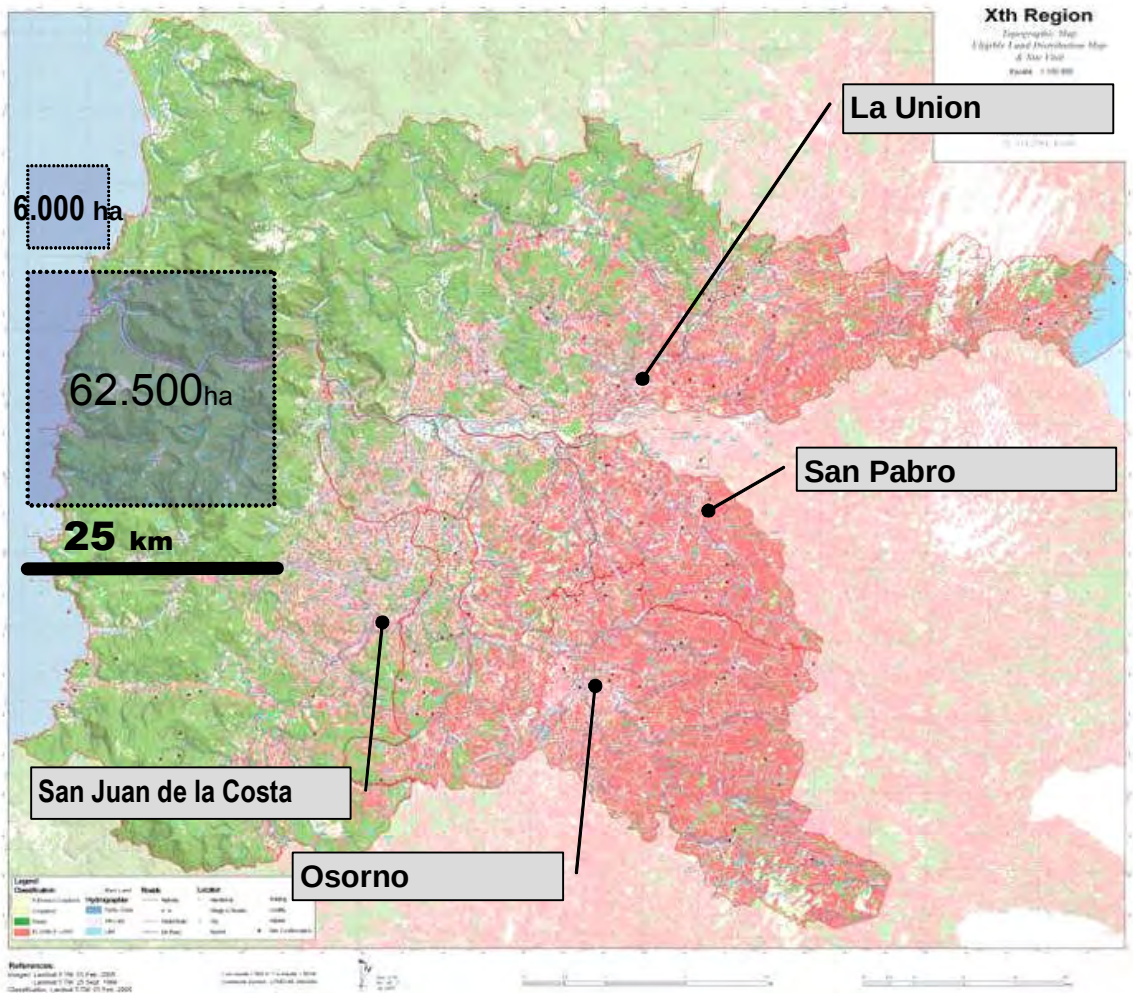
The following steps were taken in the sub-contracted work.

<u>Steps for detection of eligible lands</u>

a. Identification of area of interest (range of the commune in question)
b. Supervised training (identification of spectral signature)
c. Classification
d. Reclassification (merging fragmented land cover classes)
e. Reclassification (combination of land cover: non-vegetation, forest, non-forested lands for demonstration of eligible lands)
f. Detection of non-forested land at the end of 1989 and now
g. Intersection of both non-forested lands
h. Field verification of classified results
i. Assessment of accuracy of classification

The eligible land distribution map is shown as follows. The red parts show eligible lands. However those lands are not only unused grassland but also cropland and grazing land.

Large amount of eligible lands in Region X contiguously distributes in the central valley (*Valle Central*) while small ones are scattered along the coastal region and roads.



Note: The scale bar and the main city names are added to the original map for reference.

Figure A5-4 Eligible land distribution map for Region X

The total area of eligible lands in the Region X is as follows.

Table A5-10 Eligible land area in Region X

Region	Commune	Eligible Land	Eligible over total
	ha	*ha*	*%*
Xth Region	524,358.80	153,024.30	29.2

The accuracy level of overall and eligible land is found quite high as below.

Table A5-11 Accuracy level of overall and eligible land in Region X

■**Overall**

Region	Overall accuracy	Kappa statistics
	%	%
Xth Region	88.57	0.8005

■**Eligible land only**

Region	Producer's accuracy	User's accuracy	Kappa statistics
	%	%	%
Xth Region	92.1	89.1	0.78

The following data were used for the preparation.

Table A5-12 Data used for the study

Data/Parameters	Descriptions	Vintage	Resolution	Sources
Satellite Images	Landsat 5 TM	1984 to 2006	30 m	CONAE
Google Images	Quick Bird Images	2004 to 2006	0.6 m	GOOGLE
DEM	SRTM – 3	2005	60 m	NASA
Contour lines and river network	Derided from SRTM	2006	1/30.000	Aonek'er
Water bodies, road lines, cities, and others	Derived from Landsat Images and site visits	2006	1/30.000	Aonek'er
Names, road lines, cities, and others	And references from IGM Chile	Several years	1/50.000 and 1/250.000	IGM Chile
Vegetation Classification	Derived from Landsat Images	1984 to 2006	30 m	Aonek'er
Commune Boundary	Commune Boundary	No Info	No Info	INFOR

2. Region XI

In the case of *Pinus ponderosa* in Region XI, the existing yield estimation model at single-tree level was applied. The parameters for conversion from merchantable volume to biomass are collected from locally available data which were attained from the vicinity areas of the subject area for the pilot project.

(1) Estimation of yield and living biomass

The project activity assumes forest management by *Pinus ponderosa* for timber production. The growth of *Pinus ponderosa* in Region XI is estimated by regression analysis, etc. at single-tree level. The following equations are used. The yield estimation model at stand level is being developed.

The modeling of DBH and tree height is conducted by stem analysis with 42 sample trees (15 trees from Cochran, 12 from Flamencos, 3 from Las Mercedes and 12 from Miralejos). The following model for DBH was selected after comparing some linear or non-linear models.

In the case of the selected model, every-5-year DBH growth is predicted using stand basal area per hectare, site quality, stand age and stand basal area of larger trees than the subject trees for prediction. The used data is usually given by sample plot survey or stand tables.

Table A5-13 Growth and volume estimation equations for *Pinus ponderosa*

Pinus ponderosa **Region XI**
DBH: (Periodic – 5 year- increment model)

$$i_{d5} = 4.6 - 0.22d - 32.03d^{-1} + 9.54(d/T) - 0.02GL - 0.76Ln(G) + 0.06H_{100}$$

Where
i_{d5}= 5 year periodic increment of DBH(cm)
d= DBH overbark(cm)
G= Stand basal area (m^2/ha)
GL= Basal area overbark of the trees bigger than subject tree (m^2/ha)
H_{100}= Site index (base age=20th year)
T= age (year) Bias (%) 2.22 RMS(%): 8.89

Height:

$$HT = 30.34983 * \left[1 - \left\{1 - (SI/30.34983)^{0.664}\right\}^{(t+0.298)/(20+0.298)}\right]^{1/0.664}$$

Where
HT= total height (m)
t= age (year)
SI= Site Index (m) (estimated by maximum likelihood)

$$SI = 30.34893 * \left[1 - \left\{1 - \left(\frac{HT}{30.34983}\right)^{0.664}\right\}^{20/t}\right]^{1/0.664}$$

Stand Basal Area:

$$Ln(G_2) = 7.49 - 13.76 * (1/Hdom - 1.3) - 87.78 * 1/\sqrt{N_1} + 233.32 * (1/Hdom - 1.3) * 1/\sqrt{N_1}$$

Where
G_2= stand basal area in period 2 (m^2/ha)

Hdom= average dominant height of 100 trees biggest tree by ha (m)
N_1= Number of trees in period 1 (trees/ha)
N =42 Bias: 0.776 Bias(%): 1.618 RMS: 9.107 RMS(%): 19.0

Stand Volume (per ha):

$$Ln(V) = 1.736 + 0.057 * S - 23.712 * (1/E) + 1.060 * Ln(G)$$

Where
Ln(V)= Natural logarithm of volume (m^3)
G= basal area (m^2/ha)
S= Site index (base age= 20th year, average height of biggest 100 trees by hectare (m))
E= Age(year)
N= 42 Bias: 3.767 Bias(%): 2.073 RMS: 18.967 RMS(%): 10.435

Volume (per tree):

$$v = -0.00729326 + 0.00003942 * d^2 h + 0.00093254 * d + 0.00000151 * d^3 - 0.00000016 * d^4$$

Where
v= volume (m^3)
d= DBH (cm) h: height (m)
Bias: 0.0014 RMS: 0.033

Source: INFOR Valdivia
Note: Calculation methods of RMS (Root Mean Square) and Bias are shown in the Annex.

Site condition is selected as dominant height of 8m. Planting density is represented as 1,250 trees/ha. The following parameters were used for growth estimation. Annual precipitation in planting area of Coyhaique commune ranges from 500mm to 2,000mm. The following estimation model is based on data which do not necessarily cover the entire range of precipitation. Particularly the area with less than 700mm is out of possible area to be estimated. The possible area will be around Coyhaique city having site indices from 8 to 10m and precipitation from 700mm to 1,000mm. The estimating condition in question assumes the lowest one of 8m which could be conservative.

Table A5-14 Applied parameters

Parameters for model estimation	Assumed values in provisional estimation
1) Planting species	*Pinus ponderosa*
2) Dominant height (dominant height is given from average height of the 100 largest trees (in DBH) per ha at 20-year-old stand.	8 m
3) Basal area (m^2/ha)	39.9
4) Planting density (trees/ha)	1,250

Note: The assumed values for estimation are obtained from research plots deployed adjacently.
Source: INFOR Valdivia, July 2006

The following parameters to convert merchantable volume to living biomass are used.

Table A5-15 Applied parameters

D	BEF	R	CF
Tonnes d.m./m^3	**-**	**-**	**tonne d.m.-1**
0.360	**2.70**	**0.331**	**0.5**

Source: D, BEF, R: UACH 2002 CF: GPG-LULUCF

Conversion factor from carbon to CO_2 is given at 3.667.

The following issues were confirmed based on due consultation with INFOR.

a. Basically the parameters collected by now are used for the relevant estimation.
b. These parameters are given from the UACH's document.
   The methodologies and data used are based on the academic knowledge which can secure sufficient transparency and objectiveness to become repeatable. The sources are as follows.
   ① *Gayoso, J., Guerra, J., Alarcón, D. 2002. Contenido de carbono y funciones de biomasa en especies nativas y exóticas.Proyecto FONDEF D98I1076. Medición de la Capacidad de Captura de Carbono en Bosques de Chile y Promoción en el Mercado Mundial. Universidad Austral de Chile (UACH). Valdivia. Chile.* (Referred to as UACH 2002)
   ② *Gayoso, J., Guerra, J., Alarcón, D.* 2002. *Inventario de Biomasa y Contabilidad de Carbono. Proyecto FONDEF D98I1076. Medición de la Capacidad de Captura de Carbono en Bosques de Chile y Promoción en el Mercado Mundial. Universidad Austral de Chile (UACH). Valdivia. Chile.* (Technical information and data source)
c. The location and site conditions of the surveyed stands or plots are described as follows:
   Those are consistent with the subject site for the pilot project. However, the data does not cover the range older than 20-year-old stand.
   ① Location: Lat 45º21'S Lon 71º52'W（the area located 30 km northeast from the central of Coyhaique city）
   ② Site conditions: Altitude: 700m Precipitation: 1,000mm/yr Sandy soils Slope: 12-25%
   ③ Plot number: 26 plots (By age: 3rd yr(6), 5th yr(6), 8th yr(6), 10th yr(2), 15th yr(3), 20th yr(3))
d. Researchers and experts on forest science in Chile recognize the UACH's data as standard data in Chile. However, the data are not created for direct calculation of BEF or root-shoot ratio for GHG removals estimation. Therefore, in the form of BEF or root-shoot ratio, it cannot show uncertainty indicators such as variance.
e. Forest management model assumed by the pilot project includes pruning and thinning. The draft PDD mentioned preparation of age-dependent equation of BEF to estimate precise BEF and has a plan to conduct BEF measurement as a part of the project activity. The method and cost for BEF measurement was explained to INFOR side and discussed together. The agreed method and cost are shown in the Annex.

At the time of the 2nd work in Chile, UACH data were decided to be used for the above-mentioned parameters such as D, BEF and R. Particularly BEF was supposed to be measured when the management system will have embedded. However, it was concerned that pruning would affect the BEF considerably. Though precise BEF is planned to be monitored through the monitoring, BEF change was decided to be measured through the simple survey (see the Annex in details).

Based on the results of the simple survey, the adjusted BEF is decided to be used to obtain conservative estimation and avoid overestimation. The followings are the adjusted BEF.

Table A5-16 Adjusted BEF

Stand age	BEF2j
year	*dimensionless*
10	2.70
11	2.70
12	1.92
13	1.97
14	2.03
15	2.08
16	2.14
17	2.19
18	2.24
19	2.30
20	2.35
21	2.41
22	**2.56**
23~39	2.56

note: j = *Pinus ponderosa* Tinted parts in yellow are pruning ages.

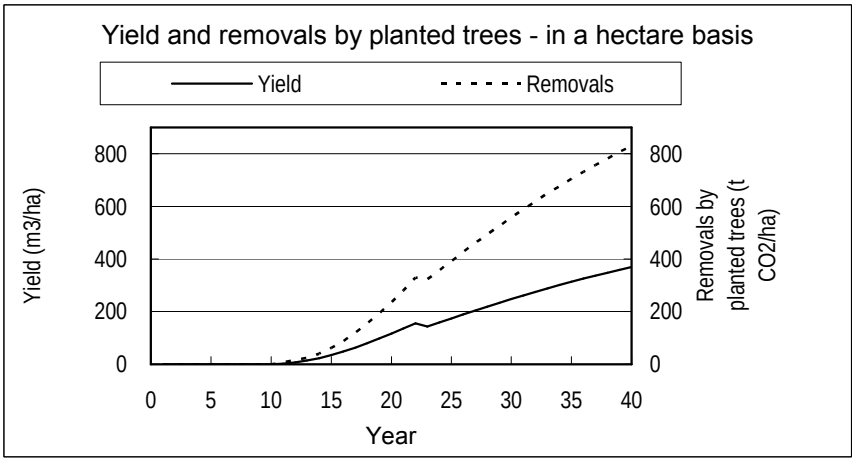
BEF is commonly known to decrease along with increase of stand age due to natural death of lower branches. When the pilot project will be implemented, the trend should be confirmed with the subject pruned stands under the standardized forest management system. Therefore, the draft PDD will be made to include the description on BEF measurement in the project activity in order to prepare age-dependent equation of BEF and identify accurate BEF. The BEF measurement in the project activity is detailed in the Annex.

In this report, the above-mentioned values were used to estimate values per hectare for 40 years, which is supposed to be the project life, by assuming the following forest management. The results are shown below. (see Annex into details)

Table A5-17 Assumed forest management

Forest management	Timing (age)	Density (pl/ha)	Remarks
Planting	0	1,250	
1st pruning	12	1,250	All trees
1st thinning	22	850	
2nd pruning		500 (among 850)	Future trees only
Final cutting	40	850	

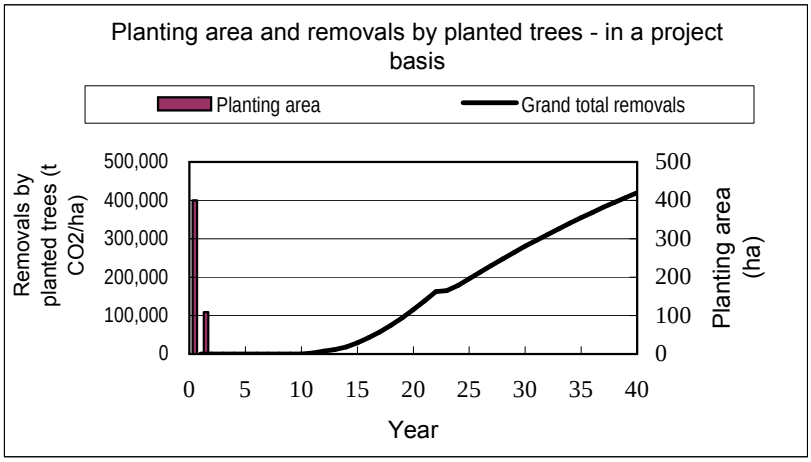
Note: INFOR Valdivia (2006)



Note: The year refers to the project year (= stand age + 1).

Figure A5-5 Estimation of yield and GHG removals by living biomass in *Pinus ponderosa* stand in a hectare basis

Based on the above data, annual values were estimated in t CO_2 as follows. (see Annex) The planting area is as proposed by INFOR. Pruning is conducted in the stand ages of 12 and 22 years while thinning is done in 22-year-old stand. Especially in the 22-year-old stand, the GHG removals will remarkably decrease. However, the decrease doesn't appear and the total removals grow almost monotonically.



Note: The year refers to the project year (= stand age + 1).

Figure A5-6 Estimation of yield of *Pinus ponderosa* stand in a project

The scale of decrease of removals is proportionate to biomass rejection by pruning or thinning and planting area. For example, when the planting years are sequential for 4 years, the valley bottom after pruning and thinning overlaps the crest segment of the-next-planting-year stand before those operations so that the total figures are leveled.

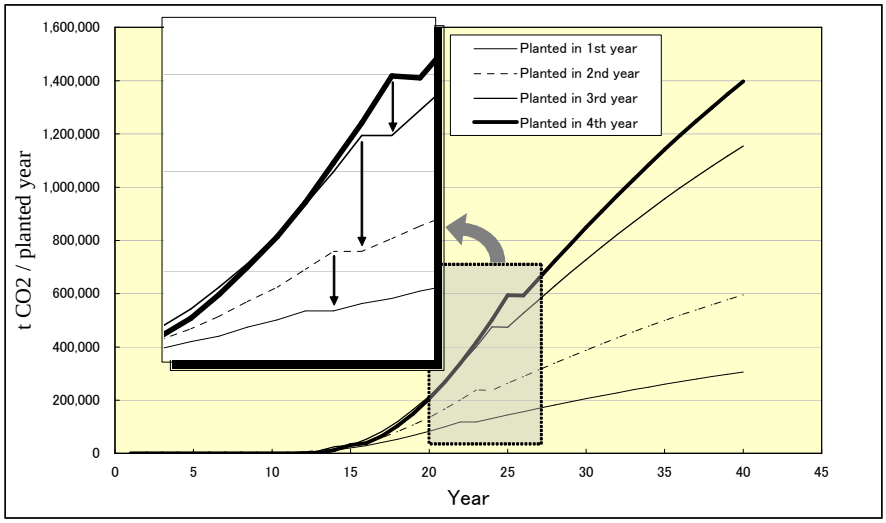


Figure A5-7 Schematics to show leveling effect of decreasing removals by sequential planting years

(2) Sampling method

1) Sampling design

a. Main principles on measurement of planted trees

The following contents were confirmed with INFOR side. This also applies to the case of Region X.

Table A5-18 Main principles for monitoring from the aspect of forest measurement

Domain for issues	Main principles
Stratification of project area	▫ In order to optimize estimation of planted forests, preferable factors for stratification factors are: 1) factors having strong influence on stand growth, 2) standard deviation in each stratum can be identified quantitatively. The potential factors are: site condition, stand age, and planting species.
Sampling frame ▫ Design of sampling size ▫ Distribution of plots	▫ Permanent sample plot is adopted. ▫ Sampling size is calculated using standard deviation by stratum. ▫ Permanent sample plots are located systematically with a random start with the help of GPS.
Monitoring frequency	▫ Conformity to the existing subsidy system will be secured. ▫ Monitoring will be conducted more frequently in the initial stage of planting as appropriate. ▫ Monitoring will be conducted every five years in accordance with verification and certification.
GHG removals by sinks (trees)	▫ Biomass will be estimated by commercial tree volume. ▫ Precision level is set to reach ±10% of the mean at the 95% confidence level.
QA/QC	▫ By securing the conformity to technical standard undertaken in Chile, the QA/QC will be considered in 1) measurement; 2) data collection; 3) data input and analysis; and 4) data archiving.

Source: JICA Study Team

b. Sampling design

INFOR has a permanent plot survey manual for planted forests (Field Operation Manual for Plantation (FOMP), 2004, INFOR, Status: Draft version) which describes operational method of plot survey. This FOMP was prepared to standardize forest measurement work using permanent plots in planted forests of Chile. The measurement subjects are not only planted trees, but regeneration trees and all plant species by taking biodiversity into account.

However, the FOMP has never been applied in forestation by the incentive system and the inspection service by CONAF since it was prepared in September 2004, though applied in the design stage and the research activities. Monitoring system for the forestation incentive system is not standardized and relies on the inspector's personal discretion.

The outline of the plot survey of FOMP can be summarized as follows.

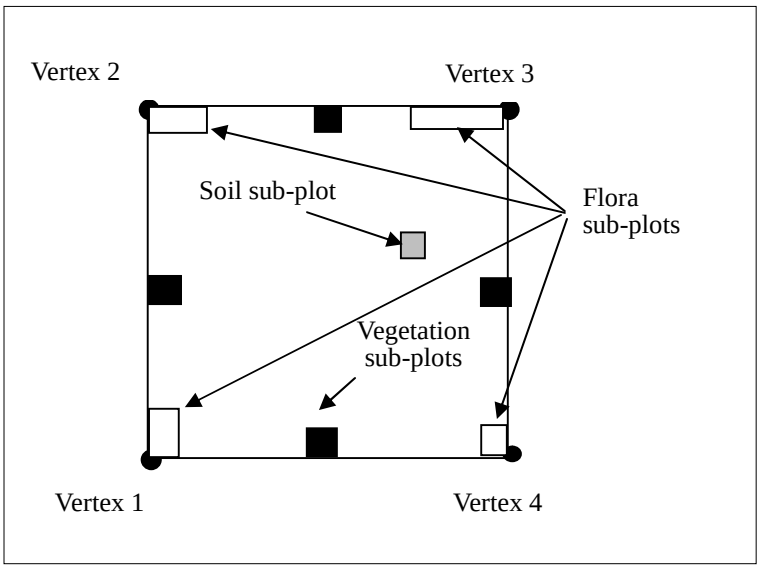
Table A5-19 Outline of the plot survey of FOMP

Issues	FOMP	Remarks
Subject forest	Adaptable to any planted forests with any conditions in Chile	Any conditions of planted species, planting density, planted area, planted year, forest intervention in any region
Plot shape	Square, nested	Within the square plot for planted trees, 1) four vegetation sub-plots and 2) four flora sub-plots are located along the side line and at the corner. Independently, one soil plot is located

Issues	FOMP	Remarks
		in the square plot.
Plot size	625 m^2 (25x25m) or 900 m^2 (30x30m)	If there are less than 50 trees in the plot of 625m^2, the plot is expanded to 900m^2 (threshold: 800 trees/ha).
Distribution of plots	Random	It is conducted under stratification.
Measured data	a. Commercial stem volume	in each square plot (Resolution: DBH by 1mm, Height by 0.5m by hypsometer (*Suunto* or *Vertex*))
	b. Regeneration status	in four vegetation sub-plots
	c. Flora abundance	in four floras sub-plots
	d. Soil condition	in a soil plot

Source: INFOR (2004) FOMP (Draft version)

Plot design is shown as follows. The configuration was simplified within the range of monitoring requirement for planted trees.



Source: INFOR (2004) FOMP (Draft version)

Figure A5-8 Plot design

The human resources and costs for the plot survey are standardized as follows.

Table A5-20 Standard cost per plot survey of FOMP

Item	Amount	Unit ($/unit/day)	Total ($/day)	Remarks
Chief engineer (allowances)	1	30,000	30,000	
Technical assistant (allowances)	1	25,000	25,000	
Assistant	1	6,000	6,000	
Vehicle operation (fuel, toll payments, others) (assumed to 300 km round trip)	1	22,000	22,000	
Vehicle rent (personal one)	1	25,000	25,000	
Miscellaneous (5%)			5,400	
Total for one team per day			113,400	
Plot number per day	**3 plots**		**37,800 (68.4**	**$/plot US$/plot)**

Source: INFOR Valdivia Note: $=Chilean Peso

The following table was proposed on the standard cost for monitoring of planted trees using the above-mentioned standard cost per plot. INFOR is supposed to finalize the figures by reflecting the change of project conditions.

Table A5-21 Framework for standard cost estimation for monitoring of planted trees

Monitoring cost for sampling survey for planted trees *03 December 2006*

For the whole project

Information base	Unit cost	Unit	Quantity	Total	Remarks
Database system					Existing?
Data logger					Existing?

For One verification

Operational process	Unit cost	Unit	Quantity	Total	Remarks
Plot assignment	30,000	day	3	90,000	Review of GIS data, Forest register, etc.
Survey arrangement (with landowners)	25,000	day	5	125,000	Review of GIS data, liaison, coordination with landowners
Field work for plot survey	37,800	plot	115	4,347,000	
Data compilation	25,000	day	5	125,000	
Verification	30,240	plot	12	362,880	10% of all plots
Resurvey	37,800	plot	2	75,600	2 plots
Reporting	30,000	day	5	150,000	Reporting and incorporation to relevant documents for
Grand total (per verification)				**5,275,480**	
Per plot base unit price				45,874	= 83.0 US$/plot

Source: INFOR Valdivia Note: $=Chilean Peso

Currency rate $/US$= 553 $

Labor cost for level	$/day
Chief engineer	30,000
Technical assistant	25,000

The sampling survey conducted with the FOMP's plot survey is outlined as follows.

Table A5-22 Sampling survey based on the plot survey shown in FOMP

Issues	Chilean situation	Remarks
Stratification	1) stand age 2) site quality 3) planted species	They are commonly applied in Chile.
Precision level	±5~10% at 95% CL	Commonly achieved figure in planted forests

Source: INFOR Valdivia, peer interview in March 2006

The contents of FOMP are well adapted to Chile-specific conditions and are supposed to have main functions to provide appropriate data for monitoring in A/R CDM. The survey method in FOMP is more adapted to the case of plated forests than the one by INFOR and UACH for the case of both natural forests and planted forests. Therefore the design of plot survey applied in the monitoring of planted forests in the Study can be judged to be more effectively and efficiently conducted by adopting the FOMP as a base.

The size of permanent sample plots shall be 625 m^2 since the tree density is assumed to be 53 after thinning (= 850 trees/ha).

c. Sampling size

The sampling size was estimated by stratified sampling method. The subject area was stratified into two by the elevation of 800 m while relevant standard deviation for each stratum was given from the data from INFOR's research plots in Region XI. (see Annex)

The calculation conditions are as follows.

a. The current planting area totals 508.8 ha.
b. The current estimation assumes the planting area of 508.8 ha. As a result of discussion with INFOR side, the planting area is supposed to consist of 400 ha in spring of 2007 and 108.8 ha in autumn of 2008[12].

The sampling size is calculated as follows.

Table A5-23 Number of permanent sample plots

Region	No. of plots	Calculation ground
XI	56	a. Standard deviations in research plots in Region XI were tentatively applied, although the number is limited for representation of typical sites. b. Precision level 10% at confidence level of 95%

The estimation was conducted by INFOR in conformity with the methodology of AR-AM0003. In the project activity, the following factor will contribute to reduce the variance of carbon stock in the planted forests.

Table A5-24 Factor to reduce the variance of carbon stock in the planted forests

Relevant factor for the ex ante estimation		Relevant factor for the ex post estimation
Variance due to forest establishment and management Quality of planting materials varies considerably. Forest establishment and management are not well standardized in terms of planting density, thinning, pruning, etc.	➔	Quality controlled seedlings will be used under standardized forest establishment and management.

As the monitoring starts, data on standard deviation will be gradually accumulated. Accordingly the sampling size needs to be arranged in an efficient manner to satisfy the targeted precision level. For example, 30 plots will be initially surveyed to acquire the standard deviation and estimated precision level in a certain year before covering all of plots. Based on the data, it will be sensible to calculate necessary and sufficient sampling size to achieve the targeted precision level and conduct the plot survey efficiently with that sampling size.

2) Monitoring implementation system

For the moment, implementation system for monitoring is drafted as follows based on discussion with relevant officials. It is expected that the private companies will become capable for such activities from the long-term perspective.

Table A5-25 Implementation system for monitoring (draft)

Role	Organization type	Assumed organization
Measurement and monitoring	Administrative body	Private company*, etc.
Technical consulting and training	Research body	INFOR

Source: JICA Study Team
Note: * An expert group being capable for such monitoring activities.

3) Relationship with landowners at the implementation stage

The following issues are better to be understood by the proponent landowners for improving accuracy and precision of forest measurement.

a. Acceptance for allocation of permanent sample plots in the owned lands

Relevant landowners should be consulted for their acceptance for possible installation of permanent sample plots.

[12] 11th Region: autumn=March~ spring=September~ 10th Region: autumn=April~ spring=September~

b. Adoption of mean value for GHG removals by sink

The credit amount will be estimated using mean value by stratum. It would be the fair way to estimate the GHG removals by sink through multiplying the mean value by the planted area. Though this issue is not to be described in the draft PDD, it should be informed at the time of organization of project participants.

c. Assurance of compliance with forest management after the initiation of the project activity

In order to assure quality of forestation activity and improve estimation precision, it is desirable to formulate agreement to ask landowners to follow the planned management system. The following issues need to be recorded in the compulsory manner.

a) Cross-check to determine whether the activity implemented in the parcel falls within the parameters set out in the technical description (e.g., correct species, planting density, climate, etc)
b) Measurement of baseline indicators such as land cover
c) Measurement of planting area

These issues are recorded in the technical study prepared in the subsidy scheme except for 2). Periodic recording these issues will contribute to quality management of project activity.

4) SOPs

All approved methodologies show requirement or recommendation for users to prepare SOPs and QA/QC plan. QA/QC plan is required to be included in the monitoring plan.

a. SOPs in the pilot project in Chile

In Chile, there is a forest measurement manual for planted forests (FOMP, only in Spanish), which could be used as a prototype for SOPs. The SOPs based on this in Spanish will be very effective to perform qualified services by staff directly involved in the measurement and analysis process.

By referring to PDDs prepared under the approved methodologies, the descriptions on SOPs were examined with the INFOR side. Among those seven PDDs, three PDDs attaches SOPs as annexes for monitoring plans. On the other hand, the other four PDDs put off the preparation of SOPs and don't include them.

Table A5-26 SOPs in PDD and the function

PDD	Description in PDD	Structure	SOPs
0010 CHN	[postpone] SOPs will be developed and adhered to over time. (in MP)		--- nil ---
0007 MDA	Section 5 thr. 8 must be adopted as SOPs. (in MP)	The following sections in the MP: 5.0 **Allocation** of permanent measurement plots 6.0 **Scheduling** of measurement, reporting, and verification events 7.0 Aboveground biomass carbon **measurement** and **analysis** 8.0 **Soil carbon** sampling and analysis	
0018 ALB	SOPs are prepared and will be adjusted periodically. (in MP)	Annex **Compass** manual (1. Measurements in the Map, 2. Measurements in the Field) Annex **GPS** manual (→very simple, GPS manual)	
0019 HON	Available (in MP.)	APPENDIX I SOP 1 **Establishment of plots** SOP 2 **Measurement** of trees SOP 3 **Verification** of algometric equations SOP 4 **Calculation** of Tree Carbon Stock Changes without Harvesting SOP 5 **Calculation** of Tree Carbon Stock Changes WITH Harvesting	
0015 BRA	[postpone] The data collection and organization will be based on the SOPs developed for the purpose. (in C6)		--- nil ---
0020 CHN	[postpone] SOPs will be developed and adhered to over time. (in MP)		--- nil ---
0021 ECU	[postpone] A detailed monitoring plan will be made available to the DOE upon submission of this PDD for validation. (in Annex)		--- nil ---

Note: Country code: IAAF code MP: Monitoring Plan

As shown in the above table, SOPs of PDDs of Moldova and Honduras have the broadest coverage in terms of technical issues. FOMP covers natural stands, erosion, drainage, forest floor and soils. However, these issues could be omitted in the monitoring of planted trees in A/R CDM project. In principle, essential subjects for SOPs are the relevant parts for identification of carbon stocks. Accordingly the parts in FOMP on plot establishment and tree measurement were extracted and centered in the contents of SOPs with due modification.

The composition of SOPs is shown as follows. It covers the indicated range of AR-AM0003.

Table A5-27 Main contents of SOPs

Contents
a. Sampling design
① Plot design
② Location of the plot
b. Measurement of variables for individual trees
① DBH, height, etc.
② Age
c. QA/QC

b. QA/QC

The following issues for *good practice* are shown in GPG-LULUCF (page 4.111) as well as AR-AM0003.

a) Reliable field measurements
b) Verification of field data collection
c) Verification of data entry and analysis
d) Data maintenance and storage

The small-scale A/R CDM methodology applies the nearly same contents as the ones of this GPG-LULUCF. Therefore this framework can be used for both normal scale (Region XI) and small-scale (Region X).

Following this framework, the contents of QA/QC was discussed with the INFOR side and the conclusion is shown in the Annex.

c. QA/QC in PDDs that have been submitted

QA/QC in the PDDs based on the approved methodologies was examined in terms of data composition. The uncertainty level is categorized into three classes: high, medium and low. The concrete evidence to interpret these uncertainty levels is not shown.

The situation can be summarized as follows.

- In terms of sinks, the common elements are: 1) location of permanent sample plots, 2) tree measurement items, and 3) conversion coefficients for biomass and carbon stock.
- In terms of emission, the main common elements are; 1) nitrogen and 2) fossil fuel use by transportation.
- One of non-common elements is soil carbon. This is examined in case that farming and stock breeding are included in the project activity.
- The uncertainty level is interpreted to be low in most cases. However there are a case to treat soil carbon and N_2O as “medium”.

The following composition is proposed on planted trees in the draft PDD for Region XI. For DBH and tree height, some comparable data are usually available to decide QC criteria. In the case of BEF or root-shoot rate, there are some comparable data in GPG-LULUCF, etc. However, for data fitting the geographical scale or location for the project of Region XI, actual measurement at parcel level will be more appropriate in some cases. The technical consequences in IPCC’s activity or the other approved projects should be carefully observed to take necessary actions, while the annual change of BEF will be measured in the project activity.

Table A5-28 Data nominated for QA/QC plan in Region XI（excl. emission-related）

Data *(Indicate ID number)*	Uncertainty level of data (High/Medium/Low)
3.1.1.05 Plot location	*low*
3.2.06 Plot area	*low*
3.1.1.10 Number of trees	*low*
3.1.1.11 Diameter of breast height (DBH)	*low*
3.1.1.13 Tree height	*low*
3.1.1.16 Biomass expansion factor (BEF)	*low*
3.1.1.18 Root-shoot ratio	*low*

(3) Geographic information for demonstration of land eligibility

1) Geographic information available in INFOR

INFOR has the following geographic data obtained through preparation of the project outline for Region XI.

Table A5-29 Used GIS data and the attribute

Data/Parameters	Descriptions	Vintage	Resolution	Sources
Land use plan map	Regional Plan of Territorial Ordering. Regional Secretariat of Planning and Coordination XI (Serplac)	2004	1: 50,000	GTZ Regional Government of Aysén.
Land use plan	Year 2005. - Regional Political Limits. Regional plan of Territorial Ordering. Regional Secretariat of Planning and Coordination XI (Serplac)	2004	1: 50,000	GTZ Regional Government of Aysén.
▫ Present land use map ▫ SNASPE map ▫ Slope map ▫ Cadastral map	Year 2005. - Present Land Use, SNASPE and Slopes. Cadastre and Evaluation of Native Vegetative Resources of Chile. Forest National corporation (CONAF)	1996	1: 50,000	GTZ Regional Government of Aysén.
Cadastral map	Year 1999 Cadastre of Properties Ministry of National Goods XI Region. Information updated to the 2004 by this Ministry.	1997	1: 50,000	CIREN and Ministry of National Goods (Region)
Sloping map	Sensorial radar with resolution 60 m	2000	60 m	NASA
Cadastral map	Digital Cadastre of Rural Properties	2006	1: 50,000	CIREN ", XI Region" (finished in Jan. 2006)
Road map	Road Network and Cities	2002	1: 50,000	Information GIS of Forestal MININCO

Source: INFOR Coyhaique

The selection criteria of subject area for planting are summarized as follows. The different point from the case of Region X is that the subject sizes of landownership cover not only small ones but also middle ones.

a. Land use planning (for forestation)

b. Present land use (grassland, shrub, others)
c. Exclusion of SNASPE-related area
d. Slope: 15~60%
e. Lands of small and medium landowners (5 ~ 2,000ha?)

Based on these criteria, 63,000 ha of subject lands are selected in Coyhaique commune.

These lands can satisfy the minimum requirement for lands for A/R CDM if the land eligibility for A/R CDM is demonstrated.

The preparation of geographic information on eligible land distribution was sub-contracted.

2) Geographic information on eligible land

The preparation was finalized in the middle of December 2006 as with the case of Region X. The following data were prepared.

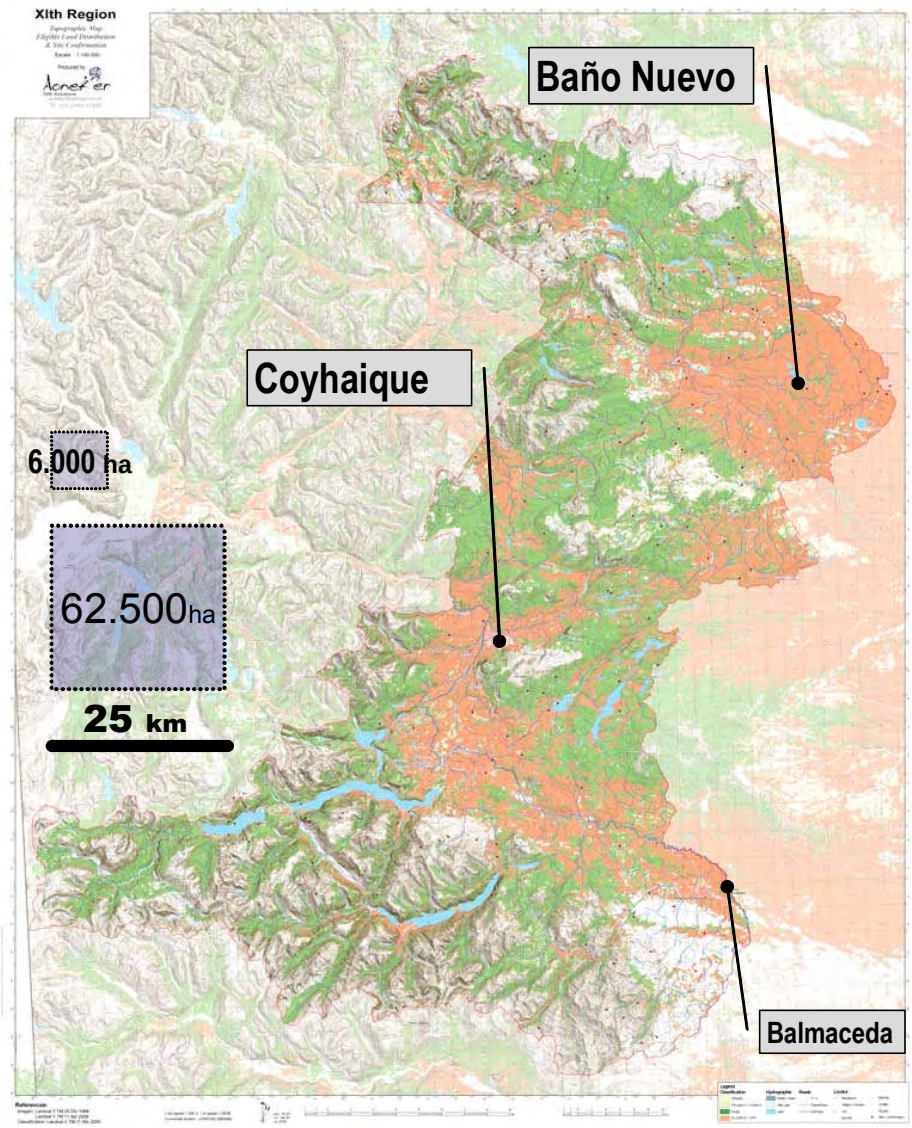
a. Land cover map for 1989
b. Land cover map for now
c. Eligible land distribution map

The information is considered to be appropriate as evidence to demonstrate land eligibility as with the case of Region X. The following data were used.

- Landsat 5 TM, 26 Dec 1984, NASA for the end of 1989
- Landsat 5 TM, 11 Apr 2006, CONAE for now

The eligible land distribution map is shown as follows. The red parts are eligible lands. However those lands are not only unused grassland but also cropland and grazing land.

Eligible lands in Region XI broadly distribute around grazing area along roads and step (or *Estepa*) in eastern Coyhaique commune which is close to the national border with Argentine. The latter place has low annual precipitation less than 400 mm and shows Patagonia-specific land cover where grassland develops potentially and tree planting doesn't fit.



Note: The scale bar and the main city names are added to the original map for reference.

Figure A5-8 Eligible land distribution map for Region XI

The total area of eligible lands in the Region XI is as follows.

Table A5-30 Area of eligible lands in Region XI

Region	Commune	Eligible Land	Eligible over total
	ha	*ha*	*%*
XIth Region	728,291.30	189,127.50	26.0

The accuracy level of overall and eligible land is found quite high as below.

Table A5-31 Accuracy level of overall and eligible land in Region XI

■**Overall**

Region	Overall accuracy	Kappa statistics
	%	%
XIth Region	89.58	0.8414

■**Eligible land only**

Region	Producer's accuracy	User's accuracy	Kappa statistics
	%	%	%
XIth Region	90.7	94.2	0.91

Used data are as mentioned in the part of Region X.

Appendix Estimation of yield and living biomass in Region X, *Eucalyptus nitens*

Region X Planting species: ***Eucalyptus nitens***

Yield: Merchantable stem volume up to top diameter of 5 cm or more

Used model: EUCA3.3 (developed by INFOR)

D	BEF	R	CF	CO_2/C
0.457	1.40	0.450	0.5	3.667
		0.350	R: from above, AGB<50t/ha, 50-150, >150	
		0.200		

Planting density=	1,429	trees/ha
Site index=	27.2	m in Region X, 10th yr
Forest intervention:	Thinning at 5 and 9 year old	
Rotation =	20	year

	Hectar-base figure					Total by years and all: Removals by planted trees				
						120 ha plan	*0 ha plan*	*0 ha plan*	*0 ha plan*	*120 ha plan*
yr	m3/ha	t/ha	t/ha	t/ha	t CO2/ha	t CO2	t CO2	t CO2	t CO2	t CO2
Proj Year	Yield	AGB	BGB	Living biomass	*Removals*	*Planted in 1st year*	*Planted in 2nd year*	*Planted in 3rd year*	*Planted in 4th year*	*Grand total of removals*
1	0.00	0.00	0.00	0.00	0	0				0
2	0.00	0.00	0.00	0.00	0	0	0			0
3	0.00	0.00	0.00	0.00	0	0	0	0		0
4	14.20	9.08	4.09	13.17	24	2,880	0	0	0	2,880
5	36.43	23.31	10.49	33.80	62	7,440	0	0	0	7,440
6	41.62	26.63	11.98	38.61	71	8,520	0	0	0	8,520
7	71.93	46.02	20.71	66.73	122	14,640	0	0	0	14,640
8	108.72	69.56	24.35	93.91	172	20,640	0	0	0	20,640
9	150.31	96.17	33.66	129.83	238	28,560	0	0	0	28,560
10	100.22	64.12	22.44	86.56	159	19,080	0	0	0	19,080
11	133.68	85.53	29.94	115.47	212	25,440	0	0	0	25,440
12	170.01	108.77	38.07	146.84	269	32,280	0	0	0	32,280
13	208.42	133.35	46.67	180.02	330	39,600	0	0	0	39,600
14	248.22	158.81	31.76	190.57	349	41,880	0	0	0	41,880
15	288.82	184.79	36.96	221.75	407	48,840	0	0	0	48,840
16	329.74	210.97	42.19	253.16	464	55,680	0	0	0	55,680
17	370.60	237.11	47.42	284.53	522	62,640	0	0	0	62,640
18	411.06	263.00	52.60	315.60	579	69,480	0	0	0	69,480
19	450.90	288.49	57.70	346.19	635	76,200	0	0	0	76,200
20	489.93	313.46	62.69	376.15	690	82,800	0	0	0	82,800
21	528.00	337.81	67.56	405.37	743	89,160	0	0	0	89,160
22	0.00	0.00	0.00	0.00	0	0	0	0	0	0
23	0.00	0.00	0.00	0.00	0	0	0	0	0	0
24	0.00	0.00	0.00	0.00	0	0	0	0	0	0
25	14.20	9.08	4.09	13.17	24	2,880	0	0	0	2,880
26	36.43	23.31	10.49	33.80	62	7,440	0	0	0	7,440
27	41.62	26.63	11.98	38.61	71	8,520	0	0	0	8,520
28	71.93	46.02	20.71	66.73	122	14,640	0	0	0	14,640
29	108.72	69.56	24.35	93.91	172	20,640	0	0	0	20,640
30	150.31	96.17	33.66	129.83	238	28,560	0	0	0	28,560

Note: AGB: Aboveground biomass BGB: Belowground biomass

Appendix Estimation of sampling size in Region X
(Prepared by INFOR Valdivia staff in June 2007)

Data from forest inventory in *Eucalyptus nitens* were used to approach the number of sample plots to consider when monitoring. The selected data corresponds to two growth zones, namely Coastal Range Mountain (CC) and Central Valley (VC). The following table shows the standard deviation of total carbon stock (above- and below-ground) based on 12 available sample plots related to the Region X area.

Table 1 Geographic zone and standard deviation of carbon stock of planted trees

Growth zone	Standard deviation （kg C）
CC	26,061.8
VC	10,350.8
Whole	22,340.9

Abbreviation： CC: Costal range mountain (Cordillera de la Costa), VC: Central valley (Valle Central)

A stratified sampling design based on the above growth zones was assumed for the estimation of "*n*". The following expression is the applied formula for "*n*" calculations.

$$n = \frac{\left[\sum_j N_j S_j\right]^2}{\left[N \frac{E}{z_{\alpha/2}}\right]^2 + \sum_j N_j \left(S_j\right)^2}$$

where,

n : number of samples plots
S_j : Standard deviation for strata *j*
N_j : Number of maximum possible plot in strata *j*
N : Number of maximum possible sample plots in the total area.
E : Allowable error in kg.
$z_{\alpha/2}$: z value (normal probability density function)

The following is the results table for the optimal allocated "*n*" sample plots:

Table 2 Error rate and sampling size "*n*"

Error rate	*n*
(25%):	11
(20%):	18
(15%):	32
(13%):	42
(10%):	69
(7%):	136
(5%):	248

Strata weights applied were 0.95 for growth zone VC and 0.05 for growth zone CC according to available data by zone. Total area was defined as 120 ha with a sample size plot of 625 m^2.

The following figure shows the "*n*" performance according to different errors.

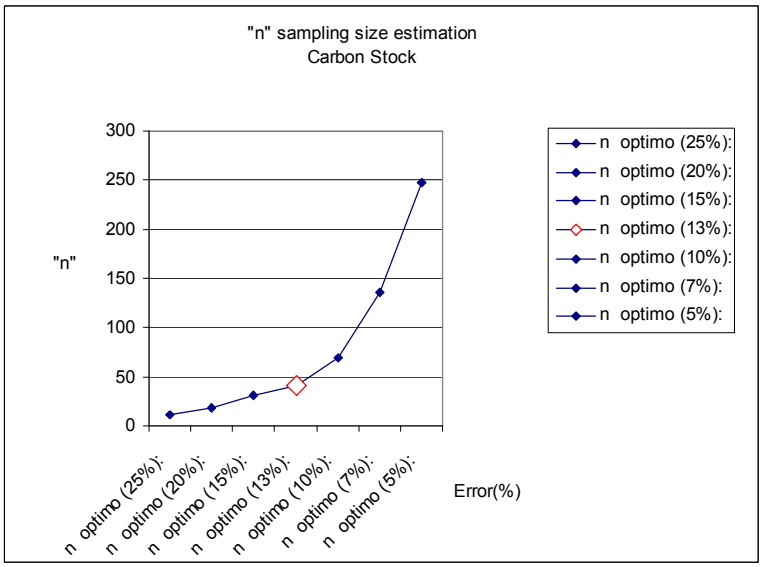


Fig. 1 Error rate and sampling size "*n*"

Appendix Equation for root mean squared (RMS) and residual value analysis (Bias)

Root mean squared (RMS)	**Residual value analysis**
$RMS = \sqrt{\frac{\sum (Y_i - Y_{est})^2}{n}}$ $RMS\% = \frac{RMS}{\overline{Y}}$ where: *RMS*= Root mean squared *Yi* = measured amount *Yest* = estimated amount $\overline{Y}$ = mean of measured amount n = number of measured samples	$Bias = \frac{\sum (Y_i - Y_{est})}{n}$ $Bias\% = \frac{\lvert Bias \rvert}{\overline{Y}}$ where: *Bias*= Bias *Yi* = measured amount *Yest* = estimated amount $\overline{Y}$ = mean of measured amount n = number of measured samples

Appendix Simple survey on pruning effect on BEF change in Region XI

(1) Background

The field measurement was decided to be conducted by taking a request on pruning effect on BEF change by INFOR counterparts (or trainees) in November 2006.

At the time of the 2nd work in Chile, UACH data were supposed to be used on parameters such as D, BEF or R. In particular, BEF was planned to be estimated annually by taking into account the pruning when the operation of the project activity will embed. However, pruning effect on BEF was seemed significant. Accordingly, it was decided to be conducted to identify the BEF change through immediate means in order to avoid overestimation in the ex ante estimation, though precise BEF will be identified through the monitoring.

In order to manage the progress of the whole study, the measurement method consisted of review of existing information and measurement of branches and leaves to estimate BEF change in a simple manner.

(2) Method

The survey contents were decided by carefully obtaining permission from forest owners and through continuous discussion with INFOR side in the training in Japan and work in Chile. The methods and arrangements of the subject measuring stands were informed to INFOR side through relevant documents showing outline and detail of method and key points of the survey.

After discussions with INFOR counterparts, the following principles were confirmed.

a. There is no stand which is comparable to the managed stand planned in the project activity. Therefore, very similar stands to the timings of pruning in the project activity will be chosen through arrangement with forest owners, and measurement will take place with pruning.
b. The measurement will be conducted in a simple manner while the detailed BEF identification will be conducted in the monitoring during the project implementation. Parameters on basic wood density and dry weight ratio will be collected through literature review as possible. The measurement will be conducted for pruned branches and leaves.

The following procedures were conducted for measurement and adjustment of BEF. These procedures were based on destructive measurement by selecting 10 sample trees having standard sizes for the 1st pruning (12 year old stand) as well as 5 ones for the 2nd pruning (22 year old stand).

<u>Biomass measurement and BEF adjustment</u>

a. A tree having standard sizes will be selected and measured in the subject stand having the relevant age. The next tree having the same characteristics will be selected with a certain distance from the previous tree.
b. Fresh weight of pruned branches and leaves are measured and multiplied by the dry weight ratio to estimate biomass.
c. DBH and tree height are measured using single-tree volume equation (stem volume) in order to estimate aboveground biomass.
d. The original BEF at the each stand age is assumed at 2.70. The BEF after pruning is given by the following equation to multiply the rate of biomass after pruning over the one before pruning.
   BEF after pruning = Original BEF * (Aboveground biomass – Pruned biomass) / Aboveground biomass
e. The adjusted BEF is given by averaging measurement results of the sample trees.

The following information on BEF, single-tree volume equation, basic wood density and dry wood ratio are collected from literature review.

- ☐ BEF= 2.70 (UACH, 2002)
- ☐ Single-tree volume equation (stem volume)

$$v = b_0 + b_1 d^2 h + b_2 d + b_3 d^3 + b_4 d^4$$

Where
v= volume (m^3)
d= DBH (cm) h: height (m)
b_0= -0.00729326 b_1= 0.00003942, b_2= 0.00093254, b_3= 0.00000151 b_4= -0.00000016

- ☐ Basic wood density = 0.360 d.m.t/m3 (UACH, 2002)
- ☐ Dry wood ratio = 0.41 (Quiroz, I.; Rojas, Y. 2003)

The measured stands given through various arrangements have the following outline. The estimation was conducted to regard those measured stands at the ages of 14 and 23 years as the virtual stands at the ages of 12 and 22 years in the project activity for calculation.

Table 1 Outline of measured stands

Pruning type	***Unit***	**1st**		**2nd**	
Stand age	*year*	14		23	
Pruning height	*M*	1.5		4.0	
Sample number	*N*	10		5	
Sampling place		MININCO 9601 Compartment		Reserva Nacional Coyhaique 71 Compartment	
Planted year & density *(pl/ha)*		*1992*	1,666	*1983*	1,675
Temperature: 14 ºC		Weather: cloudy (no rain in the prior day)			
Measurement time: 10:30 - 18:30, 4 Dec 2006, Monday					
Location		S45°28.623' W71°59.441'		S45°32.336' W72°00.859'	
Altitude		739 m		609 m	

Note: Detailed management records are shown in the end.

(3) Measurement results

The following averages from measurement results were attained.

Table 2 Averages from measurement results

		Stem ~ aboveground biomass (AGB)				Pruned part		Adjustment	
Pruning type	Sample	DBH	Height	ComVol	AGB	Fresh weight	Dry weight	Pruned biomass ratio	Adjusted BEF
Unit	*No.*	*cm*	*m*	*m3*	*kg*	*kg*	*kg*	dimentionless	dimentionless
1st	*Average*	**12.0**	**4.40**	**0.029**	**28.09**	**17.330**	**7.105**	**0.712**	**1.92**
	SD	**2.2**	**0.46**	**0.012**	**11.28**	**4.072**	**1.67**	**0.118**	**0.32**
	CV	**18%**	**10%**	**41%**	**40%**	**23%**	**24%**	**17%**	**17%**
2nd	*Average*	**22.6**	**9.15**	**0.174**	**169.52**	**34.173**	**14.011**	**0.911**	**2.46**
	SD	**1.6**	**0.94**	**0.033**	**32.14**	**17.665**	**7.243**	**0.051**	**0.13**
	CV	**7%**	**10%**	**19%**	**19%**	**52%**	**52%**	**6%**	**5%**

Note: SD: Standard deviation CV: coefficient of variance

The adjusted BEF was estimated using the above-mentioned averages in the following way.
The original BEF (=2.70) is decreased to 1.92 shown as the measurement result after the 1st pruning.
The BEF after the 2nd pruning was given at 2.46. At single tree level, it was assumed the BEF after the 1st pruning (=1.92) could recover to the one after the 2nd pruning (=2.46) provisionally in a linear manner.
The 2nd pruning is planned to be selectively conducted for 500 trees among 850 trees/ha which remain after thinning operation. By prorating 2.46 for 500 trees and 2.70 for 350 ones, the BEF

at the entire stand level was found at 2.56. After this age at the 2nd pruning, the BEF of 2.56 is naturally predicted to decrease. However, it was assumed to be constant due to data scarcity. The above-mentioned points are plotted in the following figure.

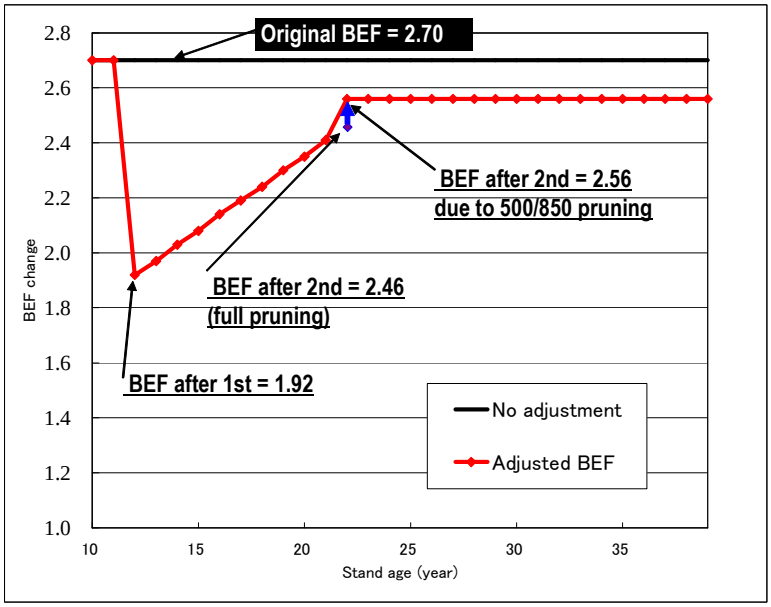


Fig. 1 Adjusted BEF

(4) Use of measurement results

a. Adoption of adjusted BEF

Measured results showed that trees of *Pinus ponderosa*, particularly young ones, had thick lower branches and large amount of biomass. Accordingly BEF decreased from 2.70 to 1.92.

It is commonly known that BEF tends to decrease in line with aging of the stand owing to factors such as dying of lower branches. However, the measurement results showed that the once decreased BEF by the 1st pruning recovered to 2.46 at least at single tree level. BEFs after the 2nd pruning are not known. Therefore, the BEFs were supposed to be constant.

The following findings were given from the measurement results.

a) Pruning accompanies large decrease of BEF.
b) In order to avoid overestimation of removals by planted trees, though the results were provided through simple measurements, decreased BEF after adjustment should be used in stead of 2.70 which was supposed to be used before this measurement.
c) The draft PDD will be made to include the description on BEF measurement in the project activity in order to prepare age-dependent equation of BEF and identify accurate BEF in the monitoring.

In the draft PDD, the adjusted BEF was decided to be used to estimate removals by planted trees.

b. Measurements in the monitoring during the project implementation

Improvement of accuracy of BEF will require continued monitoring in the project activity performed by standardized operation. In the subject stands to the monitoring, the following conditions at least should be monitored and conform to the project activity.

1) site quality, 2) planting density, 3) pruning height, 4) measurement timing just after the pruning

The general specifications of the measurements are supposed as follows.

Table 3 Quantity and timing of measurements

Measurement age and sampling numbers and required days

Subject Stand Age				Measuring rate	
10	12	14		4.0	trees/day
19	21	22	24	3.0	
29	34	39		2.0	

No.	Age *year*	Tree No.	Tree no./ 625 m2	Plot No.	Total tree No.	Field team day
1	10	1,250	4	5	20	5
2	12	1,250	4	5	20	5
3	14	1,250	4	5	20	5
4	19	1,250	4	5	20	7
5	21	1,250	4	5	20	7
6	22	1,250	4	5	20	7
7	24	850	4	5	20	7
8	29	850	4	5	20	10
9	34	850	4	5	20	10
10	39	850	4	5	20	10

BEF Measurement schedule (Ages in black cells will be measured.)

Prj yr	Stand Age 1	2
1	0	
2	1	0
3	2	1
4	3	2
5	4	3
6	5	4
7	6	5
8	7	6
9	8	7
10	9	8
11	**10**	9
12	11	10
13	**12**	11
14	13	12
15	**14**	13
16	15	14
17	**16**	15
18	17	16
19	18	17
20	**19**	18

Prj yr	Stand Age 1	2
21	20	19
22	**21**	20
23	**22**	21
24	23	22
25	**24**	23
26	25	24
27	26	25
28	27	26
29	28	27
30	**29**	28
31	30	29
32	31	30
33	32	31
34	33	32
35	**34**	33
36	35	34
37	36	35
38	37	36
40	**39**	38

Note: Five plots having four sample trees respectively are supposed for each measured age.

c. Others

In the research plots of INFOR, it was found that the growth in DBH and tree height didn't show significant change before and after pruning, even though the measurement history was not so long. Therefore, the stem growth estimation is supposed to remain as the same way as the original one.

(5) Measurement data

■Data on measurement and calculation for BEF after pruning

Pinus ponderosa

Dj	BEF2j	Rj
0.360	2.70	0.331

Dry/Fresh
0.41

Single tree volume equation:

$$v = b_0 + b_1 d^2 h + b_2 d + b_3 d^3 + b_4 d^4$$

b0	-0.00729326
b1	0.00003942
b2	0.00093254
b3	0.00000151
b4	-0.00000016

Source: INFOR

		Stem ~ aboveground biomass (AGB)				Pruned part		Adjustment	
Pruning type	Sample	DBH	Height	ComVol	AGB	Fresh weight	Dry weight	Pruned biomass ratio	Adjusted BEF
Unit	*No.*	*cm*	*m*	*m3*	*kg*	*kg*	*kg*	dimentionless	dimentionless
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
								((4)-(6))/(4)	(7)*BEForig
1st	1	**13.3**	**3.86**	0.031	30.13	**14.300**	5.863	0.805	2.17
	2	**12.5**	**4.93**	0.034	33.05	**18.150**	7.442	0.775	2.09
	3	**14.7**	**5.10**	0.047	45.68	**20.060**	8.225	0.820	2.21
	4	**10.0**	**3.90**	0.017	16.52	**18.650**	7.647	0.537	1.45
	5	**14.0**	**4.62**	0.039	37.91	**25.960**	10.644	0.719	1.94
	6	**11.3**	**4.50**	0.025	24.30	**16.660**	6.831	0.719	1.94
	7	**8.9**	**3.72**	0.013	12.64	**13.530**	5.547	0.561	1.51
	8	**11.5**	**4.60**	0.027	26.24	**11.265**	4.619	0.824	2.22
	9	**14.5**	**4.50**	0.041	39.85	**18.775**	7.698	0.807	2.18
	10	**9.1**	**4.30**	0.015	14.58	**15.945**	6.537	0.552	1.49
Average		**12.0**	**4.40**	**0.029**	**28.09**	**17.330**	**7.105**	**0.712**	**1.92**
SD		**2.2**	**0.46**	**0.012**	**11.28**	**4.072**	**1.67**	**0.118**	**0.32**
CV		**18%**	**10%**	**41%**	**40%**	**23%**	**24%**	**17%**	**17%**
2nd	1	**22.7**	**8.46**	0.161	156.49	**55.475**	22.745	0.855	2.31
	2	**23.2**	**10.50**	0.210	204.12	**19.255**	7.895	0.961	2.59
	3	**19.9**	**8.55**	0.132	128.30	**31.350**	12.854	0.900	2.43
	4	**24.1**	**9.78**	0.206	200.23	**15.695**	6.435	0.968	2.61
	5	**22.9**	**8.44**	0.163	158.44	**49.090**	20.127	0.873	2.36
Average		**22.6**	**9.15**	**0.174**	**169.52**	**34.173**	**14.011**	**0.911**	**2.46**
SD		**1.6**	**0.94**	**0.033**	**32.14**	**17.665**	**7.243**	**0.051**	**0.13**
CV		**7%**	**10%**	**19%**	**19%**	**52%**	**52%**	**6%**	**5%**

■Data on operation history of the measured stands

Assumed pruning		1st at 12 year old	2nd at 22 year old
Date: 4 Dec 2006	Owner	MININCO	CONAF
Preliminary information	Location	*Cuesta Alvarado*	*Reserva Nacional Cohyaique*
	Area	Ha	Ha
	LU Capacity	VII	VII Precipitation 1,200mm
Site condition	Ownership	Private and registered	National reserve
	Land use before forestation	Grazing land	Grazing land
Fundamental issues for plantation	Planting spp.	*Pinus ponderosa*	*Pinus ponderosa*
	Planting Density	1,666 seedling/ ha	1,675 seedling/ ha
	Planted year	1992	1983
	Plantation age	14 yr	23 yr
Forest establishment	Demarcation for planting area	GPS	GPS
	Land preparation	No	No
	Seeding procurement	Self-production	Self-production
	Planting	Self	Self
	Fertilization	No	No
	Weeding by chemical	No	No
Forest management	Pruning	(1) First pruning Year ;2000 (8 yr old) Height: 1.5 m Number: 1,000trees (2) Second pruning Year ;2004 (12 yr old) Height: 2.2 m Number: 500trees	(1) First pruning Year ;2004 (21 yr old) Height: 2 m Number: 1,666trees (2) Second pruning Year ;2005 (22 yr old) Height: 3 m Number: 200trees
	Thinning	Year ;2000 Number: 1,000trees Volume:	Year ;2004 (21 yr old) Number: 200trees Volume: 44.58
	Final cutting	Year ; ? Number: ? trees Volume: ?	Year ;2031 (48 yr old) Number: 200 trees Volume: ?
	Routine intervention	Watching, protection, insurance	Watching, protection, insurance
	Forest pest & disease control	No	No
Context	Regeneration	No	No (*P.contorta* out of shade.)
	Final product	Timber	Timber
	Accessibility	26 km from the town center	5 km from the town center
Remarks		(1) MININCO used the repellent to seedling for 2 years after planting. But now they stopped using it. (2) Deadwood of broad-leaf trees exist on the ground. (3) The target of thinning includes the trees pruned at the first pruning. The reason is not clear.	(1) The forestation aims to conserve the forest reserve on the other hand. (2) *P. contorta* has been also planted. (3) According to INFOR the tree numbers for final cutting decrease considerably in comparison with that for thinning. The cutting (selective cutting) will continue for several times until the final cutting to achieve the qualified harvest.

Appendix Estimation of yield and living biomass in Region XI, *Pinus ponderosa*

XIth Region: Pp T40

Dj		BEF2org	Rj	CFj	CO2/C
0.360		2.70	0.331	0.5	3.667

Bacic amount at a ha basis for:				
Vijt	**BEF2j**	$C_{AB,ijt}$	$C_{BB,ijt}$	C_{ikt}

Stand model (*k*): Timber production by Pinus ponderosa

Planting density= **1,250** trees/ha
Rotation= **40** years
Site index= **8** m in Coyhaique (in 20 years old)
Forest management: Thinning at 22 years old

yr	m3/ha	dimensionless	t C/ha	t C/ha	t C/ha	t CO2/ha
Stand age	Yield	BEF2j	AGB	BGB	Total C stock	Total CO2 stock
0	0.00		0.00	0.00	0.00	0
1	0.00		0.00	0.00	0.00	0
2	0.00		0.00	0.00	0.00	0
3	0.00		0.00	0.00	0.00	0
4	**0.00**		**0.00**	**0.00**	**0.00**	**0**
5	0.00		0.00	0.00	0.00	0
6	0.00		0.00	0.00	0.00	0
7	0.00		0.00	0.00	0.00	0
8	0.00		0.00	0.00	0.00	0
9	**0.00**		**0.00**	**0.00**	**0.00**	**0**
10	3.03	2.70	1.47	0.49	1.96	7
11	7.28	2.70	3.54	1.17	4.71	17
12	13.97	1.92	4.83	1.60	6.43	24
13	23.17	1.97	8.21	2.72	10.93	40
14	**34.70**	**2.03**	**12.68**	**4.20**	**16.88**	**62**
15	48.31	2.08	18.09	5.99	24.08	88
16	63.65	2.14	24.52	8.12	32.64	120
17	80.39	2.19	31.69	10.49	42.18	155
18	98.21	2.24	39.60	13.11	52.71	193
19	**116.83**	**2.30**	**48.37**	**16.01**	**64.38**	**236**
20	136.01	2.35	57.53	19.04	76.57	281
21	155.53	2.41	67.47	22.33	89.80	329
22	143.01	2.56	65.90	21.81	87.71	322
23	158.60	2.56	73.08	24.19	97.27	357
24	**174.08**	**2.56**	**80.21**	**26.55**	**106.76**	**391**
25	189.37	2.56	87.26	28.88	116.14	426
26	204.42	2.56	94.20	31.18	125.38	460
27	219.19	2.56	101.00	33.43	134.43	493
28	233.65	2.56	107.67	35.64	143.31	526
29	**247.78**	**2.56**	**114.18**	**37.79**	**151.97**	**557**
30	261.56	2.56	120.53	39.90	160.43	588
31	274.97	2.56	126.71	41.94	168.65	618
32	288.03	2.56	132.72	43.93	176.65	648
33	300.71	2.56	138.57	45.87	184.44	676
34	**313.02**	**2.56**	**144.24**	**47.74**	**191.98**	**704**
35	324.98	2.56	149.75	49.57	199.32	731
36	336.57	2.56	155.09	51.33	206.42	757
37	347.80	2.56	160.27	53.05	213.32	782
38	358.69	2.56	165.29	54.71	220.00	807
39	**369.25**	**2.56**	**170.15**	**56.32**	**226.47**	**830**
			Total	Project period		**30**
				(years)		**40**

Note: AGB: Aboveground biomass BGB: Belowground biomass
Yield: Merchantable stem volume up to top diameter of 5 cm

time *t*	Stratum ***i*** : by planted year and ***Cikt***				$C_{ik1}, C_{ik1}, C_{ik2}$	*ΔCikt*	$\Delta C_{P,LB}$
Prj yr	*1*	*2*	*3*	*4*			
	Total by planted years				Grand total		
***Aikt* (ha)**	***400.0 ha***	***108.8 ha***			***508.8 ha***	***508.8 ha***	***508.8 ha***
yr	t C	t C	t C	t C	t C	t CO2	t CO2
CP	Year	Prj year	*Planted in 1st year*	*Planted in 2nd year*	*Planted in 3rd year*	*Planted in 4th year*	*Grand total*	*Difference in grand total*	*Accumulated total*
	2007	1	**0**				**0**	**0**	**0**
1	2008	2	0	0			0	0	0
	2009	3	0	0	0		0	0	0
	2010	4	0	0	0	0	0	0	0
	2011	**5**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	2012	6	0	0	0	0	0	0	0
2	2013	7	0	0	0	0	0	0	0
	2014	8	0	0	0	0	0	0	0
	2015	9	0	0	0	0	0	0	0
	2016	**10**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
	2017	11	784	0	0	0	784	2,875	2,875
3	2018	12	1,884	213	0	0	2,097	4,816	7,691
	2019	13	2,572	512	0	0	3,084	3,620	11,311
	2020	14	4,372	700	0	0	5,072	7,287	18,598
	2021	**15**	**6,752**	**1,189**	**0**	**0**	**7,941**	**10,523**	**29,121**
	2022	16	9,632	1,837	0	0	11,469	12,935	42,056
4	2023	17	13,056	2,620	0	0	15,676	15,428	57,484
	2024	18	16,872	3,551	0	0	20,423	17,408	74,892
	2025	19	21,084	4,589	0	0	25,673	19,252	94,144
	2026	**20**	**25,752**	**5,735**	**0**	**0**	**31,487**	**21,319**	**115,463**
	2027	21	30,628	7,005	0	0	37,633	22,536	137,999
5	2028	22	35,920	8,331	0	0	44,251	24,269	162,268
	2029	23	35,084	9,770	0	0	44,854	2,213	164,481
	2030	24	38,908	9,543	0	0	48,451	13,189	177,670
	2031	**25**	**42,704**	**10,583**	**0**	**0**	**53,287**	**17,734**	**195,404**
	2032	26	46,456	11,615	0	0	58,071	17,545	212,949
6	2033	27	50,152	12,636	0	0	62,788	17,296	230,245
	2034	28	53,772	13,641	0	0	67,413	16,961	247,206
	2035	29	57,324	14,626	0	0	71,950	16,636	263,842
	2036	**30**	**60,788**	**15,592**	**0**	**0**	**76,380**	**16,245**	**280,087**
	2037	31	64,172	16,534	0	0	80,706	15,864	295,951
7	2038	32	67,460	17,455	0	0	84,915	15,432	311,383
	2039	33	70,660	18,349	0	0	89,009	15,014	326,397
	2040	34	73,776	19,220	0	0	92,996	14,618	341,015
	2041	**35**	**76,792**	**20,067**	**0**	**0**	**96,859**	**14,168**	**355,183**
	2042	36	79,728	20,887	0	0	100,615	13,775	368,958
8	2043	37	82,568	21,686	0	0	104,254	13,343	382,301
	2044	38	85,328	22,458	0	0	107,786	12,954	395,255
	2045	39	88,000	23,209	0	0	111,209	12,551	407,806
	2046	**40**	**90,588**	**23,936**	**0**	**0**	**114,524**	**12,155**	**419,961**
			554,496	134,289	0	0		280,087	
			1,333,568	338,091	0	0		419,961	

Appendix　Estimation of numbers of sample in the XIth Region
（Prepared by INFOR Valdivia counterparts, June 2007）

Existing data from the forest inventory were classified in two site classes where discriminate variable is altitude. The following table shows standard deviation of the total carbon stock (above and below ground) based on 11 available sample plots related to Coyhaique study area.

Table 1　Geographic zone and standard deviation of carbon stock of planted trees

Site class (Altitude)	Standard deviation （kg C）
Less than 800 m	3,133.6
800 m or more	1,004.2
Whole	2,214.1

A stratified sampling design based on the above classes was assumed for the estimation of "*n*". The following expression is the applied formula for "*n*" calculations.

$$n = \frac{\left[\sum_j N_j S_j\right]^2}{\left[N \frac{E}{z_{\alpha/2}}\right]^2 + \sum_j N_j \left(S_j\right)^2}$$

where,
n　: number of samples plots
Sj　: Standard deviation for strata j
Nj　: Number of maximum possible plot in strata j
N　: Number of maximum possible sample plots in the total area.
E　: Allowable error in kg.
zα/2　: z value (normal probability density function)

The following is the results table for the optimal allocated "*n*" sample plots:

Table 2　Error Rate and Sampling Size（n）

Error Rate	*N*
(25%):	**9**
(20%):	**14**
(15%):	**25**
(13%):	**33**
(10%):	**56**
(7%):	**112**
(5%):	**216**

Strata weights applied were 0.87 for class less than 800 m and 0.13 for class of 800 m or more. Total area was defined as 510 ha with a sample size plot of 625 m^2.

The following table shows changes of the sampling size according to each error rates (or accuracy).

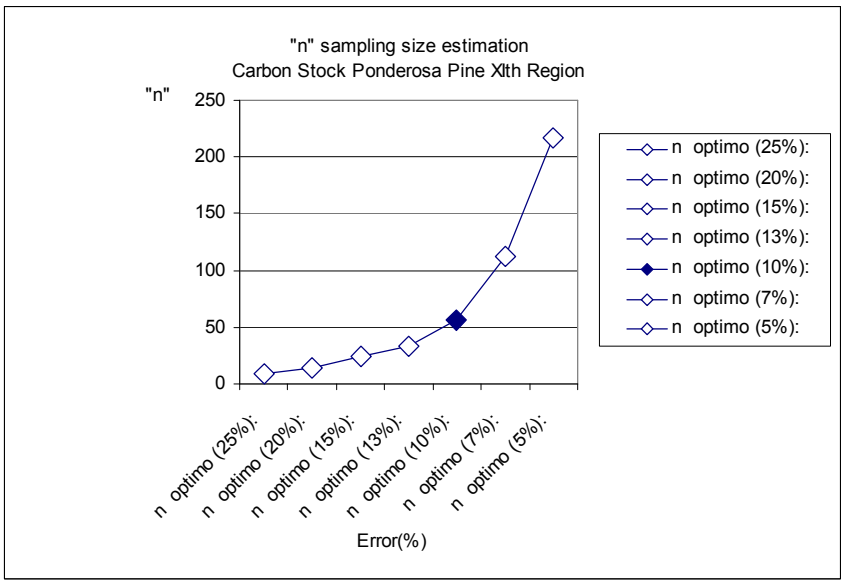
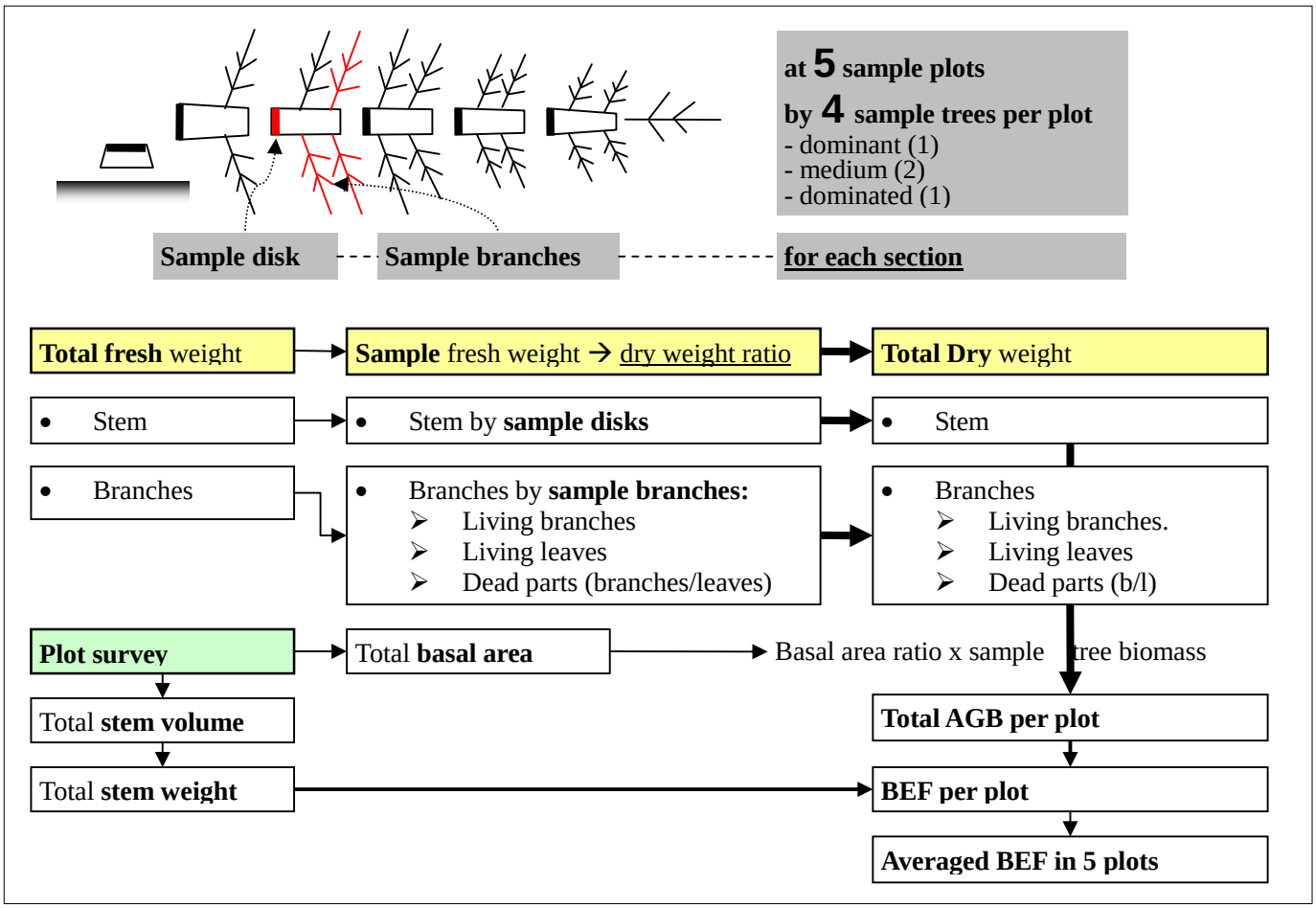


Fig 1 Error Rate and Sampling size（n）

Annex Measurement of BEF

BEF verification will be conducted through 1) plot survey and 2) biomass survey.
The following schematic shows flow and relationship between the said surveys.



Note: AGB: above-ground biomass BEF: biomass expansion factor

Fig. 1 Flow of plot survey and biomass survey

Remarks:

- The time for hot air drying depends on conditions of samples and tree species.
- On-site work and weighing can become easier and time saving if you carry out those when trees are under drier situation as possible.
- *Pinus ponderosa* has considerable amount of dead leaves on the stem. They are removed and appropriately divided for each large branch for measurement.

Reference

IPCC (2003) GPG-LULUCF (*with regard to general framework*)
Daishichiro Sato (1973) Material Production by Land Plant Community (*with regard to basal area*)
Forestry and Forest Products Research Institute in Japan (FFPRI) (2005) Manual for Forest Biomass Data and Yield Survey (*with regard to the specific process*)

The main steps and essential issues are shown below.

Plot survey

a. Establishment of plot: Inside of the plot is preferably homogenous and has no heterogeneous or abnormal conditions.

b. Stand condition data: 1) planted tree species, 2) stand age, 3) management record, 4) geographical features
c. Measurement: All trees are subject to the measurement of DBH (larger than 5 cm) and height in the plot (25 m x 25 m). (When trees whose DBHs are more than 1.0 cm are targeted, the sampling size will be narrowed to 10 m x 10 m.)
    ① DBH in 0.1cm
    ② Total height in 0.1 m
d. Estimation: Stem volume of the stand is estimated from these data.

Biomass survey

The above-ground biomass measurement shown here assumes **coniferous planted forests**.

a. Selection of sample trees: In the plot, **four trees** are selected: one dominant tree, two medium-sized trees, and one dominated tree.
b. DBH and total height: All trees are measured in DBH and total height in the same way as the plot survey.
c. Sampling trees are fallen on the ground (stump height 0.2 m).
d. A fallen tree is cut into a-meter-long sections from the stem base. The lower part of the stump lower than 0.2 m is cut off at the ground level.
e. The cross-cut sections are measured in the following ways (including the part lower than 0.2 m):
   The minimum weight for measurement is 100 g for stem and 1 g for branch and leaf.
    ① [whole] Branches are cut off from their bases on the stem. Large branches are divided into fresh branches and dead branches (Large branch: branches growing directly on the stem).
    ② Living branches
        1. [whole] The whole fresh weight is measured.
        2. [sample] A few living large branches having average sizes are selected for sample branches and divided into living branch and leaf, as well as dead branch (including dead leaves).
        3. [sample] The fresh weight of living branch and leaf on sample branches is measured.
        4. [sample] Samples for dry weight measurement are collected for leaves and branches, of which weight needs to be more than 100 g respectively, to measure fresh weight.
    ③ Dead branches
        1. [sample] Fresh weight of dead branches (including dead leaves) of sample branches is measured.
        2. [whole] Fresh weight of all dead branches (including dead leaves) is measured.
        3. [sample] Two samples from the said two dead branches, which totals a few hundred grams are appropriately mixed in terms of thick one and thin one. It is taken back for dry weight measurement after measuring the fresh weight.
    ④ Stem:
        1. [whole] Stem: Stem parts are weighed by a digital hanging scale, etc.
        2. [sample] Sample disk: Sample disks (thickness: 5 cm approx.) are collected from the bottom end and the fresh weight is measured. (Another sample disk at 1.2 m is collected for measuring basic density.)
f. Samples of leaf, branch and dead branch are oven-dried (Hot air drier, approx. 3 days at 85 ºC). The oven dry weight measured after dried.
g. Sample disks are oven-dried (Hot air drier, approx. a week at 90 ºC). The drying is stopped when there is no change. The oven dry weight measured after dried.
h. In each 1 m section, the rate of oven dry weight over fresh weight is calculated to get dry

weight of stem, leaf, branch, and dead branch (including leaf).
In order to calculate constituent fresh weight for leaf, branch, and dead branch (including leaf), total fresh weight is multiplied by each constituent rate of fresh weight in sample branches.

i. By adding oven dry weight of each 1 m section, total oven dry weight of leaf, branch, dead branch (leaf) and stem for one sample tree is calculated.
j. Total oven dry weight is summed up respectively for leaf, branch, dead branch (leaf).
k. The said each total oven dry weight is multiplied by rate of basal areas (=basal area at breast height of 4 sample trees / the whole basal area in the plot) to estimate each oven dry weight within the plot.
l. The value is converted to the one at a hectare basis.
m. The obtained biomass is divided by stem volume given by the plot survey to get BEF of the plot

Data aggregation of the whole plots

The above-mentioned plot survey and biomass survey are conducted in five (5) plots of which average BEF is assumed to be the BEF.

Schedule and Cost

Measurement schedule and cost are as following tables.

Measurement age and sampling numbers and required days

22th yr: Thinning

Subject Stand Age				Measuring rate	
10	12	14		4.0	trees/day
19	21	22	24	3.0	
29	34	39		2.0	

No.	Age *year*	Tree No.	Tree no./ 625 m2	Plot No.	Total tree No.	Field team day
1	10	1,250	4	5	20	5
2	12	1,250	4	5	20	5
3	14	1,250	4	5	20	5
4	19	1,250	4	5	20	7
5	21	1,250	4	5	20	7
6	22	1,250	4	5	20	7
7	24	850	4	5	20	7
8	29	850	4	5	20	10
9	34	850	4	5	20	10
10	39	850	4	5	20	10

BEF Measurement schedule (Ages in black cells will be measured

Prj yr	Stand Age 1	2
1	0	
2	1	0
3	2	1
4	3	2
5	4	3
6	5	4
7	6	5
8	7	6
9	8	7
10	9	8
11	**10**	9
12	11	10
13	**12**	11
14	13	12
15	**14**	13
16	15	14
17	**16**	15
18	17	16
19	18	17
20	**19**	18

Prj yr	Stand Age 1	2
21	20	19
22	**21**	20
23	**22**	21
24	23	22
25	**24**	23
26	25	24
27	26	25
28	27	26
29	28	27
30	**29**	28
31	30	29
32	31	30
33	32	31
34	33	32
35	**34**	33
36	35	34
37	36	35
38	37	36
39	38	37
40	**39**	38

BEF measurement cost for age-dependent equation

Summary of methodology

- Stand age ranges for 7 different years, i.e. 10, 12, 14, 19, 21, 22, 24, 29, 34, 39
- BEF will be interpolated from those oldest stand at each monitoring timing.
- 5 **plots** for each age, 4 average-sized trees per plot

Item	Amount	Unit	Unit cost ($/unit)	Total ($)	Remarks
Stand age: 10,12,14					
Researcher	2	manday	50,000	100,000	per one year
Chief engineer (allowances & salary)	1	manday	60,000	60,000	As above
Technical assistant (allowances &	6	manday	45,000	270,000	As above
5 Assistants	30	manday	6,000	180,000	As above
Vehicle operation (fuel, toll payments, others) (assumed to 300 km round trip)	6	day	22,000	132,000	As above
Vehicle rent (personal one)	6	day	60,000	360,000	As above
Laboratory work	3	manday	30,000	90,000	RS ration,D,Dry weight ratio, etc.
Laboratory work (drying & measurement)	1	set	402,133	402,133	oven-dry
Miscellaneous (5%)				59,600	
Total for one year				1,653,733	
			(	**3,211.10**	**US$)**
Stand age: 19,21,22,24					
Researcher	2	manday	50,000	100,000	per one year
Chief engineer (allowances & salary)	1	manday	60,000	60,000	As above
Technical assistant (allowances &	8	manday	45,000	360,000	As above
5 Assistants	40	manday	6,000	240,000	As above
Vehicle operation (fuel, toll payments, others) (assumed to 300 km round trip)	8	day	22,000	176,000	As above
Vehicle rent (personal one)	8	day	60,000	480,000	As above
Laboratory work	5	manday	30,000	150,000	RS ration,D,Dry weight ratio, etc.
Laboratory work (drying & measurement)	1	set	1,009,200	1,009,200	oven-dry
Miscellaneous (5%)				78,300	
Total for one year				2,653,500	
			(	**5,152.40**	**US$)**
Stand age: 29,34,39					
Researcher	2	manday	50,000	100,000	per one year
Chief engineer (allowances & salary)	1	manday	60,000	60,000	As above
Technical assistant (allowances &	11	manday	45,000	495,000	As above
5 Assistants	55	manday	6,000	330,000	As above
Vehicle operation (fuel, toll payments, others) (assumed to 300 km round trip)	11	day	22,000	242,000	As above
Vehicle rent (personal one)	11	day	60,000	660,000	As above
Laboratory work	5	manday	30,000	150,000	RS ration,D,Dry weight ratio, etc.
Laboratory work (drying & measurement)	1	set	1,314,667	1,314,667	oven-dry
Miscellaneous (5%)				101,850	
Total for one year				3,453,517	
			(	**6,705.90**	**US$)**
Grand total					
Stand age: 10,12,14	3	years	1,653,733	4,961,199	
Stand age: 19,21,22,24	4	years	2,653,500	10,614,000	
Stand age: 29,34,39	3	years	3,453,517	10,360,551	
				25,935,750	Pesos
			(	**50,361**	**US$)**

Source: INFOR Valdivia Note: $=Chilean Peso $/US$= 515

Laboratory work for dry weight ratio 2007/6/14

Age	Ht	DBH	Section	Branch	Laboratory				Total sample	Unit price $/tree*	Total $	Total US$
					Disk	LB	LL	D				
yr	m	cm	No.	3/section	No.	No.	No.	No.	No/tree/yr	**290$/sample**	**20 trees**	**530$/US$**
10	3.5	5.9	3	9	3	3	3	3	12	6,960	139,200	263
12	10.0	10.0	10	30	10	10	10	10	40	23,200	464,000	875
14	13.5	13.5	13	39	13	13	13	13	52	30,160	603,200	1,138
19	19.4	19.4	19	57	19	19	19	19	76	44,080	881,600	1,663
21	21.0	21.0	20	60	20	20	20	20	80	46,400	928,000	1,751
22	23.8	23.8	23	69	23	23	23	23	92	53,360	1,067,200	2,014
24	25.0	25.0	25	75	25	25	25	25	100	58,000	1,160,000	2,189
29	27.4	27.4	27	81	27	27	27	27	108	62,640	1,252,800	2,364
34	28.9	28.9	28	84	28	28	28	28	112	64,960	1,299,200	2,451
39	30.1	30.1	30	90	30	30	30	30	120	69,600	1,392,000	2,626
								Total		459,360	9,187,200	17,334

Note: LB: Living branch LL: Living leaves D: Dead branches & leaves

* Sample disk will weigh several hundreds. Therefore 500 g price were multiplied for disk number.

Sample measurement price: 1450 $/500g = 290 $/100g

	Age	Unit total	Sub-total	Ann Ave
Stand age: 10,12,14		60,320	1,206,400	402,133
Stand age: 19,21,22,24		201,840	4,036,800	1,009,200
Stand age: 29,34,39		197,200	3,944,000	1,314,667

Appendix 6. A/R CDM Manual

Informe Técnico N° 176

MANUAL

ELABORACIÓN PROYECTOS FORESTACIÓN / REFORESTACIÓN BAJO MECANISMO DE DESARROLLO LIMPIO EN CHILE

A/R MDL PROTOCOLO DE KYOTO

CHILE
POTENCIA ALIMENTARIA Y FORESTAL

GOBIERNO DE CHILE
MINISTERIO DE AGRICULTURA

INFOR

JICA

Instituto Forestal, Chile, Marzo, 2009

Informe Técnico N° 176

MANUAL

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INFOR

Santiago, Chile, 2009
Registro propiedad intelectual N° 178221
Instituto Forestal Chile - Agencia de Cooperación Internacional de Japón

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PRESENTACIÓN

El IV informe elaborado en 2007 por el Panel Intergubernamental de Cambio Climático (IPCC) fue concluyente al señalar que los efectos perceptibles en el aumento de GEI (Gases de Efecto Invernadero) tienen causas antropogénicas, es decir, el hombre con sus acciones ha participado, desde la revolución industrial, en los eventos que hoy se comienzan a visualizar.

A nivel global, estas acciones incluyen desde la contribución de las emisiones de combustibles fósiles y otras fuentes contaminantes, hasta la deforestación y degradación de los bosques a nivel planetario, sea para la ampliación de la frontera agrícola o para usos industriales y crecimiento urbano.

Las consecuencias son fuertes, entre ellas, el aumento previsto de temperatura, el deshielo de las capas polares y subsecuente aumento del nivel del mar, que llevaría al anegamiento de territorios e implicaría cambios directos e indirectos en el flujo de las corrientes. Todo ello, teniendo resultados aún inciertos en la biodiversidad, en los patrones de cultivo, la sanidad y el desplazamiento de la población humana y animal.

En Chile, producto de estos eventos se pronostican cambios. Así lo indican estudios recientemente realizados, tanto por INFOR como por otros centros de investigación universitarios, en los cuales se indica que desde Coquimbo a Aysén se producirían cambios importantes por la elevación de temperaturas, que por ejemplo significaría que zonas tradicionalmente frías variarían a temperadas.

Para cambiar las tendencias y mitigar los efectos del Cambio Climático los países se han organizado, el Protocolo de KIOTO (PK) es ejemplo de ello, como también los mecanismos que al amparo del Protocolo se han desarrollado, tal como el Mecanismo de Desarrollo Limpio o MDL, en cuyo marco se cobijan los proyectos de forestación y reforestación, que tienen por finalidad favorecer la captura de CO2 de la atmósfera, uno de los principales GEI causantes del Cambio Climático.

En efecto, los bosques, sean estos nativos o plantados, son de una gran importancia en la mantención del balance de carbono, puesto que absorben el carbono de la atmósfera y lo retienen en su biomasa. Durante los últimos cincuenta años la tercera parte de las emisiones de carbono a la atmosfera ha sido provocada por la deforestación. La conservación de las masas forestales actuales y la creación de nuevos bosques adquieren así una especial importancia en la mitigación del Cambio Climático.

Es en ese contexto que en el año 2006 el Instituto Forestal, con la asistencia técnica de la Agencia de Cooperación Internacional del Japón, JICA, en el marco del Convenio suscrito entre el Gobierno de Chile y de Japón, da inicio al proyecto “Estudio para el Desarrollo de Capacidades y Promoción de Proyectos de Forestación y Reforestación en el Mecanismo de Desarrollo Limpio del Protocolo de Kyoto sobre Cambio Climático”, contando con la cooperación de importantes servicios del Ministerio de Agricultura, como la Oficina de Estudios y Políticas Agrarias (ODEPA), el Instituto de Desarrollo Agropecuario (INDAP), la Corporación Nacional Forestal (CONAF) y la Fundación para la Innovación Agraria (FIA); además de la Corporación de Fomento de la Producción (CORFO), la Agencia de Cooperación Internacional (AGCI) y la Dirección de Promoción de Exportaciones (PROCHILE).

Este proyecto ha tenido como principal objetivo fortalecer las capacidades nacionales para la formulación y desarrollo de proyectos de forestación y reforestación bajo el mecanismo de desarrollo limpio y su registro ante la Junta Ejecutiva del Protocolo de Kyoto, además de transferir estos conocimientos a actores públicos y privados interesados en contribuir a la mitigación del Cambio Climático por esta vía.

Con el presente manual, que INFOR y JICA ponen a disposición de los interesados, se cumple el importante compromiso de transferencia, por cuanto en este documento se realiza una exhaustiva revisión y análisis de importantes aspectos metodológicos de los mencionados proyectos; como también se exponen detalles de la formulación del proyecto de forestación, llevado a cabo en Chile en la Región Aysén, en el marco del MDL, el cual prontamente será registrado ante la Junta Ejecutiva del Protocolo de Kioto, constituyéndose en pionero en su tipo, tanto en Chile como en el mundo.

INFOR cumple así, su importante misión de "Crear y Transferir conocimientos de excelencia para el uso sostenible de los recursos y ecosistemas forestales" para beneficio del sector y del país.

El presente manual y las actividades realizadas en el transcurso de los tres años del proyecto, no habrían sido posibles, sin la participación directa, colaboración y apoyo de muchos profesionales de las Instituciones participantes y asociadas, y de los representantes del Gobierno de Chile y de Japón. A todos ellos nuestros agradecimientos y reconocimientos.

Mención especial, corresponde realizar al equipo de trabajo del proyecto, constituido por profesionales de INFOR y JICA, quiénes fueron capaces de sortear los innumerables obstáculos que se presentaron en las diferentes etapas del proyecto, sin cuyo esfuerzo y dedicación ello no hubiera sido posible. En particular, al Jefe del proyecto de A/R de Aysén, Sr. Paulo Moreno de INFOR; y al Sr. Kunio Hatanaka, jefe de la misión JICA, y a todos los miembros de ambos equipos.

Finalmente, nuestros agradecimientos a todos los integrantes del Comité Consultivo del Proyecto, a la delegación de JICA en Chile, y muy en particular a la Subsecretaría del Ministerio de Agricultura.

Marta I. Abalos Romero
Directora Ejecutiva
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PRESENTACIÓN

La Agencia de Cooperación Internacional del Japón (JICA) es la institución ejecutora de la Asistencia Oficial para el Desarrollo del Gobierno del Japón, cuya misión es atender los asuntos de envergadura global, apoyar a los países en desarrollo en su crecimiento equitativo y la superación de la pobreza, mejoramiento de la gobernabilidad y hacer realidad la seguridad humana.

A partir del mes de octubre 2008, JICA pasó a ser una institución a cargo no sólo del programa de cooperación técnica sino que también del programa de cooperación financiera no reembolsable y préstamos bilaterales, transformándose en una de las mayores organizaciones ejecutoras de asistencia bilateral del mundo.

Una de las áreas prioritarias de la cooperación en Chile y establecida por el Gobierno de Japón en conjunto con el Gobierno de Chile, es asistir en los temas medio ambientales, especialmente los problemas causados por el cambio climático.

Bajo este contexto, en el año 2005 se firmó un acuerdo para la ejecución del "Estudio para el Desarrollo de la Capacidad y Promoción de Proyectos de Forestación y Reforestación en el Mecanismo de Desarrollo Limpio-MDL (2006-2009)" el cual contó con la participación del Instituto Forestal (INFOR); del Ministerio de Agricultura con la estrecha colaboración de la Oficina de Estudios y Políticas Agrarias (ODEPA); la Corporación Nacional Forestal (CONAF); el Instituto de Desarrollo Agropecuario (INDAP); la Corporación de Fomento de la Producción (CORFO) y la Dirección de Promoción de Exportaciones (PROCHILE). El objetivo del Proyecto es alcanzar dos principales resultados; la preparación del Documento de Diseño de Proyecto (PDD) y, mediante su proceso de preparación, desarrollar las capacidades de las instituciones involucradas para la coordinación y promoción de proyectos forestales MDL. Durante la ejecución del Proyecto, se organizaron numerosos seminarios y talleres en Chile para difundir sus avances, y se realizaron pasantías y capacitaciones de cuatro profesionales chilenos en Japón.

Durante la visita oficial a Japón de la Presidenta Michelle Bachelet realizada en septiembre del 2007, la cual se enmarcó en la commemoración de los 110 años de relaciones entre Chile-Japón y la firma del Tratado de Libre Comercio, los máximos mandatarios de ambas naciones realizaron una Declaración Conjunta enfatizando la importancia de realizar esfuerzos en los temas de cambio climáticos y la importancia de continuar promoviendo proyectos MDL.

Estamos confiados que Chile continuará realizando esfuerzos para el apoderamiento de los resultados obtenidos por el Proyecto y lograr un desarrollo sostenible.

Aprovecho la ocación para agradecer la colaboración y determinación de INFOR y las instituciones relacionadas al Proyecto, y felicitarlos por el alto nivel de sus profesionales, los que trabajaron estrechamente con el Equipo Consultor Japonés.

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RESUMEN

En el año 2006 el Instituto Forestal (INFOR) con la asistencia técnica de la Agencia de Cooperación Internacional del Japón (JICA) da inicio al proyecto Estudio para el Desarrollo de Capacidades y Promoción de Proyectos de Forestación y Reforestación en el Mecanismo de Desarrollo Limpio (MDL) del Protocolo de Kyoto sobre Cambio Climático, trabajo que se ha realizado en tres años, con la cooperación de otras instituciones del Ministerio de Agricultura, como la Oficina de Estudios y Políticas Agrarias (ODEPA), el Instituto de Desarrollo Agropecuario (INDAP), la Corporación Nacional Forestal (CONAF) y la Fundación para la innovación Agraria (FIA), además de la Corporación de Fomento de la Producción (CORFO), la Agencia de Cooperación Internacional (AGCI) y la Dirección de Promoción de Exportaciones (ProChile).

La actividad industrial y el transporte, la deforestación y el cambio de uso de la tierra, la sobreutilización de los recursos forestales y los incendios forestales están alterando seriamente el ciclo del Carbono y propiciando así un cambio climático global que puede producir graves daños a toda forma de vida sobre el planeta. En el año 1997 los países acuerdan el Protocolo de Kyoto y aquellos que lo han suscrito se comprometen a reducir sus niveles de emisiones de Gases de Efecto Invernadero (GEI), principalmente CO_2 , y el MDL establecido por el Protocolo de Kyoto tiene por objeto que los países desarrollados (Anexo 1 del Protocolo) puedan cumplir parte de sus compromisos mediante reducciones logradas en países en desarrollo (No Anexo 1), activándose así un mercado de Certificados de Reducción de Emisiones (CER) conocido como Mercado de Carbono.

El proyecto INFOR-JICA tiene por objetivos centrales la consolidación de capacidades en Chile para la formulación y desarrollo de Proyectos Forestales MDL y la formulación y registro ante la Junta Ejecutiva (JE) del Protocolo de Kyoto del primer proyecto piloto de este tipo en el país. Adicionalmente, contempla actividades de difusión en torno al tema y la elaboración de un manual para la preparación y registro de estos proyectos en el país.

Los objetivos están plenamente logrados; la capacidad está creada en el equipo técnico de INFOR; se ha desarrollado el primer proyecto piloto en el país mediante un Proyecto de Reforestación bajo MDL en la Región de Aysén, hoy en etapa de validación y cuyo registro se espera para el el año 2009; se ha efectuado una cantidad de seminarios y charlas técnicas; y se ha elaborado el presente manual, que en su Primera Parte revisa y analiza toda la información sobre las metodologías, modalidades y procedimientos del MDL y, en su Segunda Parte presenta su aplicación a la elaboración del Proyecto en Aysén. INFOR y JICA esperan que este manual sea un importante apoyo técnico y práctico para la promoción y desarrollo de proyectos MDL F/R en Chile.

SUMMARY

The Chilean Forest Institute (INFOR) and the Japanese International Cooperation Agency (JICA) have carried out the project Study for Capacity Building and Promotion of Afforestation and Reforestation Projects under the Kyoto Protocol's Clean Development Mechanism (CDM) on Climate Change. The three years project has been developed since 2006 with the participation not only of other institutions belonging to the Agriculture Ministry, as the Studies and Agriculture Policies Office (ODEPA), the Agriculture and Cattle Development Institute (INDAP), the National Forest Corporation (CONAF) and the Agriculture Innovation Foundation (FIA), but also the Production Promoting Corporation (CORFO), the Chilean International Cooperation Agency (AGCI) and the Exports Promotion Direction (ProChile).

Industrial activities and transport, deforestation and land use change, forest resources over exploitation and forest fires, are seriously perturbing the carbon cycle and generating that way a global climate change, which effects can produce serious damages to all kind of life over the Earth. On 1997 countries agree to reduce Greenhouse Gas Emissions (GHG), mainly CO_2, through the Kyoto Protocol, and the Clean Development Mechanism (CDM) is established by this protocol to allow developed countries (Annex 1) to fulfill part of their reduction commitments by using reduced emissions in developing countries (Non-Annex 1), generating that way a Certified Emission Reductions (CER) market known as the Carbon Market.

The INFOR-JICA's project has as main objectives capacity building on Afforestation/ Reforestation (A/R) Projects under CDM, for data collection, preparation, formulation, validation and registration of the first pilot project in Chile. Furthermore, diffusion activities on the matter are considered and also the elaboration of a manual to carry out this kind of projects in Chile.

These objectives are achieved with capacity created on the INFOR's technical working group; the first pilot project has been carried out through a CDM Reforestation Project in Aysén Region, which is now under validation process with an expectation to be registered at the CDM Executive Board in 2009; a number of seminars have been organized, and the present handbook is elaborated. In this handbook, the First Part review and analyze CDM methodologies, modalities and procedures, and the Second Part presents their application to Chilean case, in particular to the formulation of the Aysén Project. INFOR and JICA hope this manual will serve as an introductory technical material for the promotion of A/R CDM projects in Chile.

CONTENIDO

PRIMERA PARTE: INFORMACIÓN GENERAL

PRIMERA PARTE
INFORMACIÓN GENERAL

1. EL PROTOCOLO DE KYOTO Y EL CAMBIO CLIMÁTICO

1.1. IMPACTO DEL CAMBIO CLIMÁTICO

El término clima se define como el conjunto de valores promedio de las condiciones atmosféricas que caracterizan una región, valores que se obtienen de la información meteorológica registrada durante un periodo de tiempo suficientemente largo.

La Convención Marco sobre el Cambio Climático (CMCC) define este cambio como "cambio global del clima atribuido directa o indirectamente a actividades humanas, que alteran la composición de la atmósfera mundial, y que viene a añadirse a la variabilidad natural del clima observada durante períodos de tiempo comparables".

Durante el último siglo, las actividades humanas han afectado las tasas de liberación de los gases efecto invernadero (GEI), afectando directamente su nivel en la atmósfera, y el de los aerosoles que producen el efecto contrario, alterando los balances radiactivos y cambiando las pautas espacial y temporal de las precipitaciones que interactuarán con la variabilidad natural, afectando sí el bienestar social y económico. Las proyecciones de los modelos climáticos predicen un aumento de la temperatura media en la superficie del planeta de 1 - 3,5°C para el año 2100.

Cabe esperar que la vulnerabilidad a estos cambios varíe de una región a otra, ante los efectos que podría tener en los ecosistemas, las pautas en la utilización de recursos y los factores considerados en la toma de decisiones políticas.

Los estudios muestran que aspectos vitales para un desarrollo sustentable son sensibles a los cambios del clima; la salud humana, los sistemas ecológicos y los sectores socioeconómicos son altamente sensibles a ellos. En algunas regiones el cambio climático ocasionará efectos adversos mientras que en otras serían beneficiosos, teniendo lugar un desarrollo económico que podría hacer a algunos países menos vulnerables al incrementar los recursos para la adaptación.

1.1.1. Ecosistemas

Los sistemas ecológicos son intrínsecamente dinámicos y están constantemente influenciados por la variabilidad del clima. La principal influencia del cambio climático antropógeno sobre los ecosistemas se derivará,previsiblemente, de la rapidez y magnitud con que cambien los valores medios y extremos, ya que se espera que el cambio climático sea más rápido que el proceso de adaptación y reasentamiento de los ecosistemas, y de los efectos directos de una mayor concentración de CO_2 en la atmósfera, que podría incrementar la productividad y la eficiencia de utilización del agua en algunas especies vegetales. Los efectos secundarios del cambio climático consistirían en cambios de las características de los suelos y de los regímenes de perturbación (por ejemplo, incendios, plagas o enfermedades), que favorecerían a algunas especies más que a otras alterando, por consiguiente, la composición de los ecosistemas.

Basándose en simulaciones de distribución de la vegetación y en escenarios del clima definidos a partir de Modelos de Circulación General[1], cabrá esperar importantes desplazamientos de las fronteras de vegetación hacia latitudes y altitudes mayores.

En el caso de las latitudes medias, un calentamiento promedio entre 1 y 3,5 ºC en el próximo siglo equivaldría a un desplazamiento hacia los polos de las actuales franjas geográficas de similar temperatura (isotermas) en aproximadamente 150 y 550 km o un desplazamiento en altitud de aproximadamente 150 a 550 m. En estas condiciones, es probable que cambie la composición de los bosques en términos de especies; desaparición de tipos enteros de bosques, creación de nuevos equilibrios entre especies y nuevos ecosistemas.

Por efecto de un posible cambio en la temperatura y en la disponibilidad de agua, suponiendo dos veces la concentración de CO_2 en la atmósfera en condiciones de equilibrio, una fracción importante de la superficie boscosa actual del planeta podría experimentar cambios importantes de los géneros en latitudes altas.

1.1.2. Hidrología y Recursos Hídricos

Los cambios del clima podrían exacerbar la escasez periódica y crónica de agua, particularmente en las áreas áridas y semiáridas del globo. Los países en desarrollo son muy vulnerables al cambio climático, ya que muchos de ellos están situados en regiones áridas y semiáridas y, en su mayoría, obtienen sus recursos hídricos de puntos de abastecimiento únicos, como, por ejemplo, perforaciones o embalsamientos

aislados. Estos sistemas de suministro son, por naturaleza, vulnerables, ya que carecen de reservas alternativas en caso de necesidad. Además, dada la escasez de recursos técnicos, financieros y de gestión en los países en desarrollo, acomodarse a las situaciones de escasez e implementar medidas de adaptación representará una pesada carga para sus economías.

Hay indicaciones de que los problemas derivados de las inundaciones van a aumentar en muchas regiones templadas y húmedas, lo que obligará a adaptarse no sólo a las sequías y a la escasez crónica de agua, sino también a las inundaciones y a los daños causados por éstas, y a prever el posible fallo de los embalses y de los diques.

Los impactos del cambio climático dependerán del estado comparativo del sistema de abastecimiento de agua y de la capacidad de los gestores de recursos hídricos para responder no sólo al cambio climático sino también al crecimiento de la población y a los cambios en la demanda, en las tecnologías y en las condiciones económicas, sociales y legislativas.

1.1.3. Producción de Alimentos y de Fibras

En algunos países se espera que el consumo de alimentos se duplique en los próximos 30 años, debido al aumento poblacional y a los mayores ingresos. El último aumento en la producción ocurrió con la revolución agrícola, en un periodo de 25 años, gracias a sistemas de regadío tecnificados, nutrientes químicos y el cultivo de variedades de alto rendimiento, situación que, sin embargo, también generó problemas por escorrentía química, salinización, erosión y compactación del suelo. Algunas adaptaciones que permitirían un nuevo aumento en la producción requieren de capital, formación técnica y disponibilidad de recursos hídricos. Utilizar tierras marginales, biotecnología, resultaría en una situación que provocaría competencia por las tierras, intensificaría las emisiones de GEI y reduciría los sumideros naturales.

Los cambios del clima interactuarán con los efectos negativos de las medidas que se adopten para incrementar la producción agrícola, afectando así de diversas maneras al rendimiento de los cultivos y a la productividad, según el tipo de práctica o de sistema agrícola en uso.

Los efectos directos más importantes se deberán al cambio de factores tales como la temperatura, la precipitación, la duración de la estación de cultivo o los momentos en que se produzcan fenómenos extremos o se alcancen umbrales críticos que influyan en el desarrollo de los cultivos, así como a los cambios de concentración de CO_2 en la atmósfera (que podrían tener un efecto beneficioso sobre el crecimiento en muchos tipos de cultivo). Los efectos indirectos consistirían en un posible agravamiento de la situación en cuanto a las enfermedades, las plagas o las malas hierbas, cuyos efectos no están todavía cuantificados en la mayoría de los estudios realizados.

Los efectos positivos del cambio climático (estaciones de cultivo más largas, menor mortalidad natural en invierno o mayores tasas de crecimiento en latitudes altas) podrían quedar contrarrestados por otros factores negativos, tales como la alteración de las pautas de reproducción existentes, de las rutas migratorias o de las relaciones de los ecosistemas.

Las pesquerías y la producción pesquera son sensibles a los cambios del clima y están actualmente amenazadas por la pesca excesiva, la disminución de los criaderos y una abundante contaminación en la tierra y en las aguas costeras. A nivel mundial, se espera que la producción de pesquerías marinas permanezca invariable en respuesta a los cambios del clima; en latitudes altas, la producción de especies de agua dulce y acuícola aumentará probablemente, suponiendo que la variabilidad natural del clima y la estructura e intensidad de las corrientes del océano no varíen apreciablemente. Los impactos más importantes se harán notar a nivel nacional y local, a medida que se desplacen los centros de producción.

1.1.4. Sistemas Costeros

Se estima que actualmente la mitad de la población mundial habita en zonas costeras caracterizadas por actividades socioeconómicas y ecosistemas diversos. El cambio climático afectará los ecosistemas y la infraestructura humana, con un aumento en el nivel del mar y/o mayor intensidad de los fenómenos extremos.

Las costas de muchos países están ya hoy

[1] Modelos que incluyen también la interacción océano - atmósfera

seriamente afectadas por un aumento del nivel del mar causado por hundimientos de origen tectónico y antropógeno. Unos 46 millones de personas al año están expuestas a inundaciones en la eventualidad de una marea de tempestad. El cambio climático acentuará estos problemas, posiblemente repercutiendo en los ecosistemas y en la infraestructura costera humana.

Dado que cada vez es mayor el número de megalópolis situadas en áreas costeras, este cambio podría afectar a una gran cantidad de infraestructura. Aunque para muchos países los costos anuales de protección son relativamente modestos (en torno a un 0,1% del PIB), el costo medio anual representaría para muchos pequeños países insulares varios puntos porcentuales de su PIB. Para algunos de ellos, el elevado costo de la protección frente a las mareas de tempestad haría ésta prácticamente inviable, especialmente si se tiene en cuenta la limitada disponibilidad de capital para inversiones.

El aumento de la densidad de población en las zonas costeras, los largos períodos de preparación requeridos por muchas de las medidas de adaptación y las limitaciones institucionales, financieras y tecnológicas (particularmente en muchos países en desarrollo) significan que los sistemas costeros deben ser considerados vulnerables a los cambios del clima.

1.1.5. Salud Humana

En buena parte del mundo, la esperanza de vida va en aumento y, por añadidura, la mortalidad neonatal e infantil disminuye en la mayoría de los países en desarrollo. Sin embargo, frente a este panorama positivo parecen extenderse o resurgir enfermedades nuevas y transmitidas por vectores, como el dengue, el paludismo, los hantavirus o el cólera. Adicionalmente, se espera que el porcentaje de la población mundial en desarrollo que habita en ciudades pase de un 25%, en 1960, a más de un 50% en 2020, mientras que en algunas regiones se rebasará con mucho ese promedio.

El cambio climático podría influir en la salud humana, incrementando la mortalidad debida al calor, las enfermedades tropicales transmitidas por vectores y la contaminación del aire en las ciudades, y reduciendo las enfermedades vinculadas al frío. Si se comparan con la totalidad de las enfermedades, no es probable que estos problemas sean muy notables. En su conjunto, sin embargo, los impactos directos e indirectos del cambio climático sobre la salud humana entrañan efectivamente un riesgo para la salud de la población humana, especialmente en los países en desarrollo de las regiones tropicales y subtropicales, y las posibilidades de que estos impactos acarreen cuantiosas muertes, afecten a las comunidades, encarezcan las prestaciones sanitarias e incrementen los días no trabajados son considerables.

La salud humana es vulnerable a los cambios del clima, particularmente en las áreas urbanas en que las posibilidades de acondicionar los espacios pueden ser limitadas, en aquellas áreas en que pudiera aumentar la exposición a las enfermedades transmitidas por vectores y a las contagiosas, y en aquellas en que los cuidados sanitarios y la prestación de servicios básicos (por ejemplo, de higiene) son deficientes.

1.2. LA CONVENCIÓN MARCO DE LAS NACIONES UNIDAS SOBRE CAMBIO CLIMÁTICO (UNFCCC).

1.2.1. Objetivos

En consideración de los antecedentes expuestos, la alteración del clima por causas antropogénicas es considerado uno de los retos más importantes a que se enfrentan los países en el Siglo XXI. Avanzar en los niveles de bienestar y desarrollo humano, mantener la estabilidad y el crecimiento económico, evitando las interferencias sobre el sistema climático y sus impactos, constituye un importante reto social y tecnológico.

La globalidad de las razones que explican esta alteración climática requiere de acciones concertadas de la comunidad internacional para mitigarla y adaptarse a sus impactos. En consecuencia, Naciones Unidas, el 11 de diciembre de 1990, estableció un Comité Intergubernamental de Negociación con el encargo de elaborar las bases para un acuerdo internacional sobre esta materia.

Este Comité preparó un texto para lo que lo que hoy se conoce como la Convención Marco de Naciones Unidas sobre Cambio Climático (UNFCCC por sus siglas en inglés), que fue aceptado en Nueva York en mayo de 1992. A partir de junio de este mismo año, coincidiendo con la celebración en Río de Janeiro

de la Conferencia de las Naciones Unidas sobre Medio Ambiente y Desarrollo, se abrió el período de firma de la Convención que fue respaldada por 155 estados, constituyendo este acto uno de los principales resultados políticos de la Cumbre.

Esta Convención establece un marco para la acción, cuyo objetivo es la estabilización de la concentración de GEI en la atmósfera, para evitar que interfiera peligrosamente con el sistema climático. Específicamente, en su Artículo 2, establece que su objetivo último es "lograr la estabilización de las concentraciones de gases de efecto invernadero en la atmósfera a un nivel que impida interferencias antropogénicas peligrosas en el sistema climático. Ese nivel debería lograrse en un plazo suficiente para permitir que los ecosistemas se adapten naturalmente al cambio climático, asegurar que la producción de alimentos no se vea amenazada y permitir que el desarrollo económico prosiga de manera sostenible".

1.2.2. Principios y Compromisos

Los principios sobre los que se construyó este marco de acción son los siguientes:

Las partes (o países que conforman la UNFCCC) deben proteger el sistema climático para el beneficio de las generaciones presentes y futuras, en base a la equidad y a la responsabilidad común, pero diferenciada.

Las necesidades específicas y circunstancias especiales de los países en desarrollo, especialmente de aquellos más vulnerables a los efectos adversos del cambio climático, deben ser tomadas en especial consideración.

Las partes deben tomar medidas precautorias para anticipar, prevenir o minimizar las causas del cambio climático. La falta de certeza científica absoluta no será razón para posponer medidas para controlar daños serios o irreversibles. Las partes tienen el derecho y el deber de promover el desarrollo sostenible.

Las partes deben cooperar en la promoción de un sistema económico internacional que contribuya al crecimiento económico sostenible y el desarrollo de todas las partes. Las medidas para combatir el cambio climático no deben constituir un medio para la discriminación o la restricción del comercio internacional.

En lo específico, por esta Convención las partes se comprometen a:

Desarrollar, actualizar y publicar inventarios nacionales de GEI.

Desarrollar programas para la mitigación del Cambio Climático mediante la reducción de emisiones de GEI y el uso de sumideros.

Establecer medidas para la adaptación al Cambio Climático.

Promover y cooperar en el desarrollo de tecnologías, prácticas y procesos que controlen, que reduzcan o prevengan la emisión de GEI incluyendo a los sectores agrícola y forestal.

Para las Partes que son países desarrollados, indica que sus emisiones en el año 2000 debían ser iguales a las que estos países tenían el año 1990.

La Convención Marco establece que la Conferencia de las Partes (CoP) será el órgano superior de la misma, responsable de las decisiones que se adoptan, y se reunirá, en principio, anualmente.

Dependen de ella dos órganos subsidiarios que preparan las Conferencias de las Partes (CoP):

Órgano Subsidiario de Asesoramiento Científico y Tecnológico (SBSTA por sus siglas en inglés).

Órgano Subsidiario de Implementación (SBI por sus siglas en inglés).

Una Secretaría con sede en Bonn (Alemania), integrada por funcionarios internacionales, presta el apoyo necesario a las instituciones relacionadas en el Cambio Climático y particularmente a la CoP y a los Órganos Subsidiarios.

Además existen otros Grupos de Expertos y Comités, algunos independientes de la propia Convención como son, el Panel Intergubernamental sobre Cambio Climático, que le provee de información

científica sobre el tema, a su solicitud (IPCC por sus siglas en inglés), y el Fondo Mundial para el Medio Ambiente Global, que actúa como su instrumento financiero (GEF por sus siglas en inglés).

Para las Partes desarrolladas de este acuerdo internacional, que se encuentran identificadas en el Anexo I de su texto (Cuadro N°1), la Convención precisa que deben adoptar políticas nacionales y supranacionales para mitigar el cambio climático, limitando sus emisiones de GEI y protegiendo y ampliando sus sumideros y reservorios. Asimismo, la Convención establece que estas Partes deberán comunicar periódicamente a la CoP su inventario nacional de emisiones y absorciones de los GEI, mediante metodologías aprobadas por la propia CoP.

Igualmente, este tratado internacional establece que las Partes desarrolladas incluidas en el Anexo II de la Convención (Cuadro N°2), proveerán asistencia financiera (incluida la transferencia tecnológica) a las Partes en desarrollo para que éstas puedan cumplir sus obligaciones.

Cuadro N°1

PAÍSES EN ANEXO I CONVENCIÓN MARCO SOBRE EL CAMBIO CLIMÁTICO

Alemania	Irlanda
Australia	Irlanda del Norte
Austria	Islandia
Bélgica	Italia
Bielorusia*	Japón
Bulgaria*	Letonia*
Canadá	Lituania*
Comunidad Económica Europea	Luxemburgo
Checoslovaquia*	Noruega
Dinamarca	Nueva Zelanda
España	Polonia*
Estados Unidos	Portugal
Estonia*	Bretaña
Federación Rusa*	Rumania*
Finlandia	Suecia
Francia	Suiza
Grecia	Turquía
Holanda	Ucrania
Hungría*	

*Países en transición a economía de mercado

Cuadro N°2

PAÍSES EN ANEXO II
CONVENCIÓN MARCO SOBRE EL CAMBIO CLIMÁTICO

Alemania	Irlanda
Australia	Islandia
Austria	Italia
Bélgica	Japón
Bulgaria	Luxemburgo
Canadá	Noruega
Comunidad Económica Europea	Nueva Zelanda
Dinamarca	Portugal
España	Reino Unido de Gran Bretaña e Irlanda del Norte
Estados Unidos	Suecia
Finlandia	Suiza
Francia	Turquía
Grecia	
Holanda	

La UNFCCC entró en vigencia el 21 de marzo de 1994 y actualmente tiene 188 estados parte. Sin embargo, a poco de iniciado su accionar quedó en evidencia que sus acuerdos cuantitativos en materia de mitigación de GEI no se iban a cumplir ni eran cuantitativamente suficientes para la envergadura del problema y los tiempos disponibles para logar el objetivo de la Convención, de acuerdo a la información contenida en Segundo Informe del IPCC .

Los motivos para prever un no cumplimiento estaban directamente vinculado a que la Convención no contemplaba algún sistema de sanciones para el no cumplimiento y a que la meta de reducción igualitaria para todas las naciones industrializadas no recogía las diferencias existentes en las matrices energéticas de ellas. Esto significaba que los costos iniciales para poner en marcha las transformaciones tecnológicas requeridas variaban de país a país, lo que se traducía en el peligro de afectar la competitividad económica existente entre ellos y, consecuentemente, el "orden económico" mundial. Nadie estaba dispuesto a aceptar esto, ni menos en un escenario en que la inacción de otros no fuera al menos sancionada.

En 1995, la primera reunión de la Conferencia de las Partes de la Convención (CoP 1) estableció el Grupo *Ad Hoc* del Mandato de Berlín, cuya misión fue alcanzar un acuerdo sobre el fortalecimiento de los esfuerzos para combatir el cambio climático y solucionar estos problemas.

1.3. EL PROTOCOLO DE KYOTO (CoP 3 - 1997)

Las negociaciones iniciadas con esta decisión culminaron en la CoP 3 en Kyoto, Japón, en diciembre de 1997, cuando las Partes acordaron un Protocolo para la UNFCCC (PK) que compromete a los países desarrollados y a los países en transición hacia una economía de mercado a alcanzar objetivos cuantificados de reducción de emisiones, les permite el uso de mecanismos con base a conceptos de mercado para encontrar las formas más costo-efectivas para lograrlos y establece sanciones por no cumplimiento.

De acuerdo a este instrumento, las Partes del Anexo I se comprometieron a reducir su emisión total de seis GEI, expresadas en sus equivalentes de CO_2, hasta al menos un 5,2% por debajo de los niveles de emisión de 1990 durante el período 2008-2012 (conocido también como el primer período de compromiso), con objetivos específicos que varían de país en país. El nivel de reducción o control de crecimiento de las emisiones de GEI de estos países se refleja en el Anexo B del PK en forma de porcentajes respecto al año base de 1990 (Cuadro N°3).

Sin embargo, la magnitud de estos compromisos de reducción de emisiones ha sido afectada por dos hechos no previstos.

El primero, la decisión enunciada a comienzos del año 2002 de no proceder a la ratificación de este acuerdo internacional, con argumentos que por último dicen relación con una preocupación que los países industrializados han permanentemente tenido en consideración en este proceso de negociación y que se refiere a los efectos que el acuerdo podría tener sobre su competitividad económica a nivel global. El nuevo Gobierno de los EE.UU., que asumía entonces, difería de las consideraciones que tuvo el que le cupo negociar el PK y firmarlo en Kioto, y consideró que la falta de un compromiso cuantitativos de control de emisiones para algunos países en desarrollo con altas emisiones, particularmente China, dejaba a estos en posiciones económicas ventajosa que ellos no podían aceptar.

El segundo, que para países como Rusia y Ucrania, sus niveles de emisiones para el año en que entró en vigor el PK, esto a comienzos del 2005, estaban todavía por debajo de las metas que para ellos establecía el PK, aún sin que estos países hayan implementado medidas de reducción para estos GEI. Esta diferencia entre las emisiones reales y las metas del protocolo ha sido llamado "*Hot Air*" porque este excedente de derechos de emisión podría ser vendido, bajo los mecanismos de flexibilidad económica establecidos en el marco de este acuerdo, a muy bajo precios ya que, en principio, no existen costos en su generación.

Como muestra la figura siguiente es posible que haya suficiente "*Hot Air*" para cumplir con la mayor parte de los requerimientos de reducción de GEI, sin considerar a los EE.UU. Sin embargo se espera que para el período de compromiso, este "*Hot Air*" de Rusia haya disminuido sensiblemente por el crecimiento de su economía, por una parte, y, por otra, que por razones económicas estratégicas, usando una posibilidad que otorga

Cuadro N°3

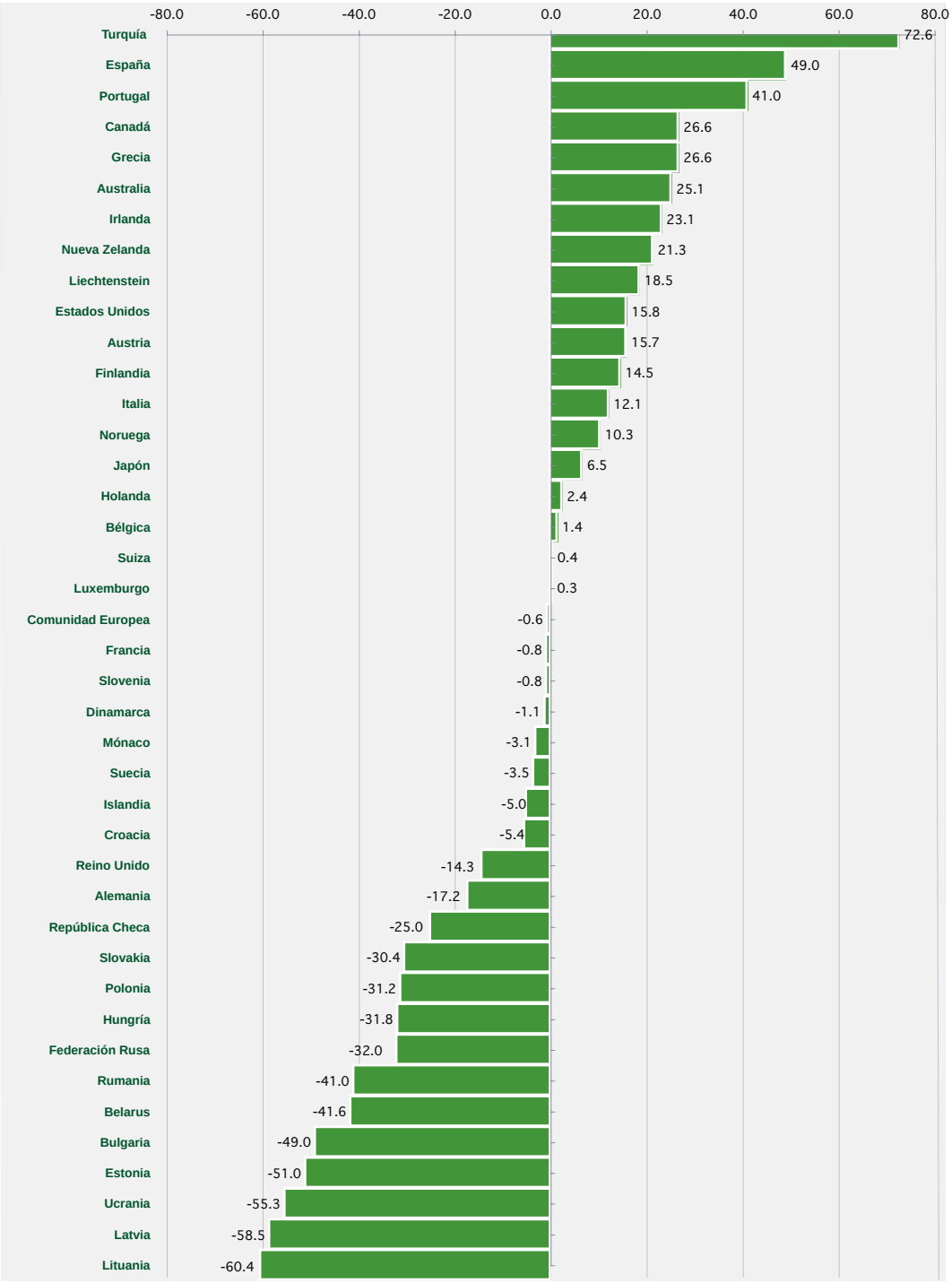
ANEXO B
COMPROMISO CUANTIFICADO DE LIMITACIÓN O REDUCCIÓN DE EMISIONES
(% del nivel del año o período de base)

Alemania	92	Islandia	110
Australia	108	Italia	92
Austria	92	Japón	94
Bélgica	92	Letonia*	92
Bulgaria*	92	Liechtenstein	92
Canadá	94	Lituania*	92
Comunidad Económica Europea	92	Luxemburgo	92
Croacia*	95	Monaco	92
Dinamarca	92	Noruega	101
Eslovaquia*	92	Nueva Zelanda	100
Eslovenia*	92	Países Bajos	92
España	92	Polonia*	94
Estados Unidos	93	Portugal	92
Estonia*	92	Reino Unido de Gran Bretaña e Irlanda del Norte	92
Federación Rusa*	100	República Checa*	92
Finlandia	92	Rumania*	92
Francia	92	Suecia	92
Grecia	92	Suiza	92
Hungría*	94	Ucrania*	100
Irlanda	92		

*Países en transición a economía de mercado

el PK de “ahorrarlos” para ser usados en un eventual segundo periodo de compromiso no sea puesto en el mercado en su totalidad, a fin de no afectar los precios.

En la Figura N°1 se muestra los países del Anexo B y el porcentaje de variación que han tenido sus emisiones de GEI en el periodo 1990 - 2004.



Nota: Las Partes a las que les está permitido usar un año base diferente a 1990 han también proporcionado información sobre sus respectivos años base de acuerdo con las decisiones 9/CP 2 y 11/CP 4. Estas partes y su año base son Bulgaria (1988), Hungría (promedio 1985-1987), Polonia (1988), Rumania (1989) y Slovenia (1986)

Figura N°1

VARIACIÓN EMISIONES DE GEI PAÍSES ANEXO B SIN LULUCF PERIODO 1990 - 2004 (%)

1.4. LOS MECANISMOS DE FLEXIBILIDAD ECONÓMICOS DE KYOTO

El Protocolo estableció tres mecanismos económicos para asistir a las Partes del Anexo I en el logro de sus objetivos nacionales de un modo costo-efectivo. Sin embargo, la reducción del tratamiento de ellos sólo a sus definiciones y la postergación de las decisiones relacionadas a las características y modalidades de operación de estos mecanismos para el momento en que este Protocolo entrara en vigor, crearon la condición para que proliferaran diversas interpretaciones e incertidumbres sobre sus alcances y valor.

Esta situación se tradujo en una barrera para que los países industrializados pudieran iniciar los procesos de ratificación de sus voluntades expresadas en Kyoto. Lograr un entendimiento único del texto del PK y un acuerdo de cómo operarían los mecanismos de flexibilización que contempla, era una condición que los Países Industrializados requerían conocer para poder evaluar con propiedad el significado del compromiso que irían a adoptar y cómo éste los afectaría en términos económicos absolutos y en su competitividad respecto a sus pares.

En estas circunstancias, en la CoP 4, realizada en Buenos Aires a fines del año 1998, se decidió iniciar un proceso de negociación que pudiera resolver estas materias, que culminó en la CoP 7, finalizada el 10 de Noviembre del 2001, y que se conoce también como Acuerdo de Marrakech[2], por ser ésta la ciudad donde se realizó dicha Conferencia.

Según este Acuerdo, la definición y características más relevantes de estos mecanismos son las descritas a continuación.

1.4.1. Transacción de Permisos / Derechos de Emisiones (TE)

Habilita a los países del Anexo I, que hayan cumplido con sus compromisos cuantitativos de reducción o control de emisiones de GEI, según el Protocolo de Kyoto, para vender el excedente de sus derechos/permisos de emisión a otros países del mismo grupo.

Para posibilitar transacciones comerciales de estos excedentes durante el Primer Periodo de Compromisos, sin esperar el término de éste, que será el momento cuando se sabrá en definitiva si un país del Anexo I tuvo o no un excedente en el cumplimiento de sus compromisos, ha debido construirse un complejo sistema de medidas de control y sanciones que lo permitan y dé certeza y valor de mercado a esos eventuales excedentes.

Los permisos/derechos de emisión de GEI se "miden" en las denominadas Unidades de Cantidad Asignada (AAU por sus siglas en inglés).

1.4.2. El Mecanismo de Implementación Conjunta (IC)

Por medio del Mecanismo de Implementación Conjunta (IC), un país listado en el Anexo I de la Convención puede participar en la realización de un proyecto de mitigación de GEI en otro país Anexo I y obtener a cambio Unidades de Reducción de Emisiones (ERU por sus siglas en Inglés), que podrá utilizar para demostrar el cumplimiento de su compromiso de limitación o reducción cuantitativa de sus emisiones de GEI de acuerdo a dicho tratado.

Los proyectos de IC pueden beneficiar a gobiernos y/o empresas, e incluyen todas las categorías de actividades que los países en el Anexo I pueden utilizar para este objeto de acuerdo al Protocolo de Kyoto y sus precisiones establecidas en Marrakech.

Los proyectos de IC son entendidos como suplementarios y adicionales a las medidas domésticas adoptadas por cada país y pueden expedir ERU para un periodo de acreditación que comience después del año 2008.

1.4.3. El Mecanismo de Desarrollo Limpio (MDL)

El Mecanismo de Desarrollo Limpio (MDL) es el único que posibilita la participación de los países en desarrollo en este tipo de instrumento económico. Este mecanismo permite que proyectos de inversión elaborados e implementados en países en desarrollo, que también se propongan la mitigación de las emisiones de GEI asociados a la actividad económica en cuestión, o que secuestren CO_2 desde la atmósfera como resultado de actividades de forestación o reforestación, puedan

[2] El texto completo del Acuerdo de Marrakech se encuentra a disposición del público en el sitio de la UNFCCC: www.unfccc.int

obtener beneficios económicos adicionales a través de la venta de "Certificados de Emisiones Reducidas" (CER).

El propósito del MDL es ayudar a los países en desarrollo a lograr un desarrollo sostenible y a contribuir al logro del objetivo de la Convención, así como a ayudar a los países con metas de reducción o control a cumplir con sus compromisos cuantificados.

El MDL, a diferencia de los otros mecanismos, permite la comercialización de los CER materializados desde el año 2000 y no estar limitado a los cinco años del primer período de compromiso, 2008 -2012.

1.5.- LAS ACTIVIDADES FORESTALES EN EL PROTOCOLO DE KYOTO

El Protocolo de Kyoto considera, además de los mecanismos de flexibilización a que se ha hecho mención anteriormente, otras herramientas que permiten a las Partes con compromisos de reducción o control de sus emisiones encontrar las formas de costos más efectivos para el cumplimiento de ellos.

En particular, en su Artículo 3.3, establece que las variaciones netas de las emisiones que se deban a actividades humanas directamente relacionadas con el cambio del uso de la tierra y la silvicultura, limitada a la forestación, reforestación y deforestación desde 1990, calculadas como variaciones verificables del carbono almacenado en cada período de compromiso, podrán ser utilizadas a los efectos de cumplir los compromisos de las Partes.

Así mismo establece, en su Artículo 3.4, que en el primer período de sesiones de su organismo de dirección, o lo antes posible después de éste, se deberá determinar las modalidades, normas y directrices sobre la forma de sumar o restar a las cantidades atribuidas a las Partes del Anexo I el resultado de actividades humanas adicionales relacionadas con las variaciones de las emisiones por las fuentes y la absorción por los sumideros de GEI, en las categorías de suelos agrícolas y de cambio del uso de la tierra y silvicultura

Nuevamente, la generalidad de estos enunciados requirió de mayores precisiones que también fueron parte de las negociaciones que culminaron en el Acuerdo de Marrakech. Entre las muchas decisiones sobre esta materia, por su pertinencia a los objetivos de este trabajo, se destaca las siguientes:

> A los efectos del párrafo 3 del Artículo 3, serán actividades admisibles aquellas actividades humanas directas de forestación, reforestación o deforestación que se hayan iniciado el 1º de enero de 1990 o después, y antes del 31 de diciembre del último año del período de compromiso.
>
> Conforme al párrafo 4 del Artículo 3, toda Parte incluida en el Anexo I podrá optar por contabilizar, en el primer período de compromiso, las emisiones antropógenas de GEI por las fuentes y la absorción antropógena por los sumideros vinculadas a una cualquiera o la totalidad de las siguientes actividades humanas directas: restablecimiento de la vegetación, gestión de bosques, gestión de tierras agrícolas y gestión de pastizales.
>
> Para el primer período de compromiso únicamente, las adiciones y sustracciones a la cantidad atribuida de una Parte derivadas de la gestión de bosques de conformidad con el párrafo 4 del Artículo 3 del Protocolo y resultantes de las actividades de proyectos de gestión de bosques en el ámbito del Artículo 6 (Mecanismo de Implementaciones Conjuntas), no superarán el valor que se indica en el Cuadro N°4, multiplicado por cinco.

Cuadro N°4

ADICIONES Y SUSTRACCIONES PRIMER PERÍODO DE COMPROMISO

País	M t C / Año	País	M t C / Año
Alemania	1,24	Islandia	0,00
Australia	0,00	Italia	0,18
Austria	0,63	Japón	13,00
Belarús	-	Letonia	0,34
Bélgica	0,03	Liechtenstein	0,01
Bulgaria	0,37	Lituania	0,28
Canadá	12,00	Luxemburgo	0,01
Croacia	-	Mónaco	0,00
Dinamarca	0,05	Noruega	0,40
Eslovaquia	0,50	Nueva Zelanda	0,20
Eslovenia	0,36	Países Bajos	0,01
España	0,67	Polonia	0,82
Estonia	0,10	Portugal	0,22
Federación Rusa	17,63*	Reino Unido de Gran Bretaña e Irlanda del Norte	0,37
Finlandia	0,16	República Checa	0,32
Francia	0,88	Rumania	1,10
Grecia	0,09	Suecia	0,58
Hungría	0,29	Suiza	0,50
Irlanda	0,05	Ucrania	1,11

* Esta cifra se cambia a 33 Mt C/año por la decisión 12/CoP.7
(Actividades de gestión de bosques en el marco del párrafo 4 del Artículo 3 del Protocolo de Kyoto: Federación de Rusia).

Se establece un nuevo tipo de unidades que expresa el resultado de estas acciones y permite otorgar el valor de flexibilidad buscada con estos esfuerzos. Estas unidades se denominan Unidades de Remoción y son conocidas como RMU por sus siglas en inglés. Ellas además de poder ser utilizadas por la Parte que las genera para efectos de demostrar cumplimiento, de la misma forma que ocurre con las AAU, podrán ser transferidas entre los países del Anexo I, desde el año 2008, como otro instrumento que les permita encontrar el camino de menor costo económico para el cumplimiento de sus compromisos de limitación o reducción de emisiones de GEI.

Por último, el Acuerdo de Marrakech establece dos restricciones sobre el uso de actividades forestales para efectos de demostración de cumplimiento de sus compromisos en relación a aquellas que pueden ser emprendidas en los países no Anexo I, en el marco del MDL. Ellas son:

La admisibilidad de las actividades de los proyectos de uso de la tierra, cambio de uso de la tierra y silvicultura en el ámbito del artículo 12 se limita a la forestación y reforestación.

Para el primer período de compromiso, el total de las adiciones a la cantidad atribuida de una Parte, derivadas de actividades admisibles de proyectos de uso de la tierra, cambio de uso de la tierra y silvicultura en el ámbito del Artículo 12, no será superior al 1% de las emisiones del año de base de esa Parte, multiplicado por cinco.

2. RESEÑA DEL MDL

2.1. ANTECEDENTES

Como se ha señalado, entre los mecanismos llamados de flexibilización económica que contempla el Protocolo de Kyoto, destaca uno en particular por su atingencia a naciones en desarrollo. Es el definido en el Artículo 12 de este acuerdo internacional y se conoce con el nombre de Mecanismo de Desarrollo Limpio (MDL). Por medio de él, los países industrializados adquieren el derecho de poder demostrar el cumplimiento de sus obligaciones de reducción de emisiones, adicionalmente a los esfuerzos realizados en sus propios países en tal sentido, por medio de la adquisición de certificados internacionalmente validados de reducciones o remoción de GEI realizados en países en desarrollo.

En la etapa de negociaciones de la Convención, Noruega introdujo la idea de que en la búsqueda de flexibilidad en el cumplimiento de los compromisos y costo-efectividad en el uso de los recursos, los países con obligaciones cuantitativas de reducción de GEI también pudieran contabilizar a su cuenta los logros obtenidos como resultados de iniciativas llevadas a cabo más allá de sus fronteras geográficas. Este concepto se conoció en ese momento con el término Implementación Conjunta de los objetivos de la Convención.

De acuerdo a sus proponentes, su implementación, entre otros beneficios, lograría canalizar nuevos fondos y recursos desde el Norte al Sur, expandir el menú de inversiones en reducción de emisiones, aumentar la penetración de tecnologías innovadoras en los países receptores, contribuir a un crecimiento económico sostenible en los países en vías de desarrollo, y otros beneficios.

Por su parte los países en vías de desarrollo se mostraron escépticos ante las bondades del mecanismo. A menudo se simplificó esta oposición diciéndose que ella era más bien de carácter Ético-Moral: “No se puede aceptar que el Norte, cuyo sobre-consumo es la principal causa del problema, transfiera su responsabilidad de reducción de emisiones de GEI al Sur con el propósito de continuar con sus patrones de producción y consumo”.

Lo cierto es que, sin desmerecer la importancia de esa razón, el problema era mucho más complejo. A modo de resumen, los temas de conflicto sobre este mecanismo podían agruparse, con gran generalidad, en cinco:

Los potenciales desincentivos que su uso pudiera significar para los esfuerzos que las naciones industrializadas debieran hacer en sus propios países para cumplir con los objetivos de la Convención; particularmente los esfuerzos requeridos en innovación tecnológica y cambios en los patrones de consumo energético de sus sociedades.

La potencial pérdida de soberanía sobre los programas nacionales de desarrollo, especialmente en las naciones en vía de desarrollo, por la inducción de cambios en el tipo y ritmo de la innovación tecnológica que la disponibilidad específica de estos recursos pudiera significar.

Las dificultades objetivas para cuantificar y distinguir las reducciones reales de emisiones de GEI logradas en los países en desarrollo por este tipo de inversiones, respecto a aquellas que se hubieran producido, de todos modos a lo largo del tiempo, por la penetración natural de las nuevas tecnologías en las economías de estas naciones.

Los criterios a utilizarse para la acreditación de las emisiones reducidas por el uso del mecanismo, debido a que una de las partes podría no tener obligaciones de reducción.

Finalmente, el temor a que una generalización del uso del mecanismo podía significar una drástica reducción de los recursos monetarios a ser canalizados desde el mundo industrializado al mundo en desarrollo a través del Mecanismo Financiero establecido en la Convención y, lo más grave, que esto mismo pudiera extenderse a aquellos destinados a la Ayuda Oficial al Desarrollo.

En el texto de la Convención no se define el término “Implementación Conjunta” pero se hace mención explícita a él y se estipula que los criterios de su aplicación serían establecidos en la primera Conferencia de las Partes, que en respuesta a este mandato decidió establecer una fase piloto para lo que llamó Actividades Implementadas Conjuntamente (AIC) entre Partes de la Convención que así lo requirieran.

De acuerdo a esta decisión las AIC deberían ser compatibles y sustentar las prioridades y estrategias nacionales de desarrollo y medio ambiente, contribuir al logro de los beneficios globales de una manera costo-efectiva, requerir previa aceptación, aprobación y respaldo de los gobiernos de las Partes que participan en la actividad, tener financiamientos adicionales a las obligaciones financieras de los países industrializados al Mecanismo Financiero de la Convención, tanto como a sus contribuciones corrientes a la Ayuda Oficial al Desarrollo, y ningún crédito sería otorgado a ninguna Parte como resultado de emisiones de GEI reducidas o secuestradas durante esta fase piloto. Por último, estableció que la Conferencia de las Partes debería tomar una decisión conclusiva sobre la evolución de esta fase piloto a un régimen en que se pudieran acreditar las reducciones o secuestro de GEI logradas por medio de estas actividades, antes que finalizara la década.

De esta manera, el acuerdo de Kyoto sobre el MDL no es más que otro paso en el establecimiento de la modalidad en que el mundo en desarrollo puede ser parte del emergente mercado mundial de certificados de reducciones o secuestro de emisiones de GEI. Un paso que, en lo fundamental, intenta avanzar en los procedimientos y regulaciones que posibiliten controlar a una escala internacional los principios que se han ido perfilando a lo largo de este proceso y que se considera necesario atender para dar respuesta a las inquietudes de todas las Partes potencialmente involucradas en él.

2.2. EL ARTÍCULO 12

El Artículo 12 del Protocolo de Kyoto define un MDL que tiene un triple propósito. Ayudar a las Partes No incluidas en el Anexo I de la Convención, los Países en Desarrollo, a lograr un desarrollo sostenible y contribuir al objetivo último de la Convención, y ayudar a las Partes incluidas en el Anexo I, los Países Industrializados, a dar cumplimiento a sus compromisos cuantificados de limitación y reducción de las emisiones, en el entendido implícito que los costos de las medidas de mitigación de GEI son menores en el mundo en desarrollo.

En el marco de este mecanismo, se establece específicamente que:

> Las Partes no incluidas en el Anexo I se beneficiarán de las actividades de proyectos que tengan por resultado reducciones certificadas de emisiones de GEI.
>
> Las Partes incluidas en el Anexo I podrán utilizar las reducciones certificadas de emisiones resultantes de esas actividades de proyectos para contribuir al cumplimiento de una parte de sus compromisos cuantificados de limitación y reducción de las emisiones contraídos en virtud del Artículo 3, conforme lo determine la Conferencia de las Partes actuando en calidad de Reunión de las Partes al presente Protocolo (CoP / MoP por sus siglas en inglés).
>
> El Mecanismo para un Desarrollo Limpio estará sujeto a la autoridad y la dirección de la CoP / MoP y a la supervisión de una Junta Ejecutiva del MDL.
>
> La reducción de emisiones resultante de cada actividad de proyecto deberá ser certificada por las Entidades Operacionales que designe la CoP / MoP, sobre la base de:
>
> > La participación voluntaria aprobada por cada Parte participante.
> >
> > Beneficios reales, mensurables y a largo plazo con relación a la mitigación del cambio climático.
> >
> > Reducciones de las emisiones que sean adicionales a las que se producirían en ausencia de la actividad de proyecto certificada.
>
> El MDL ayudará, según sea necesario, a organizar la financiación de actividades de proyectos certificadas.
>
> La CoP / MoP, en su primer período de sesiones, deberá establecer modalidades y procedimientos que permitan asegurar transparencia, eficiencia y responsabilidad por medio de la auditoria y verificación independiente de las actividades de proyectos.
>
> La CoP / MoP, se asegurará que una parte de los fondos procedentes de las actividades de proyectos certificadas se utilice para cubrir los gastos administrativos, tanto como para ayudar a las Partes que son países

en desarrollo particularmente vulnerables a los efectos adversos del cambio climático a hacer frente a los costos de adaptación.

Podrán participar en el MDL, tanto en las actividades de proyectos que resulten en reducciones de emisiones certificadas como en la adquisición de certificados de emisiones reducidas (CER), entidades privadas o públicas, y esa participación quedará sujeta a las directrices que imparta la Junta Ejecutiva del MDL.

Los CER que se obtengan en el período comprendido entre el año 2000 y el comienzo del primer período de compromiso (2008) podrán utilizarse para contribuir al cumplimiento de las obligaciones de los países Anexo I en el primer período de compromiso (2008-2012).

2.3. EL ACUERDO DE MARRAKECH

Estas definiciones genéricas para este mecanismo requirieron de mayores precisiones y el establecimiento de una apropiada organización institucional para hacerlo operativo. Ellas, como se ha señalado anteriormente, fueron adoptadas en la Séptima CoP de la Convención que tuvo lugar en Marrakech el año 2001 (decisión número 17)

En particular, los problemas fundamentales que se debió resolver para poder poner en ejecución el mecanismo fueron de dos tipos. Uno de ellos, resultante de la falta de criterios internacionales, unánimemente aceptados, que permitan evaluar si una actividad contribuye o no al desarrollo sostenible. El otro, que las reducciones logradas por las actividades de los proyectos en los países No - Anexo I, que serán utilizadas por los países Anexo I para demostrar el cumplimiento de parte de sus compromisos cuantificados de limitación y reducción de emisiones, si no son bien contabilizadas pueden resultar en una alteración del objetivo que se ha propuesto el Protocolo de Kyoto para su Primer Período de Compromisos.

Sobre el primero de estos problemas ni el Artículo 12 del Protocolo de Kyoto ni otros artículos del Protocolo hace alguna otra elaboración adicional. Sobre el segundo, el Artículo 12 enuncia algunas provisiones con el propósito de cuidar de este importante aspecto para los objetivos del Protocolo.

La primera de ellas, es que establece la existencia de una Junta Ejecutiva del Mecanismo, la que bajo la autoridad y orientación de la CoP / MoP, supervisará y será responsable del MDL.

La segunda, que las reducciones de emisiones resultantes de las actividades de los proyectos serán certificadas por Entidades Operativas que serán designadas por la CoP / MoP.

La tercera, que los proyectos deben ser aprobados por las Partes involucradas en la realización de los proyectos.

La cuarta, y última, que las reducciones logradas por las actividades de los proyectos deben ser reales, mensurables, de beneficio de largo plazo con relación a la mitigación del cambio climático, y, lo más importante, adicionales a las que hubieran ocurrido en la ausencia de las actividades certificadas de los proyectos.

Si bien estos elementos, en principio, contribuyen a abordar el problema, el artículo que define el MDL no elabora sobre ellos. Como consecuencia, las negociaciones post Kyoto sobre esta materia estuvieron centradas en cómo precisar, organizar e implementar estos resguardos para hacerlos efectivos. En particular, sobre cuál debiera ser la composición y atribuciones de la Junta Ejecutiva, cuáles serían los requisitos y modos de designación de las Entidades Operativas, cómo se entendería y evaluaría el requerimiento de que las reducciones logradas por las actividades de los proyectos MDL debieran ser adicionales a las que hubieran ocurrido en la ausencia de ellas, y de cómo se integran todos estos elementos en una forma operativa.

2.4. LA JUNTA EJECUTIVA DEL MDL

La Junta Ejecutiva (JE) es el órgano encargado de la supervisión del funcionamiento del mecanismo MDL, y está sujeta a la autoridad de la Cop / MoP.

La JE está integrada por diez miembros procedentes de Partes del Protocolo de Kyoto, de la siguiente manera:

Un miembro de cada uno de los cinco grupos regionales de Naciones Unidas.
Dos miembros procedentes de Partes incluidas en el Anexo I.
Dos miembros procedentes de Partes no incluidas en el Anexo I.

Un miembro en representación de los pequeños Estados insulares en desarrollo.

Adicionalmente y con la misma procedencia, se suman a ellos otros 10 miembros llamados alternos[3].

La JE cumple esencialmente las siguientes funciones:

Formular recomendaciones a la CoP / MoP sobre nuevas Modalidades y Procedimientos (MyP) del MDL, así como las enmiendas a su Reglamento que considere procedentes.

Informar a la CoP / MoP de sus actividades en cada período de sesiones de este órgano.

Aprobar nuevas metodologías relacionadas, entre otras, con las bases de referencia, los planes de vigilancia y los ámbitos de los proyectos.

Acreditar a las Entidades Operacionales Designadas (DOE), formulando las recomendaciones precisas a la CoP / MoP para su designación como DOE.

Adicionalmente, debe cuidar de la distribución regional y subregional de las actividades de proyectos del MDL, poner a información pública las actividades de proyectos MDL que necesiten financiamiento, mantener a disposición pública una recopilación de las reglas, procedimientos, metodologías y normativas vigentes, preparar y mantener a disposición del público una base de datos sobre las actividades de proyectos MDL, con información sobre los proyectos registrados, las observaciones recibidas, los informes de verificación, sus decisiones y todas las reducciones certificadas de emisión expedidas.

Para llevar a cabo estas funciones la Junta Ejecutiva puede establecer comités, paneles o grupos trabajo que le den apoyo. Hasta la fecha la Junta ha establecido los siguientes:

Panel de Acreditación: Establecido para dar soporte a la JE y facilitarle la toma de decisiones relativas al procedimiento de acreditación de las DOE.

Panel de Metodologías: Establecido para elaborar y dar recomendaciones a la JE sobre las directrices para las metodologías de líneas base y planes de monitorización o vigilancia y sobre las nuevas metodologías que se presenten.

Grupo de Trabajo sobre Forestación y Reforestación: Trabaja elaborando recomendaciones sobre las metodologías de líneas base y monitorización que se presenten para actividades de proyectos de forestación y reforestación.

Grupo de Trabajo de Pequeña Escala: Trabaja elaborando recomendaciones sobre las metodologías de líneas base y monitorización que se presenten para actividades de proyectos de pequeña escala.

2.5. ENTIDAD OPERACIONAL DESIGNADA (DOE)

Una Entidad Operacional Designada es una entidad independiente acreditada por la JE y designada por la CoP / MoP para realizar la validación de proyectos MDL y su presentación a la JE para aprobación y registro, así como también para la verificación y certificación de las reducciones de emisiones de GEI que generen los proyectos. Salvo en el caso de proyectos de pequeña escala, una misma DOE no puede realizar la validación, y la verificación y certificación en un mismo proyecto.

Las DOE deben, por tanto, cumplir con las siguientes funciones:

Validar las actividades de los proyectos MDL propuestos.
Verificar y certificar las reducciones de emisiones antropógenas de GEI.

Demostrar que tanto ellas como sus empresas subcontratistas, no tienen un conflicto de intereses, real o potencial, con los participantes en las actividades de proyectos MDL, para cuya validación o verificación y certificación hayan sido seleccionadas.

[3] Los derechos y deberes de los miembros alternos son idénticos que los titulares, salvo en el caso que la JE deba dirimir desacuerdos por medio de procesos de votación, en cuyo caso sólo tienen derecho a voto los titulares, o su alterno en caso de su ausencia.

Cumplir adecuadamente con una de las funciones relacionadas con las actividades del proyecto MDL propuesto: validación o verificación y certificación. Cuando así se solicite, la Junta Ejecutiva podrá, sin embargo, autorizar que una sola DOE cumpla todas las funciones relativas a una misma actividad de un proyecto MDL.

Adicionalmente, deben llevar una lista pública de todas las actividades de proyectos MDL de cuya validación y/o verificación y certificación se hayan responsabilizado, presentar un informe anual de sus actividades a la Junta Ejecutiva y poner a disposición pública la información obtenida de los participantes en proyectos MDL, cuando así se lo solicite la Junta Ejecutiva. A estas funciones, se debe agregar una última, otorgada por la JE del MDL, que es la de presentar, en nombren de los participantes de un proyecto que así lo requieran, las nuevas metodologías a la Junta Ejecutiva para su consideración y aprobación.

Al solicitar su acreditación como DOE deben especificar en qué tipos de proyectos o actividades tienen capacidad de trabajar, escogiendo de entre una lista de sectores previamente definida, que se basa en los sectores y fuentes contenidas en el Anexo A del Protocolo de Kyoto (Cuadro N°5).

Cuadro N°5

SECTORES DE CAPACIDAD DE LAS DOE SEGÚN ANEXO A DE PROTOCOLO KYOTO

1.	Industrias energéticas (fuentes renovables y no renovables)
2.	Distribución de energía
3.	Demanda de energía
4.	Industrias manufactureras
5.	Industria química
6.	Construcción
7.	Transporte
8.	Minería y producción de minerales
9.	Producción de metales
10.	Emisiones fugitivas de combustibles (sólidos, fuel y gas)
11.	Emisiones fugitivas de la producción y consumo de halocarburos y SF6
12.	Uso de disolventes
13.	Gestión y almacenamiento de residuos
14.	Forestación y reforestación
15.	Agricultura

Para poder acreditarse, estas entidades deben solicitarlo y pasar por un proceso complejo en el que deben quedar demostradas sus habilidades y capacidad de gestión y auditoría en los ámbitos de trabajo elegidos. Los aspectos relativos a la acreditación de DOE son tratados por un grupo de trabajo dependiente de la JE, denominado Panel de Acreditación, que hace presentes sus recomendaciones a ella para su designación provisional, para que luego sea esta Junta la que solicite su designación a la CoP/ MoP.

A la fecha hay acreditadas 19 Entidades Operacionales Designadas que pueden encontrarse en la página Web: http://cdm.unfccc.int/DOE/list.

2.6. REQUISITOS DE ELEGIBILIDAD QUE DEBEN CUMPLIRSE EN EL MDL

Los Acuerdos de Marrakech establecen específicamente que los participantes del proyecto pueden recibir o transferir reducciones certificadas de emisiones, siempre y cuando el país que autorice su participación sea parte del Protocolo de Kyoto y esté en conformidad con sus obligaciones.

A continuación se resume estos condicionantes que deben satisfacer las Partes del Protocolo de Kyoto que participen en el proyecto, así como los criterios básicos que deben cumplirse por parte del propio proyecto.

2.6.1. País Anfitrión

El País Anfitrión es aquella Parte del Protocolo de Kyoto no incluida en el Anexo I de la Convención en la que se implanta un proyecto MDL. La Parte anfitrión debe cumplir los requisitos siguientes:

Haber ratificado el Protocolo de Kyoto.

Participar voluntariamente en la actividad del proyecto MDL (tanto el país participante como las entidades privadas o públicas autorizadas por él).

Tener establecida una Autoridad Nacional Designada para el MDL.

El País anfitrión tiene la potestad de aprobar el proyecto MDL, en función de su contribución al modelo de desarrollo sostenible que soberanamente ha escogido, y a tal fin debe emitir una declaración acorde. Esta declaración la realiza por medio de una Autoridad Nacional Designada (AND) para el MDL.

En el caso de proyectos MDL de F/R, el País anfitrión tiene que haber informado a la JE del MDL, por medio de su AND, los parámetros que utilizará para definir un bosque para estos efectos.

2.6.2. País Incluido en el Anexo I

En el caso de participación en el proyecto de Países Anexo 1 se requiere cumplir con los condicionantes a que se hace referencia en el apartado anterior y además con los siguientes requisitos:

Haber calculado su Cantidad Atribuida, lo que supone tener fijado, en términos de toneladas equivalentes de CO_2, el objetivo asumido por ese país en la ratificación del Protocolo de Kyoto, teniendo fijado, por tanto, su tope cuantitativo de emisiones para el primer periodo de compromiso.

Tener establecido un Registro Nacional, en el cual se lleva la cuenta de todas las unidades generadas, asignadas y transferidas en el marco del Protocolo de Kyoto. A este registro será al que transfiera la JE los CER generados por el proyecto MDL.

Disponer de un Sistema Nacional para la estimación de emisiones.

Haber entregado, en su debido tiempo, el último y más reciente inventario de emisiones.

2.6.3. El Proyecto

En cuanto a los proyectos en sí mismos, ni el Protocolo de Kyoto en su artículo 12 ni los Acuerdos de Marrakech proporcionan una lista de actividades o tecnologías que califiquen a los mismos como MDL. No se establece, por tanto, un listado de tecnologías que puedan optar a participar en el mecanismo, sino que existen unos criterios básicos que deben cumplir, independientemente de la tecnología o actividad de la que se trate. Estos criterios básicos pueden resumirse de la siguiente forma:

Los Proyectos MDL deben generar reducciones de emisiones de GEI en un país en desarrollo que sean reales, mensurables y a largo plazo.

La delimitación del proyecto definirá el ámbito en el cual ocurre la reducción o secuestro de los GEI.

Las reducciones de emisiones de GEI generadas en el proyecto deben ser adicionales.

Este último es un requisito básico para cualquier proyecto MDL. Para ser consideradas adicionales, sus emisiones de GEI deben ser menores que las emisiones que hubieran ocurrido en ausencia del mismo; además, debe demostrarse que el proyecto no se habría implementado en ausencia del mecanismo MDL. Las reducciones adicionales de GEI serán calculadas en relación con un escenario referencial hipotético que no incluye el proyecto, y que se define como base de referencia.

Los proyectos MDL deben contribuir al desarrollo sostenible del País anfitrión. El PK específica que uno de los principales objetivos del mecanismo MDL es la contribución al desarrollo sostenible de las Partes No - Anexo 1. Sin embargo, no existen directrices claras para la aplicación de este requisito, sino que los países anfitriones son soberanos para elegir el modelo de desarrollo sostenible que han de seguir y, por tanto, basta con una declaración por su parte en el sentido de que efectivamente la tecnología o actividad propuesta realiza dicha contribución.

Los proyectos deben de ser compatibles con cualquier requisito legal del país anfitrión

Las Partes deben evitar los certificados generados por proyectos que utilicen la energía nuclear.

No podrá utilizarse fondos provenientes de la Ayuda Oficial al Desarrollo para financiar proyectos MDL
.

Por último, y aunque no se trata de un requisito básico para la elegibilidad del proyecto, se debe promover una distribución geográfica equitativa de las actividades de estos proyectos para conseguir un desarrollo limpio en los ámbitos regional y subregional, aspecto que es vigilado por la JE.

En el Cuadro N°6 se resume los requisitos de elegibilidad de los proyectos de MDL.

Cuadro N°6

REQUISITOS ELEGIBILIDAD PROYECTOS MDL

	MDL Ordinarios	MDL Pequeña Escala	Proyectos Sumideros
A cumplir por el proyecto		Cumplir con definición de Pequeña Escala (Decisión p. 23 para. 6 c*)	Solo proyectos de forestación y reforestación (Decisión p. 24 para. 7a*. Trato especial para pequeña escala (Anexo ´. 19 Para. 1i**)
	Solo emisiones de GEI listadas en Anexo A del PK (Artículo 3 PK)		
	Demostrar su contribución al desarrollo sostenible (Anexo 38. Para 40a*)		
	Aprobación por escrito de la participación voluntaria expedida por por la AND de cada Parte (Anexo p. 38, Para 40a*)		
	Evitar el uso de ayuda oficial para el desarrollo. (Decisión p. 22*)		
	Adicionalidad: Barreras o evidencia cuantitativa		Adicionalidad (Anexo p. 21, Para. 12d*)
	Evitar uso de créditos generados por plantas nucleares (MDL Decisión P. 20*)		Evitar coincidencia sistemática en verificación y períodos de máxima reserva de C (Anexo p. 21 Para. 12e+)
	Valen proyectos que empezaron desde el año 2002 (Decisión p. 13 Para. 13*)		
	Analizar efectos ambientales. Estudio de impacto ambiental si lo requiere el país anfitrión (Anexo p. 37 Para. 37c*)	Analizar los efectos ambientales si así lo requiere el país anfitrión.	Analizar las repercusiones socioeconómicas y ambientales, incluidas las repercusiones en la biodiversidad y los ecosistemas naturales y las repercusiones fuera del ámbito del proyecto (Anexo p. 21 Para. 12c**)
	Comentarios de los interesados locales y un informe dirigido a la EOD sobre cómo se tuvieron en cuenta los comentarios (Anexo p. 37 para 37b*)		
Parte Anfitrión	Haber designado una autoridad nacional para el MDL (Anexo p. 35 Para. 29*)		
	Haber ratificado el Protocolo de Kyoto (Anexo p. 35 Para. 31a*)		
			Seleccionar y notificar a la JE definición de bosque (Anexo p. Para. 8**)
Parte Incluida en Anexo I	Haber designado una autoridad nacional (Anexo p. 35 Para. 29*)		
	Haber ratificado el Protocolo de Kyoto (Anexo p. 35 Para. 31a*)		
	Haber calculado su cantidad atribuida (Anexo p. 35 Para. 31b*)		
	Haber establecido un registro nacional (Anexo p. 35 Para. 31d*)		
	Tener un sistema nacional para la estimación de emisiones (Anexo p. 35 ara 31c*)		
	Haber entregado anualmente el último inventario erquerido (Anexo p. 35 Para. 31e*)		
	Haber presentado información suplementaria en la cantidad asignada (Anexo p. 36 Para. 31f*)		
			Hay un límite cuantitativo. El primer período de compromiso ≤ 1 % de las emisiones del año base multiplicado por 5 (Decisión p. 24 para. 7b*)

Fuentes:

* Naciones Unidas, 2001. Decisión 17/CP.7 y anexo: Modalidades y Procedimientos de un Mecanismo para un Desarrollo Limpio FCCC/CP/2001/13/Add.2

** Naciones Unidas, 2003. Decisión 19/CP.9 y anexo: Modalidades y Procedimientos para las actividades de proyectos de Forestación y Reforestación del Mecanismo para un Desarrollo Limpio en el Primer Período de Compromiso del Protocolo de Kyoto FCCC/CP/20031/6/Add.2

2.7. CICLO DE UN PROYECTO MDL

Finalmente, el Acuerdo de Marrakech estableció una serie de etapas, conocidas como el ciclo de un proyecto del MDL, que abarcan desde la concepción de una actividad de proyecto por los participantes en el proyecto, llamados en adelante participantes, hasta la aprobación de la expedición de las reducciones certificadas de emisiones (CER) por la JE del MDL, resultado de su operación. Ellas son:

Diseño: Los participantes (PP) deberán evaluar la actividad de proyecto propuesta y los requisitos de elegibilidad. El Documento de Diseño de Proyecto (PDD por sus siglas en inglés) incluirá la metodología y determinación de la base de referencia, el cálculo de la reducción de emisiones y la metodología y plan de vigilancia de la actividad del proyecto.

Validación: Evaluación independiente del diseño por una DOE, en relación con los requisitos del MDL.

Registro: Aceptación oficial por la JE de un proyecto validado como proyecto MDL.

Implementación del diseño.

Vigilancia: La vigilancia incluye la recopilación y archivo de todos los datos necesarios para medir o estima las emisiones de GEI del proyecto MDL, de la base de referencia y cálculo de las reducciones de emisiones debidas al proyecto.

Verificación y Certificación: La verificación consiste en un examen independiente y periódico por una DOE de las reducciones de emisiones registradas; unida a la certificación escrita de la DOE confirmando las reducciones de emisiones durante un tiempo determinado.

Expedición de las Reducciones Certificadas de Emisiones (CER) por la JE del MDL.

Un detalle pormenorizado de cada una de ellas será presentado más adelante, cuando se informe sobre los proyectos de F/R en particular.

2.8. PROYECTOS MDL DE PEQUEÑA ESCALA - MODALIDADES Y PROCEDIMIENTOS SIMPLIFICADOS

Este ciclo que los proyectos deben cumplir para lograr su registro en el MDL y la expedición de sus certificados de reducción involucra tiempos y costos que pueden ser un impedimento objetivo para su realización, principalmente cuando el tamaño de esas actividades de proyectos tienen asociadas reducciones de emisiones de baja cuantía. En otras palabras, cuando los beneficios pecuniarios que estos proyectos pudieran lograr, por la comercialización de los certificados a que darían origen, pudieran incluso no compensar los costos de transacción asociados al cumplimiento de este ciclo de proyecto.

Por ello, y con el fin de minimizar esta posibles barreras y disminuir los costos de transacción unitarios, las Modalidades y Procedimientos (MyP) para el MDL acordadas en Marrakech el año 2001, revisadas por la CoP / MoP en su segunda reunión el año 2006, establecieron las bases para el desarrollo de modalidades y procedimientos simplificados aplicables a los denominados proyectos de pequeña escala, y tipificó tres tipos de proyectos de esta naturaleza:

Tipo I: Actividades de Proyectos de energías renovables con una capacidad máxima de producción equivalente de 15 MW (o equivalente apropiado)

Tipo II: Actividades de Proyectos de mejora de la eficiencia energética que reduzcan el consumo de energía, por el lado de la oferta y/o de la demanda, con un máximo equivalente de 60 GWh/año

Tipo III: Actividades de Otros Proyectos que reduzcan las emisiones antropogénicas por las fuentes y emitan directamente menos de 60 kt de CO_2 equivalente por año

Se entiende que los tipos en esta clasificación son mutuamente excluyentes, por lo que un proyecto sólo puede acogerse a uno de ellos aunque pudiera cumplir con más de una definición. Cuando se trate de una actividad de proyecto con más de un componente en el que se apliquen las MyP simplificados del MDL, cada componente deberá cumplir por separado el criterio aplicable.

Las MyP para Proyectos de Pequeña escala fueron desarrolladas por la JE del MDL y ratificada por la octava Conferencia de las Partes celebrada en Nueva Delhi en noviembre 2002, complementándola con aclaraciones sobre las definiciones de actividades admisibles para este tipo de proyectos.

Las etapas del ciclo del proyecto de pequeña escala del MDL son similares a las de un proyecto ordinario, pero se ha introducido modificaciones que permiten agilizar elproceso y reducir sensiblemente los costos de transacción, pretendiendo con ello dar un impulso al desarrollo de este tipo de proyectos. Estas modificaciones son descritas a continuación.

2.8.1. Agrupación de Actividades

Las actividades de proyectos de pequeña escala pueden agruparse y en tal condición transitar por el ciclo del proyecto MDL como tal; esto es, en la preparación del documento del proyecto, su validación, el registro de esta agrupación de actividades en el MDL, la vigilancia de ellas, la verificación y certificación de sus resultados y la solicitud de expedición de los CER.

La única limitación a la agrupación de actividades reside en que el total agrupado no exceda los límites máximos establecidos para cada tipo de proyecto de pequeña escala. Además, las actividades agrupadas deben satisfacer los criterios establecidos en las definiciones para cada una de las actividades del proyecto, y deben corresponderse con las categorías especificadas anteriormente. Del mismo modo, no existe ninguna limitación al hecho de que las actividades agrupadas pertenezcan a tecnologías distintas; por ejemplo, si se trata de un proyecto con componentes de energías renovables y eficiencia energética, el componente de energía renovable deberá satisfacer el criterio establecido para este tipo de proyectos, y el componente de eficiencia energética debe cumplir con lo establecido para proyectos clasificados así.

Igualmente se permite que las actividades que se va a agrupar estén localizadas en países distintos, aunque este último supuesto puede dificultar la gestión conjunta del proyecto. Esta posibilidad de agrupación contribuye a la reducción de los costos de transacción.

Sin embargo, las actividades agrupadas no podrán ser componentes separados de una actividad de proyecto mayor. La JE del MDL ha elaborado un procedimiento que sirve para determinar si un proyecto de pequeña escala es un componente proveniente de la des-agrupación de un proyecto de mayor escala.

Establece que se considerará como tal un proyecto si ya ha sido registrada una actividad de proyecto de pequeña escala (o existe una solicitud de registro) en la que se dan las siguientes condiciones:

Son los mismos participantes de proyecto
Pertenecen a la misma categoría y tecnología o medida
Se ha registrado dentro de un periodo de dos años de anterioridad al proyecto propuesto
Se encuentra a una distancia inferior a 1 km del punto más cercano al proyecto propuesto

2.8.2. Simplificación del Documento de Diseño de Proyecto

El Documento de Proyecto incluye las mismas secciones que el PDD de un MDL ordinario pero el tratamiento es más sencillo. Por ejemplo, no es necesario utilizar estudios separados de la base de referencia y del plan de vigilancia, en la evaluación de impacto ambiental es opcional la presentación del estudio, siendo sólo necesario en el caso de que sea requerido por el País anfitrión.

2.8.3. Simplificación en la Demostración de Adicionalidad

En el caso de los proyectos de pequeña escala no es necesario realizar un estudio complejo para demostrar la adicionalidad de la propuesta, sino que basta con demostrar que el proyecto no habría sido implantado dada la existencia de una o más barreras preestablecidas. Las barreras posibles de utilizar son las siguientes:

De Inversión: Una alternativa financieramente más atractiva a la actividad del proyecto habría conducido a emisiones más altas.

Tecnológicas: Una alternativa tecnológica menos avanzada que la actividad de proyecto implicaría para los participantes riesgos más bajos, dada la menor incertidumbre

en su funcionamiento, pero se producirían emisiones más altas

Prácticas Habituales (BAU): Las prácticas habituales, y la existencia de requisitos reguladores o políticos, habrían conducido a la implantación de tecnologías con emisiones más altas a las del proyecto

Otras Barreras: Sin la actividad del proyecto, las emisiones habrían sido más altas por razones identificadas por los participantes del proyecto, de carácter institucional, información limitada, escasos recursos empresariales, poca capacidad de organización, o dificultades serias para asimilar nuevas tecnologías.

2.8.4. Simplificaciones en las Metodologías

El Apéndice B de las MyP simplificadas incluye metodologías más sencillas para base de referencia y de vigilancia para 15 categorías de proyectos MDL de pequeña escala allí definidas. Estas metodologías podrán ser utilizadas en el diseño de un proyecto de pequeña escala si los participantes pueden demostrar, a una DOE, que el proyecto cumple con los criterios de aplicabilidad que ellas establecen

En el caso de que se plantee un proyecto que no corresponda en ninguna de las categorías establecidas, los participantes del proyecto deben proponer una nueva categoría a la JE antes de presentar el PDD. La propuesta debe incluir una descripción de cómo se aplicaría a esa nueva categoría la metodología simplificada de cálculo de la línea base y de vigilancia. Si la JE aprueba la nueva categoría, ésta se incluirá en las clasificaciones y en las modalidades y procedimientos simplificados, con lo que las listas se irán ampliando y perfeccionando con el tiempo.

2.8.5. Otras Simplificaciones.

En los proyectos de pequeña escala el ámbito del proyecto queda delimitado por el lugar físico y geográfico de la actividad de proyecto, simplificando su definición.

Los requisitos de determinación de las fugas están simplificados en los proyectos de pequeña escala.

En este tipo de proyectos una única DOE puede validar, verificar y certificar la actividad del proyecto.

Se acorta el periodo de tiempo para el registro del proyecto por la JE, siendo de cuatro semanas desde la fecha de recepción de la petición de su registro, salvo que una Parte participante en el proyecto, o al menos tres miembros de la JE soliciten una revisión de la actividad propuesta.

2.8.6. Proyectos Forestales de Pequeña Escala

Además de los proyectos descritos anteriormente y de proyectos que puedan proponer los promotores y que configuren categorías adicionales, se decidió por parte de la CoP aceptar también proyectos de sumideros de carbono de pequeña escala.

Para este tipo de proyectos se ha elaborando modalidades y procedimientos específicos y que fueron aprobadas durante la celebración de la CoP 10, en Buenos Aires (Argentina) en diciembre de 2004. Esta decisión fue revisada en la tercera reunión de la CoP / MoP el año 2007 y establece que “Actividades de proyectos de forestación y reforestación de pequeña escala son aquellas que se espera resulten en remociones netas de gases de efecto invernadero por los sumideros en una magnitud menor de las 16 kt CO_2 por año y son desarrolladas o implementadas por comunidades e individuos de bajos ingresos de acuerdo a lo determinado por el país huésped.”

2.9. PROGRAMAS DE ACTIVIDADES EN EL MDL

Uno de lo últimos desarrollos en el MDL, en busca de maximizar su uso por parte de los países en desarrollo, busca posibilitar la implementación de proyectos en el marco de este mecanismo que, por su volumen en cuanto a reducciones o secuestro y/o características (dispersos), no son viables bajo los costos de transacción y precios actuales.

Un Programa de Actividades (PoA), usualmente llamado MDL Programático, es una acción voluntaria llevada a cabo por una entidad privada o pública, la cual coordina la implementación de una política/medida o meta específica dirigida a

la reducción de emisiones antropogénicas de GEI o captura de CO_2 que sean adicionales a aquellas que ocurrirían en la ausencia del PoA, a través de un número ilimitado de actividades de proyectos MDL (denominadas CPA por sus siglas en inglés)

En esencia el PoA sirve como una estructura paraguas bajo la cual actividades MDL individuales pueden desarrollarse para la consecución de un objetivo de reducción de GEI específico.

Las principales característica de estos PoA son las siguientes:

Un PoA requiere una entidad coordinadora, publica o privada, que asegura el cumplimiento de las CPA que en él participan con los propósitos del PoA. Esta entidad es un participante de proyecto y requiere la autorización de todas las AND de los países anfitriones donde se desarrollará el PoA. También es reconocido en las modalidades de comunicación como la entidad que se comunica con la JE en representación de todos los otros participantes de proyectos. En particular sobre tema relacionados con de la distribución de los CER.

La frontera física de un PoA puede extenderse más allá de los límites políticos de un país y debe establecerse adecuadamente. Se debe evitar la doble contabilidad de reducciones o capturas, contabilizar las fugas y cuidar que las absorciones netas por los sumideros y las reducciones de emisiones sean reales, medibles y verificables.

En términos de adicionalidad debe ser demostrado que en ausencia del PoA, la medida propuesta voluntariamente no se implementaría, o la política/regulación mandataria no se aplicaría sistemáticamente, o bien que el PoA dará lugar a un mayor nivel de cumplimiento de la actual política obligatoria y regulación.

Todos las CPA de un PoA deben aplicar la misma metodología para establecer las emisiones de GEI en el escenario de referencia y también aquella aprobada para dar seguimiento a sus resultados.

El PoA puede utilizar cualquier de las metodología aprobada o puede desarrollar una nueva metodología, para luego de ser aprobada por la JE poder usarla.

La duración de un PoA es de 28 años para los proyectos no forestales y de 60 años para proyectos forestales.
El escenario de referencia y la metodología de seguimiento se verificarán cada 7 años y los cambios que pudieran ser necesarios se aplican a todos las CPA con oportunidad de la primera renovación y de manera similar en las siguientes oportunidades.

Múltiples CPA pueden ser incluidos en el PoA en el momento de su registro y múltiples CPA adicionales pueden incluirse en cualquier momento dentro del tiempo de vida del PoA.

Las CPA pueden ser implementadas por muchas entidades/propietarios. Todos ello son idénticos unos a otros en términos que cumplen con los criterios de elegibilidad de una única metodología para el establecimiento del escenario de referencia y el seguimiento de sus resultados, y pueden demostrar su adicionalidad con los argumentos establecidos en el PoA.

Para el registro de un PoA la entidad coordinadora necesita desarrollar: un documento de diseño para el Programa de Actividades (PoA - DD), que establece el marco de referencia para la implementación del PoA; el documento de diseño para las actividades de proyectos (CPA - DD) que es específico para el PoA y actúa como un diseño; y un CPA - DD con la información para una primera actividad de proyecto que será parte del PoA.

Cuando una nueva CPA desea incorporarse subsecuentemente al PoA, debe someter el correspondiente CPA - DD a la entidad coordinadora del PoA, quién a su vez lo someterá para su consideración a la DOE que validó dicho PoA. Si esta DOE considera que ese documento satisface los requerimientos establecidos en el PoA, informa a la JE para la incorporación de esta nueva CPA al PoA registrado, sin necesidad de cumplir con un nuevo procedimiento de validación y registro.

Si una AND involucrada en el PoA o un miembro de la JE identifica algún error que descalifique una CPA para su inclusión en el PoA, la CPA será excluida y no podrá ser tomada en consideración nuevamente ni para este PoA, uno diferente, o como un proyecto MDL.

La DOE que incluyó esta CPA tiene que transferir a una cuenta de cancelación operada por la JE, una cantidad de CER equivalentes a la cantidad de CER emitidos a la PoA como resultado del error.

Cuando el periodo de acreditación del PoA termina, así también sucede con el de todas las CPA que comprende, independientemente de la fecha en que ellas se incorporaron al programa.

3. PROYECTOS FORESTALES EN EL MDL

3.1. CATEGORÍAS DE PROYECTOS MDL DE F/R

Como se ha señalado en 1.5., para el primer período de cumplimiento del PK (2008-2012) se limita el ámbito de actividades forestales elegibles para ser parte del MDL a proyectos de forestación y reforestación (F/R).

Se entiende por forestación para estos fines a aquellas actividades humanas destinadas a convertir tierras que no han tenido bosque durante un período de al menos 50 años a terrenos con bosque, mediante plantación, siembra o manejo de la siembra natural.

Por actividad de Reforestación, a aquellas actividades humanas destinadas a repoblar tierras que tenían bosque, pero que habían sido convertidas en terrenos sin bosque. Para el primer período de cumplimiento, la reforestación deberá ocurrir en terrenos sin bosque al 31 de diciembre del año 1989.

Para fines prácticos, los proyectos deben demostrar que el suelo, dentro de los límites del proyecto, no estaba cubierto de bosques en 1990, y que, a la vez, no se encuentra cubierto de bosque al inicio del proyecto.

El MDL entiende por bosque, genéricamente, a un área mínima de suelo de 0,05 -1,0 ha, con la cobertura de copa arbórea (o el nivel de la media equivalente) de más de 10 - 30 % y con los árboles maduros *in situ*, con el potencial para alcanzar una altura mínima de 2 - 5 m. Pero deja en manos de país anfitrión del proyecto la libertad de elegir el valor en particular que utilizará para esos parámetros en los rangos establecidos. Tal selección deberá ser comunicada a la JE y tendrá validez para todos los proyectos de forestación y reforestación registrados antes del término del primer periodo de compromisos (31 de Diciembre del 2012)

La demostración del estado de la vegetación en el suelo desde el año 1990, en la mayoría de los casos no es algo sencillo, debido principalmente a la disponibilidad limitada de datos históricos sobre la cobertura del suelo. Por esta razón, la JE aclaró que la prueba de la falta de bosque en 1990 podría demostrarse por alguno(s) de los siguientes medios:

Fotografías aéreas o imágenes satelitales complementadas con datos de referencias.

Estudios tales como permisos de uso de la tierra, planes de uso del suelo o información de los registros locales, como catastros, registro de propietarios, uso de la tierra o registro de manejo del suelo.

Si las opciones anteriores no son aplicables o viables, los participantes del proyecto someterán un testimonio escrito resultante de una metodología de evaluación con participantes rurales.

No obstante estas definiciones, debe recordarse que la actividad del proyecto en cuestión debe cumplir con las normativas nacionales para poder obtener los permisos correspondiente para su ejecución. En estas circunstancias debe tenerse presente que pueden existir diferencias en las definiciones que requieran un cuidadoso uso del lenguaje para responder a los requerimientos en los ámbitos correspondientes.

3.2. RESERVORIOS DE CARBONO

Según las MyP del MDL, los reservorios de carbono posibles de tener en consideración en proyectos forestales son:

Biomasa sobre la superficie del suelo.
Biomasa bajo la superficie del suelo.
Litter.
Madera muerta.
Carbono orgánico del suelo.

Al calcular la absorción neta de referencia de GEI por los sumideros, esto es la absorción neta en la situación sin proyecto y/o la absorción neta efectiva de GEI por los sumideros, esto es la absorción neta en la situación con proyecto, los participantes del proyecto pueden escoger no contabilizar uno o más reservorios de carbono y/o emisiones de GEI, medidas en unidades de CO_2 equivalentes, en tanto se evite el doble conteo. Esta posibilidad está sujeta a la entrega de información transparente y comprobable que muestre que el escogimiento no aumentará la absorción antropógena neta esperada de GEI por los sumideros. De otra forma, los proponentes del proyecto deberán contabilizar todos los cambios significativos en el carbono almacenado en los reservorios de carbono y/o emisiones de GEI, medidos en unidades de CO_2 equivalentes, que van a aumentar como resultado de la implementación de la actividad de proyecto MDL de F/R propuesta, en tanto se evite el doble conteo. En general, no

se contabilizan aquellos reservorios con una baja variación del carbono almacenado.

3.3. DISEÑO DEL PROYECTO Y FORMULACIÓN

3.3.1. Participantes del Proyecto

Según las MyP del MDL, el participante en el proyecto es un país involucrado o una entidad privada y/o pública autorizada por un país involucrado a participar en una actividad de proyecto del MDL.

La autorización que la(s) entidad(es) privada(s) y/o pública(s) debe(n) obtener para poder ser considerada(s) participante(s) del proyecto, se certifica por medio del documento de aprobación de participación voluntaria que debe extender la(s) Autoridad(es) Nacional(es) Designada(s) (AND) para el MDL de el(los) país(es) involucrado(s), y que los proponentes de la actividad de proyecto deben entregar a la DOE antes de que ella pueda proceder a solicitar el registro de ésta a la JE.

En otras palabras, la aprobación escrita de participación voluntaria extendida por una AND constituye la autorización dada por la AND de participación de una(s) entidad(es) específica(s) como proponente(s) de una actividad de proyecto MDL de F/R específica.

Esta declaración escrita de participación voluntaria extendida por una AND debe incondicionalmente incluir los siguientes elementos:

Dejar constancia que el país en cuestión ha ratificado el Protocolo de Kyoto.

La aprobación de participación voluntaria en la actividad de proyecto MDL de F/R propuesta.

En el caso de el(los) país(es) anfitrión(es) (esto es el o los países donde se implementará el proyecto), se requiere la afirmación de que la actividad del proyecto MDL de F/R propuesta contribuye al desarrollo sustentable de ese(os) país(es).

Adicionalmente se debe tener presente que:

La autorización de una entidad privada y/o pública a participar en una actividad de un proyecto MDL de F/R debe ser otorgada, en los términos que se ha explicado anteriormente, por la AND del país donde la entidad privada y/o pública se constituye como una entidad legal.

Los Fondos Multilaterales que se desee considerar participantes en el proyecto, no necesariamente requieren aprobación escrita de cada AND involucrada en el Fondo. Sin embargo, aquellos miembros del Fondo que no provean una aprobación escrita pueden estar abandonando alguno de sus derechos y privilegios en término de ser un país involucrado en el proyecto.

3.3.2. Elegibilidad del Suelo

Para precisar la actividad de forestación o reforestación, los participantes del proyecto deberán atenerse a la definición de “bosque” seleccionada por el país de acogida. La definiciones de bosque que hayan seleccionado los países y hayan comunicado oficialmente a la JE, pueden encontrarse en la página de la AND en el sitio Web de la Secretaría de la Convención para el MDL

Teniendo en consideración esta definición, se debe especificar la elegibilidad del suelo para un proyecto de forestación o reforestación, proporcionando evidencia que la superficie dentro del límite del proyecto, al inicio del proyecto, no constituye un bosque, esto es:

La superficie se encuentra con valores por debajo de los determinados para la definición de bosque (cobertura, altura y superficie mínimas), según lo establecido en las decisiones 11/CP 7 y 19/CP 9, y comunicado por la AND respectiva.

La superficie no está temporalmente sin vegetación como resultado de la intervención humana, tal como cosechas o causas naturales, o no está cubierta por individuos naturales jóvenes o plantaciones que no han aún alcanzado una densidad de copa o altura en acuerdo con el umbral nacional y que tiene el potencial de convertirse en un bosque sin intervención humana.

3.3.3. Adicionalidad

De acuerdo a las MyP para las actividades

de F/R en el MDL, un proyecto de esta naturaleza es adicional si la absorción neta efectiva de GEI por los sumideros resultantes de su implementación, supera la suma de las variaciones del carbono almacenado en los reservorios de carbono, dentro del ámbito del proyecto, que hubieran ocurrido en la ausencia de él. En otras palabras, de acuerdo a la definición de un escenario de referencia, una actividad de proyecto MDL de F/R es adicional si la absorción neta efectiva de GEI por los sumideros resultantes de su implementación, supera la absorción neta efectiva de GEI del escenario de referencia, de tal manera que la actividad de proyecto propuesta no es la actividad de proyecto que se deriva en acuerdo con la metodología seleccionada para establecer el escenario de referencia.

Las metodología para establecer escenarios de referencia, por exigencia de la JE, deben contener una herramienta que permita a sus usuarios demostrar que la actividad de proyecto propuesta no es el escenario de referencia.

3.3.4. Impactos Ambientales

Los proponentes del proyecto deben documentar el análisis de los impactos ambientales de su emprendimiento, si los hay, incluyendo aquellos sobre biodiversidad y ecosistemas naturales, junto con los impactos fuera del límite de la propuesta de la actividad del proyecto MDL de F/R.

Este análisis debe incluir, entre otra, información referente a hidrología, suelo, riesgo de incendio, plagas y enfermedades.

Si cualquier impacto negativo es considerado significativo por los participantes del proyecto o países de acogida, se requiere una declaración que los participantes del proyecto han preparado una evaluación de impacto ambiental, de acuerdo con los procedimientos requeridos por los Países de acogida, incluyendo conclusiones y todas las referencias que apoyen la documentación.

Para cada impacto significativo determinado, se deberá establecer las medidas de reparación y el plan de vigilancia que permitan reponer o restablecer los componentes del medio ambiente a una calidad similar a la que tenían con anterioridad al proyecto.

3.3.5. Impactos Sociales y Económicos

También se debe documentar el análisis de los impactos del proyecto, incluido los impactos fuera del límite de la propuesta de la actividad del proyecto MDL de F/R.

Este análisis debe incluir, entre otra, información sobre comunidades locales, población indígena, tenencia de la tierra, empleo local, producción de alimentos, sitios culturales y religiosos, y acceso al combustible y otros productos del bosque.

Si cualquier impacto negativo es considerado significativo por los participantes del proyecto o países de acogida, se requiere una declaración que los participantes del proyecto han preparado una evaluación de impacto socio económico, de acuerdo con los procedimientos requeridos por los países de acogida, incluyendo conclusiones y todas las referencias que apoyen la documentación.

Para cada impacto significativo determinado, se deberá establecer las medidas de reparación y el plan de vigilancia que permitan reponer o restablecer los componentes socio-económicos a una condición similar a la que tenían con anterioridad al proyecto.

3.4. METODOLOGÍAS APROBADAS

Para la definición de la línea de base y del plan de monitoreo, los proyectos pueden utilizar, ya sea metodologías aprobadas, o bien, presentar nuevas metodologías para aprobación. Un proyecto, que decide presentar una nueva metodología de línea de base y monitoreo, sólo podrá validarse una vez que su metodología haya sido aprobada. En otras palabras, el registro del proyecto sólo será posible hasta después que la JE haya aprobado la metodología presentada.

Actualmente la JE del MDL ha aprobado diez diferentes metodologías para proyectos de F/R, una de ellas ha sido reemplazada por una versión consolidada, cinco para proyectos de esta naturaleza pero de Pequeña Escala y un conjunto de herramientas metodológicas funcionales a la aplicación de estas metodologías y referentes a elegibilidad de terrenos, técnicas de muestreo y otros aspectos.

Un análisis pormenorizado de estos avances será entregado más adelante.

3.5. CARACTERÍSTICAS DE LOS CRÉDITOS DE CARBONO DE PROYECTOS FORESTALES

A diferencia de los CER generados por proyectos de energía y otros proyectos de reducción de emisiones, los CER de los proyectos de Uso de la Tierra, Cambio de Uso de la Tierra y Silvicultura (LULUCF por su sigla en inglés) son de validez limitada, debido a la naturaleza no permanente de la vegetación como sumidero.

La regulación del MDL define los créditos de proyectos forestales como créditos de corto plazo (tCER Reducciones Certificadas de Emisiones Temporales) y créditos de largo plazo (lCER Reducciones Certificadas de Emisiones de Largo Plazo) con diferentes periodos de validez. Tanto los tCER como los lCER deben ser sustituidos a su vencimiento.

A diferencia de los proyectos en el sector energía, donde las reducciones son permanentes dado que una emisión evitada no alcanzará nunca la atmósfera (IPCC, 2000), los proyectos forestales mitigan el cambio climático en la medida en que el carbono secuestrado permanezca almacenado en la vegetación y el suelo, pero los sumideros forestales son potencialmente reversibles cuando se presentan disturbios tales como incendios o plagas, cuando se cortan para propósitos madereros, cuando se convierten suelos forestales a suelos de pastoreo, y otros, liberándose de nuevo el carbono secuestrado a la atmósfera y revirtiendo el beneficio climático inicialmente obtenido

Por esta razón, las MyP del MDL establecen que los proyectos forestales tendrán que verificarse periódicamente (cada cinco años), para constatar que el carbono continúe almacenado.

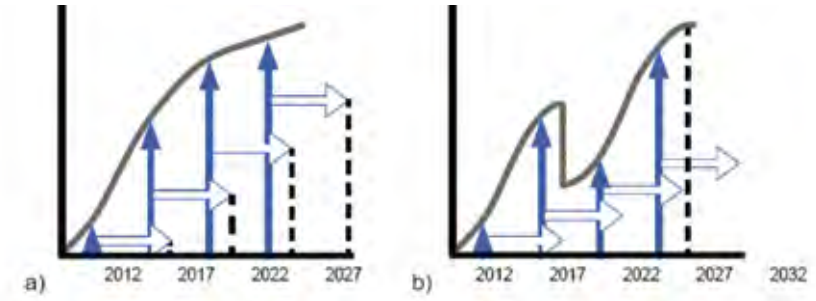
En algunos casos, los créditos emitidos inicialmente podrían tener que ser sustituidos aún antes del término de su validez, cuando se presenten incidentes como los antes señalados.

La opción entre tCER y lCER depende del desarrollador del proyecto y es importante considerar las consecuencias de la selección.

Los créditos de corto plazo (tCER) son válidos por un período de cumplimiento de cinco años, lo que significa que los créditos expedidos sobre el carbono existente son re-emitidos después de cada evento de verificación (Figura N°2). Si entre dos eventos de verificación se pierde la existencia de carbono o parte de ella, simplemente se obtendrán menos créditos que al inicio.

La responsabilidad en este sistema no es considerada una variable, ya que solo se asignan créditos sobre el carbono existente. Esto permite reaccionar, más fácilmente, a fluctuaciones en la biomasa que pueden presentarse a partir de prácticas forestales tales como raleos (Figura N°2b).

Los tCER no pueden ahorrarse y deben ser utilizados en el período de compromiso en el cual fueron expedidos. Al vencimiento, un tCER debe ser sustituido por un AAU, un CER permanente, un ERU, un RMU o por otro tCER. En ningún caso un tCER puede ser sustituido por un ICER.



(Fuente: Locatelli y Pedroni, 2004)
a) Existencias crecientes de carbono
b) Existencias fluctuantes de carbono

Figura N°2
ACTIVIDAD DE PROYECTO GENERANDO UNA FUENTE DE tCER

Si la biomasa es mantenida hasta el final del período de acreditación, se tendrá una fuente de tCER de reemplazo sobre la totalidad de la vida útil del proyecto (Figura N°2)

Por otro lado, los créditos de un proyecto que genera lCER tienen validez hasta el final del período de acreditación del proyecto. Como se puede ver en la Figura N°3, durante la verificación, sólo el incremento desde la última verificación es acreditado y estos lCER son válidos hasta el final del período de acreditación.

Por ejemplo, con un período de acreditación de 30 años, los lCER expedidos tras la primera verificación, en el año 5, tienen una validez de 25 años, los lCER expedidos tras la verificación en el año 10 tienen validez durante 20 años, y los expedidos luego de la tercera verificación tienen una validez de 15 años, etc. Al vencimiento, un lCER debe ser sustituido por un AAU, un CER permanente, un ERU, o un RMU. No es posible sustituir un lCER por un tCER u otro lCER.

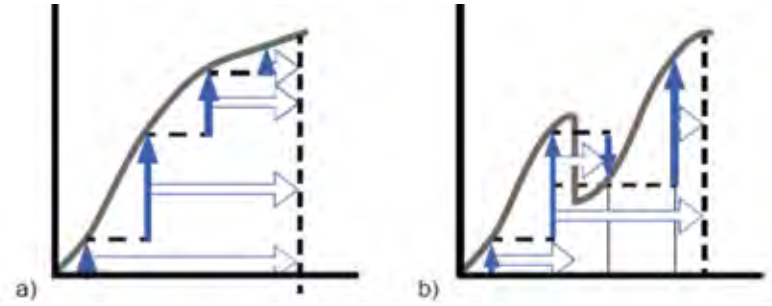
Una característica importante de los lCER es que implican una mayor responsabilidad para el vendedor. Los ICER deben ser sustituidos en el caso de pérdidas de carbono. Esto es, cuando durante una verificación se descubre una cantidad de biomasa menor a la encontrada y acreditada en la verificación anterior.

Algunas actividades forestales que reducen temporalmente la biomasa, tales como raleos, (Figura N°3b), tienen que ser tomadas en cuenta durante el cálculo de la cantidad de ICER que pueden ser vendidos, sin que se presenten problemas de responsabilidad. De otra forma, la cantidad de créditos que eventualmente pudiera perderse debe ser reemplazada. Las influencias abióticas tales como incendios, tormentas o plagas, representan un riesgo incalculable en este caso.

3.6. PROYECTOS REGISTRADOS

El registro de proyectos forestales ha resultado un proceso lento y dificultoso, por la complejidad propia de las metodologías para el establecimiento de los escenarios de referencia, pero también por una baja demanda del tipo de certificados a que dan origen, que ha afectado notablemente el número de proyectos que buscan su registro en el MDL.

En estas circunstancias, hasta la fecha hay sólo un proyecto que ha logrado su registro, aunque hay un número en aumento que está en etapa de validación. No intentando ser exhaustivo en la lista, y sólo para propósitos ilustrativos, el siguiente cuadro compila información sobre algunos de ellos.



(Fuente: Locatelli y Pedroni, 2004)
a) Existencias crecientes de carbono
b) Existencias fluctuantes de carbono

Figura N°3
ACTIVIDAD DE PROYECTO GENERANDO ICER

Cuadro N°7

PROYECTOS DE F/R EN EL MDL

List of A/R CDM projects in the pipeline (Feb. 1, 2009)

TÍTULO PROYECTO	PAÍS	ESTADO	TIPO	METODOLOGÍA	kt CO_2 2012	AÑOS	VALIDADOR
Assisted Natural Regeneration of Degraded Lands in Albania	Albania	V	R	AR-AM3	155	20	TÜV-SÜD
Reforestation of Grazing Lands in Santo Domingo	Argentina	V	R	AR-AM5	126	20	TÜV-SÜD
Carbon Sequestration through Reforestation in the Bilivian Tropics by Smallholders of the Federación de Comunidades Agropecuarias de Rurrenabaque (FECAR)	Bolivia	V	R	AR-AMS1	23	20	JACO
Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil	Brazil	V	R	AR-AM5	3148	30	TÜV-SÜD
AES Tietê Afforestation/Reforestation Project in the State of São Paulo	Brazil	V	R	AR-AM10	0	30	SGS
Nerquihue Small-Scale CDM Afforestation Project using Mycorrhizal Inoculation in Chile	Chile	V	F	AR-AMS1	93	20	TÜV-SÜD
Facilitating Reforestation for Guangxi Watershed Management in Pearl River Basin	China	RE	R	AR-AM1	174	30	TÜV-SÜD
Small Scale Reforestation for Landscape Restoration	China	V	R	AR-AMS1	28	30	TÜV-SÜD
Afforestation and Reforestation on Degraded Lands in Northwest Sichuan	China	V	R	AR-AM3	160	20	TÜV-SÜD
Reforestation on Degraded Lands in Northwest Guangxi	China	V	R	AR-ACM1	74	20	TÜV-SÜD
Small-scale Afforestation for Desertification Combating at Kangping County, Liaoning Province	China	V	F	AR-AMS1	4	10	JQA
Multiple-purposes Reforestation on Degraded Lands in Longyang, Yunnan	China	V	R	AR-ACM1	37	30	TÜV-SÜD
PROCUENCA: Forestry Project to Restore the Watershed of the Chinchiná River, an Environmental and Productive Alternative for the City of Manizales and the Surrounding Region.	Colombia	V	R	AR-AM4	1515	20	TÜV-SÜD
Argos CO_2 Offset Project, through Reforestation Activities for Commercial Use	Colombia	V	R	AR-AM5	106	30	TÜV-SÜD
Forestry Project for the Chinchiná River Basin, an Environmental and Productive Alternative for the City and Region	Colombia	V	R	AR-AM4	232	20	TÜV-SÜD
"Reforestation project using native species in Maringa-Lopori-Wamba region (Democratic Republic of Congo): establishment of the ""Bonobo Peace Forest""	Congo DR	V	R	AR-AM1	543	30	RINA
Humbo Ethiopia Assisted Natural Regeneration Project	Ethiopia	V	R	AR-AM3	181	30	JACO
Reforestation of Severely Degraded Landmass in Khammam District of Andra Pradesh India under ITC Social Forestry Project	India	V	R	AR-AM1	470	30	BV Cert
Bagepalli CDM Reforestation Programme	India	V	R	AR-AM1	446	20	TÜV-SÜD
Reforestation Project at Shree Nasik Panchavati Panjrapole (SNPP), Nasik	India	V	R	AR-AM1	68	30	TÜV-SÜD
Reforestation of Degraded Land in Chhattisgarh	India	V	R	AR-AM1	0	20	TÜV-Nord
Small Scale Cooperative Afforestation CDM Pilot Projec Activity on Private Lands Affected by Shifting Sand Dunes in Sirsa, Haryana	India	V	F	AR-AMS1	52	20	TÜV-SÜD
The International Small Group and Tree Planting Program (TIST)	India	V	R	AR-AMS1	34	30	TÜV-SÜD
Mali Jatropha Curcas Plantation Project	Mali	V	R	AR-AM4	41	30	TÜV-SÜD
Moldova Soil Conservation Project	Moldova	CR	R	AR-AM2	777	20	SGS
Reforestation of Croplands and Grasslands, in Low Income Communities of Paraguarí Department	Paraguay	V	R	AR-AMS1	33	20	TÜV-SÜD
Reforestation, Sustainable Production and Carbon Sequestration Project in Ignacio Tavara´s Dry Forest, Piura	Peru	V	R	AR-AM3	89	10	TÜV-SÜD
Laguna de Bay Community Watershed Rehabilitation Project -1	Philippines	V	R	AR-AM1	15	20	TÜV-SÜD
Laguna de Bay Community Watershed Rehabilitation Project -2	Philippines	V	F	AR-AMS1	19	20	TÜV-SÜD
Afforestation in Grassland areas of Uchindile, Kilombero, Tanzania & Mapanda, Mufindi, Tanzania	Tanzania	V	F	AR-AM5	1696	20	TÜV-SÜD
Reforestation at the Idete Forest Project in the Southern Highlands of Tanzania	Tanzania	V	R	AR-AM5	373	20	TÜV-SÜD
Uganda Nile Basin Reforestation Project No.3	Uganda	V	R	AR-AMS1	30	20	DNV
Uganda Nile Basin Reforestation Project No 1	Uganda	V	R	AR-AMS1	28	20	JACO
Uganda Nile Basin Reforestation Project No 4	Uganda	V	R	AR-AMS1	26	20	JACO
Uganda Nile Basin Reforestation Project No 2	Uganda	V	R	AR-AMS1	16	20	JACO
Uganda Nile Basin Reforestation Project No 5	Uganda	V	R	AR-AMS1	53	20	JACO
Cao Phong Reforestation Project	Vietnam	V	R	AR-AMS1	10	16	JACO

(Source : CD4CDM/UNEP)

V: Etapa Validación RE: Registrado R: Reforestación F: Forestación CR: Corrección Requerida

4. MERCADO DE CARBONO

Se conoce como mercado del carbono al arreglo institucional que se ha desarrollado en torno a la ejecución de transacciones entre partes interesadas de, indistintamente, documentos que acreditan: reducciones certificadas de emisiones de GEI que se generan por la ejecución de proyectos que tienen este beneficio, certificados que lo hacen sobre capturas de CO_2 por medio del establecimiento de plantaciones forestales con este propósito, derechos de emisión que se han establecido para aquellos países que tienen obligaciones de reducir emisiones de GEI, o unidades que cuantifican capturas de CO_2 por incremento de actividades forestales en estos países. El nombre genérico con que se conocen estos documentos es de certificados o bonos de carbono.

Cada uno de estos documentos representa la reducción, captura o derecho de emisión de una tonelada de CO_2 equivalente. Esta precisión ha sido necesaria ya que en el caso de proyectos de reducción de emisiones, o en el establecimiento de los derechos de emisión, en principio, está involucrado cualquiera de los GEI cuyas emisiones son objeto de control por parte del PK; esto es, CO_2, N_2O, CH_4, PFC, HCFC y HF_6. Por medio de un factor de conversión, denominado potencial de calentamiento global (GWP), y que mide cuantitativamente las diferencias existente entre estos gases en la atmósfera en cuanto a su capacidad de retención del calor emitido por la superficie terrestre, ellos son convertidos en su equivalentes en unidades de CO_2. Por ejemplo, el potencial de calentamiento global del metano es 21 y el del oxido nitroso es 310 cuando al GWP del CO_2 se le ha asignado el valor 1.

Hay diferentes tipos de mercado en que se transan hoy certificados de carbono, destacan el internacional (Kyoto), los mercados nacionales y regionales (Gran Bretaña, Dinamarca, Unión Europea), mercados provinciales o sub-nacionales (Australia, EEUU), mercados informales (compañías e individuos que voluntariamente han reducido emisiones de GEI) y mercados de certificados de energías renovables.

Cada uno de ellos ha tenido diferentes razones y objetivos para su establecimiento, pero la característica que mejor permite diferenciarlos es si ellos son de Cumplimiento o Voluntarios.

4.1. MERCADOS DE CUMPLIMIENTO

Como su nombre lo expresa, se trata de mercados donde se transan certificados que los reconocen como instrumentos posibles de utilizar para dar cumplimiento a obligaciones que resultan de acuerdos jurídicamente vinculantes, cualquiera sea la escala de ellos; global, regional, nacional o subnacional.

Su desarrollo ha sido marcado significativamente por la ocurrencia de dos hechos fundamentales; la aparición de los Fondos de Carbono del Banco Mundial y el desarrollo del Sistema de Transacción de Emisiones de la Unión Europea.

4.1.1. Los Fondos de Carbono del Banco Mundial

Se trata de una incursión pionera del Banco Mundial destinada a fortalecer los acuerdos internacionales sobre el Cambio Climático. Desde fines de 1999, esta institución comenzó a explorar la implementación de las reglas que posteriormente fueron sancionadas en el Acuerdo de Marrakech, el año 2001, para los proyectos MDL y de IC. Su trabajo comenzó con el establecimiento del Fondo Prototipo de Carbono para financiar proyectos del área de energías renovables, cambio de combustibles, eficiencia energética y manejo de desechos. Con base a esa experiencia exitosa, hoy en día ha expandido su actividad y tiene bajo su administración y gestión varios otros fondos, tales como el Fondo Español, el italiano, el Holandés, el Fondo para el Desarrollo de Comunidades, y uno especializado en proyectos de captura de CO_2.

Todos estos fondos operan de manera similar; Gobiernos y empresas de países industrializados aportan financiamiento para el desarrollo de proyectos basados en las reglas de Kyoto, el que es administrado por la Unidad de Financiamiento del Carbono del Banco Mundial. Por su parte, los países anfitriones de los proyectos (países en desarrollo), presentan una idea de proyecto MDL, la cual es sometida al escrutinio de expertos de dicha Unidad. Si es aceptada para alguno de los fondos, el Banco Mundial proveerá los recursos financieros y técnicos necesarios, a objeto de financiar los costos de desarrollo del documento de diseño del proyecto, de la metodología de línea de base, del desarrollo del protocolo de monitoreo y verificación y del

contrato de compra y venta de reducciones entre proponente y comprador.

Este último tipo de contrato merece algunos comentarios adicionales. Los Acuerdos de Compras de Reducciones de Emisiones (ERPA por sus siglas en inglés), son instrumentos que se han ido consolidado como parte del accionar del mercado, en tanto que en los inicios de estos Fondos los proponentes de los proyectos y los interesados en adquirir los certificados a que ellos darían origen firmaron acuerdos de negocios, en que estos últimos realizaron compras ex ante o se comprometieron a la compra de los CER que estos proyectos generarían en los años futuros. Esta práctica, que permitía a los proponentes de los proyectos resolver aspectos de financiamiento para la realización de sus iniciativas, es una práctica que ha dominado las transacciones de certificados basados en proyectos hasta hoy y se conoce también como el mercado primario de los CER.

A diferencia de este proceder, las ventas directas de certificados emitidos por la JE del MDL en el mercado spot para ellos, es el llamado mercado secundario. Indudablemente que los precios en este último tipo de transacciones son mucho más altos que en el primario, porque su adquisición no conlleva los riesgos de una compra ex ante. Por lo mismo, es un aspecto que debe tenerse en consideración al momento de planificar la estrategia de financiamiento de un emprendimiento que desea ser parte de este mercado

4.1.2. Sistema de Transacción de Emisiones de la Unión Europea

El segundo hecho que marcó el mercado de cumplimiento fue la decisión de la Unión Europea (UE) de dar inicio, desde Enero del 2005, a un sistema de transacción de derechos de emisión para el control de las emisiones de GEI de un número significativo de sus instalaciones industriales, con el objetivo de instaurar un comportamiento en cuanto a este tipo de emisiones en los países que la comprenden, que le permitiera dar cumplimiento a sus compromisos bajo el Protocolos de Kioto.

Particularmente importante también, porque contiene además una Directiva de Enlace que permite la comercialización bajo este mercado de certificados de carbono provenientes de países fuera de la frontera de la UE, fundamentalmente del mundo en desarrollo.

Este sistema establece sanciones pecuniarias para las instalaciones industriales que no cumplan con sus planes de reducción acordados, con multas que van desde los 40 euros hasta los 100 euros por tonelada de CO_2 equivalente no reducida, además de la obligación de adquirir los derechos de emisión u otros certificados de carbono permitidos en el sistema, para dar cumplimiento con la obligación.

El poder comprador para certificados de carbono con base a proyectos y la magnitud de las sanciones pecuniarias que significó el establecimiento de este sistema europeo, jugó un papel trascendente en el despegue del MDL y las señales de precio para los CER.

4.1.3. Experiencias en estos Mercados

La ratificación del Protocolo de Kyoto en febrero de 2005; el inicio del Sistema de Transacciones de la Unión Europea en enero del mismo año, como ya ha sido señalado; el establecimiento de nuevos fondos, más allá de los que administra el Banco Mundial, por nuevos países que desean realizar compras centralizadas de certificados de carbono, como parte de las estrategias nacionales para dar cumplimiento a sus compromisos de reducción de emisiones bajo el PK; la probable creación de otros mercados nacionales como en Canadá, Japón y Noruega; y la agresiva incursión del sistema financiero europeo en el negocio de compra y ventas de los CER, han infundido gran dinamismo a este novedoso mercado, que hoy incluye brokers, traders, entidades financieras, consultores y entidades auditoras, que crecen en número y tamaño, dando respuesta a un aumento exponencial del volumen de transacciones y requerimientos de servicios conexos.

De acuerdo a las informaciones contenidas en el informe “Estado y Tendencias del Mercado del Carbono” que el Banco Mundial publica anualmente, la evolución de las transacciones de certificados de carbono basadas en proyectos, esto es excluyendo derechos de emisión y sólo contemplando aquellas referidas a compromisos de entrega hasta el año 2012, ha tenido el comportamiento que se describe en la Figura N° 4 y que constata lo expresado anteriormente.

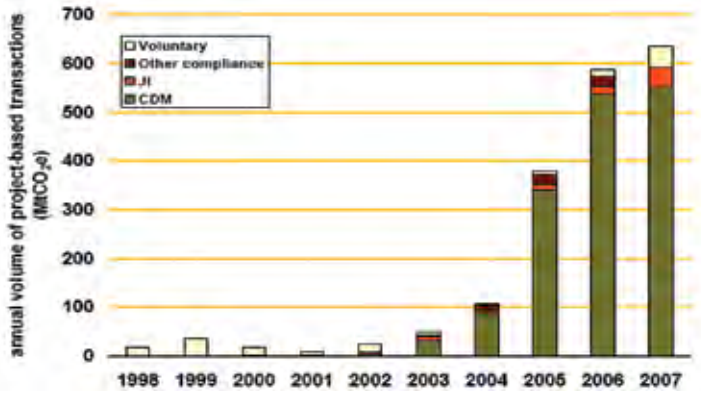


Figura N°4
VOLUMEN ANUAL DE TRANSACCIONES DE REDUCCIÓN DE EMISIONES BASADAS EN PROYECTOS

Otras importantes conclusiones se derivan de las siguientes cifras que cita el mismo documento y se exponen en el Cuadro N° 8.

Cuadro N°8

COMPORTAMIENTO DE LOS MERCADOS BASADOS EN PROYECTOS

	2006		2007	
	Volumen ($MtCO_2e$)	**Valor (MUS$)**	**Volumen ($MtCO_2e$)**	**Valor (MUS$)**
	Mercados de Permisos de Emisión			
EU ETS	1.104	24.436	2.061	50.097
New South Wales	20	225	25	224
Chicago Climate Exchange	10	38	23	72
UK ETS	na	na		
Sub total	**1.134**	**24.699**	**2.109**	**50.394**
	Mercados Basados en Proyectos			
MDL Primario	537	5.804	551	7.426
MDL Secundario	25	445	240	5.451
JI	16	141	41	499
Otras Transacciones de cumplimiento/voluntarias	33	146	42	265
Sub total	**611**	**6.536**	**874**	**13.641**
TOTAL	**1.745**	**31.235**	**2.983**	**64.035**

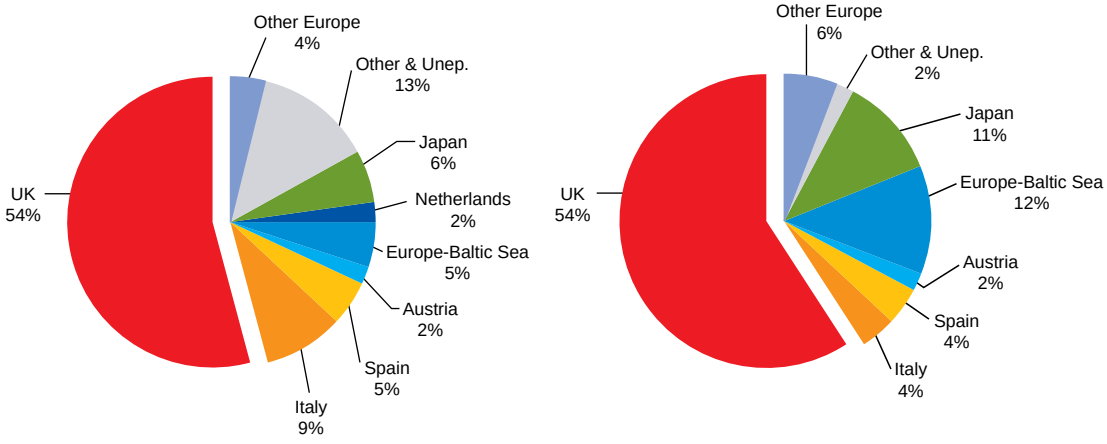
Según estos datos, este mercado creció al 2007 a un valor estimado de 64 mil millones de dólares estadounidenses, dos veces más que en el 2006. La venta y reventa de permisos de emisión en el sistema de transacción de la Unión Europea dominó esta cifra, con un valor cercano a los $US 50 mil millones.

La transacción de bonos de carbono provenientes de proyectos bajo el MDL y el mecanismo de Implementación Conjunta, creció hasta un valor cercano a los US$ 7.5 mil millones, en el que alrededor de un 91% de este valor fue provisto por proyectos MDL de países en desarrollo.

El mercado voluntario, formado por corporaciones e individuos, creció en forma importante en comparación con el 2006, a aproximadamente US$ 265 millones.

El valor promedio de los CER en el mercado primario estuvo a un nivel de US $ 13,5, en el mercado secundario a US $ 22,6 y los certificados en el mercado voluntario a US $ 6,3

Por segundo año consecutivo, los compradores europeos dominaron el Mercado del MDL y de las IC y, al cerrar el 2007, su participación alcanzaba el 90% (algo más que en 2006), como se muestra en la Figura N° 5.



2006
Overall volume 553 $MtCO_2e$

2007
Overall volume 592 $MtCO_2e$

Figura N°5
PARTICIPACIÓN EN LOS MERCADOS

Los compradores más activos fueron compañías privadas, con un volumen transado de 79% (un 2% más que en 2006). Londres se sigue erigiendo como el centro neurálgico de las transacciones, que aumentaron de 54% en 2006 a 59% en 2007. Por su parte, Japón ha vuelto a subir en transacciones, prácticamente duplicando su participación del 6% en 2006 a 11% en 2007.

En cuanto a los proveedores de certificados, el mercado es dominado claramente por China, aunque en número de proyectos que los originan, esta a la par de India, como se puede apreciar en las Figuras N° 6 y N° 7.

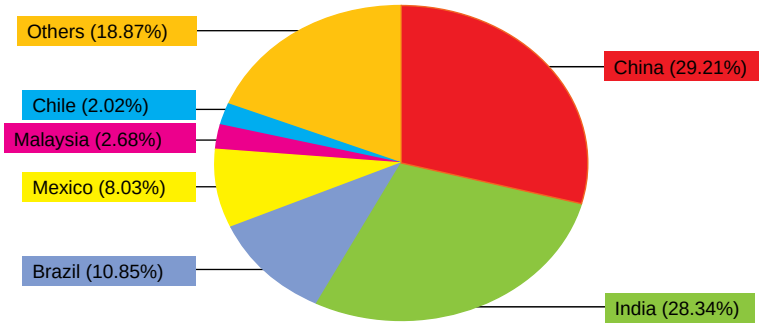


Figura N°6
ACTIVIDADES REGISTRADAS DE PROYECTOS POR PAÍS ANFITRIÓN
(Total: 1383)2

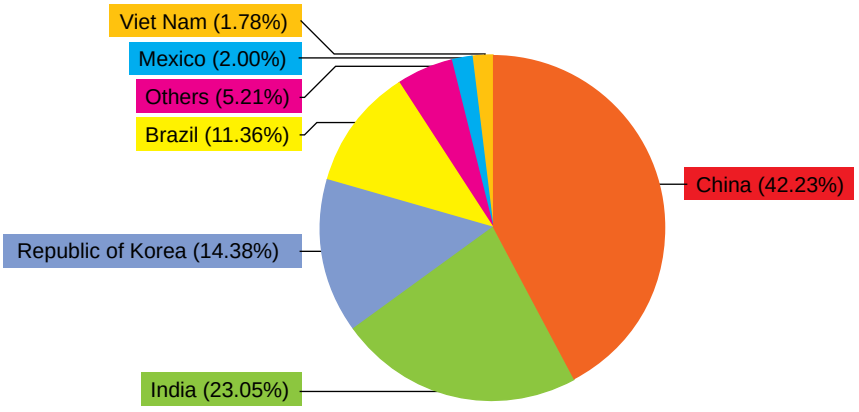


Figura N°7
EMISION DE CER POR PAÍS ANFITRIÓN
(Total: 252.039.060)

4.2. MERCADOS VOLUNTARIOS

Muchas corporaciones de gran tamaño han establecido metas de reducción de GEI voluntariamente. Compañías como ABB, Dupont, Entergy, IBM, Shell, Ontario Power Generation, Toyota de EE.UU., Marubeni, United Technologies Corp., TransAlta, entre otras, se han comprometido voluntariamente a metas de reducción y dan la bienvenida al mercado de carbono para cumplir con estos compromisos.

Compañías multinacionales, como Shell y BP, han implementado esquemas de comercio internos para internalizar el costo de las emisiones de carbono en sus operaciones. En la mayor parte, estas compañías están tomando decisiones en base a estrategias de inversión a futuro, ante las expectativas de cambio en la regulación ambiental y la convicción de que el desarrollo sostenible y la responsabilidad social de la compañía en temas ambientales fortalecen el negocio.

En muchos casos, estas compañías invierten en reducciones de carbono de proyectos en países en desarrollo o en economías en transición donde el costo de mitigación es menor. Aunque estas inversiones no sólo están dirigidas a reducir GEI y se mantienen relativamente pequeñas, están creando un mercado por créditos de carbono.

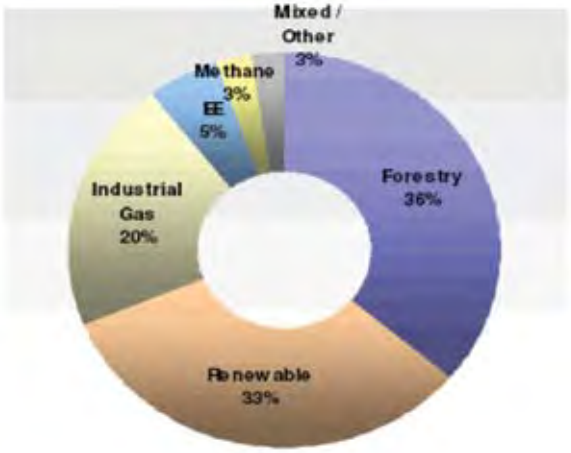
Según el Banco Mundial, también se está desarrollando un mercado al por menor. Este mercado es pequeño pero está en crecimiento. Son iniciativas voluntarias de corporaciones, individuos, productos particulares o servicios, eventos de carbón-neutral y otras.

El mercado es al contado o futuros (*forwards*) de corto plazo (hasta de 3 años). Las ONG son usadas frecuentemente como verificadoras que dan la aprobación a proyectos que satisfagan los criterios ambientales y sociales. Por lo mismo los documentos que cuantifican las emisiones reducidas de GEI o el secuestro de CO_2 se denominan reducción de emisiones verificadas (VER por sus siglas en inglés).

Las compañías americanas son compradoras claves y los proveedores son principalmente países en desarrollo. Se está pagando por pequeños volúmenes de créditos de carbono (usualmente pequeños proyectos que producen menos de 10 mil toneladas) para proyectos de desarrollo sostenible. El volumen en este mercado se estima en el rango de 150 mil tCO_2e/año y está creciendo rápidamente.

(De acuerdo a: Estado del Mercado Voluntario del Carbono 2007, publicado por by EcosystemMarketplace & New Carbon Finance)

Figura N°8
VALORES DE TRANSACCIÓN EN EL MERCADO VOLUNTARIO DE CARBONO

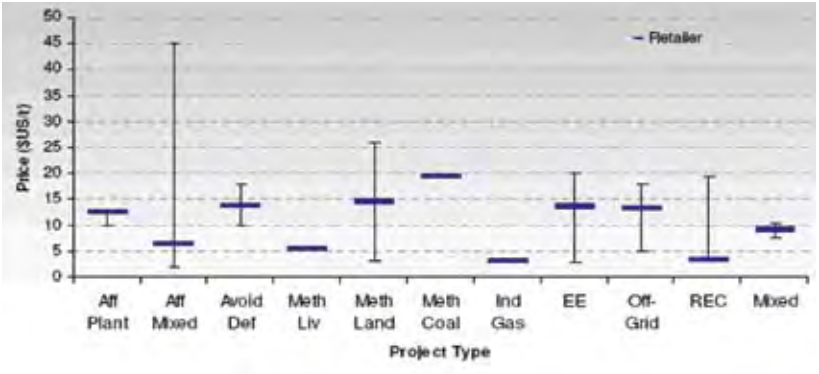


(De acuerdo a: Estado del Mercado Voluntario del Carbono 2007, publicado por by EcosystemMarketplace & New Carbon Finance)

Figura N°9
TRANSACCIONES SEGÚN TIPO DE PROYECTO

El tipo de proyectos que provee estos certificados de reducción de emisiones es variado, pero a diferencia de lo que sucede en el mercado de cumplimiento, la demanda por VER resultantes de actividades forestales es predominante, como ilustra la Figura N° 9).

Los precios que se cancela por este tipo de certificados son variables según el tipo de proyectos y están fuertemente marcados por las razones que motivan a los compradores para realizar esto esfuerzos voluntarios. La Figura N° 10 ilustra este hecho.



(De acuerdo a: Estado del Mercado Voluntario del Carbono 2007, publicado por by EcosystemMarketplace & New Carbon Finance)

Figura N°10
TRANSACCIONES SEGÚN TIPO DE PROYECTO

El Gobierno federal de Estados Unidos a través de la administración Bush, ha presentado una alternativa al Protocolo de Kyoto para reducir emisiones. A diferencia de los límites absolutos establecidos en el Protocolo de Kyoto, Estados Unidos propone estabilizar las emisiones de GEI a través de la reducción de la intensidad de carbono en 18% para el año 2012, es decir, el ratio entre el total de emisiones y el producto bruto interno. Los esfuerzos serán voluntarios y ya existe una lista de compromisos por parte de organizaciones industriales, como la automotriz, la química, la minera, la petrolera y la industria de acero.

En ausencia de un compromiso federal para reducción de emisiones han surgido diversas iniciativas estatales:

Límites Obligatorios para Instalaciones Estatales. Ejemplo, Massachusetts, que se convirtió en el primer estado de Estados Unidos en imponer límites a la emisión de CO_2 en las antiguas plantas térmicas de energía. Las restricciones fueron impuestas sobre 6 plantas del Estado. Las plantas tienen que reducir sus emisiones en 10% en el año 2006 respecto al año base promedio de 1997-1999.

Desarrollo de medidas para reducir CO_2 en el transporte. Ejemplo, California.

Establecimiento de Fondos para Proyectos de Reducciones. Es el caso de Oregon Climate Trust. El Estado de Oregon impuso a las nuevas plantas de generación eléctrica metas de reducción de emisiones de CO_2e. La condición para obtener un permiso de operación es de emitir 17% menos que la planta más eficiente de ciclo combinado de gas natural. Para cumplir con esta ley, promulgada en 1997, las plantas deben reducir emisiones, comprar créditos de carbono o pagar US$ 0,85 por tCO_2 al Climate Trust Fund. El Oregon Trust Fund, con los ingresos obtenidos, busca proyectos que reduzcan emisiones.

Discusión de iniciativas de secuestro de carbono. Varios estados.

Desarrollo de regulación para comercio de emisiones de CO_2. Ejemplo, Nueva Jersey y otros.

Diversas iniciativas del Congreso tienen un potencial de cambiar el enfoque de las medidas de mitigación de Estados Unidos, como son las propuestas de ajustes presupuestarios para apoyar la mitigación de GEI, leyes de soporte a Kyoto, leyes sobre secuestro de carbono y de eficiencia energética, y otras. Mayores son las posibilidades de que estos cambios ocurran con la llegada de una nueva administración a este país, que ya ha anunciado una actitud diferente sobre el tema.