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Forest Reference Emission Level / Forest Reference Level of Native Forests in Chile

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ESTRATEGIA NACIONAL DE CAMBIO CLIMÁTICO Y RECURSOS VEGETACIONALES

Forest Reference Emission Level/ Forest Reference Level of the Chilean Native Forests Preliminary Document
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Editors: Javier Cano[1], Angelo Sartori[1], Osvaldo Quintanilla[1], Verónica Oyarzún[2].
[1]Unidad de Cambio Climático y Servicios Ambientales.
[2]Departamento de Monitoreo de Ecosistemas Forestales
[1,2]Gerencia de Desarrollo y Fomento Forestal.
Corporación Nacional Forestal.
Ministerio de Agricultura. Gobierno de Chile.

Authors:
CONAF: Javier Cano, Angelo Sartori, Osvaldo Quintanilla, Verónica Oyarzun.

Winrock-UAustral-INFOR Consortium:
Winrock International: Gabriel Sidman, Felipe Casarim, Anna McMurray, Timothy Pearson.
Universidad Austral de Chile: Jorge Gayoso, Víctor Sandoval, y Noemi Almonacid.
Instituto Forestal de Chile through Carlos Bahamondez, Yasna Rojas, y Rodrigo Sagardia

ENCCRV Consultant: Pablo Honeyman.

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1. Introduction

Chile voluntarily presents its subnational Forest Reference Emission Level/Forest Reference Level (FREL/FRL) for native forests, as part of Chile's commitment to the United Nations Framework Convention on Climate Change (UNFCCC) and in response to the invitation extended by the UNFCCC under decision 12/CP.17 paragraphs 9 and 11. In doing so, Chile adheres to the Convention's objective to encourage developing countries to develop and implement policies and measures to promote reducing emissions from deforestation and forest degradation, conservation, sustainable management of forests, and the enhancement of forest carbon stock, also known as REDD+.

As stated in decision 12/CP.17 paragraph 7 of the UNFCCC, an FREL/FRL is a benchmark with which to evaluate the effectiveness of the country's implementation of REDD+ activities. A FREL/FRL must create a historical inventory of greenhouse gases (GHG) found in the country and future projections of these to use as a reference when evaluating the effectiveness of the implemented policies related to REDD+ activities.

This document and its annexes were prepared in accordance with the modalities and guidelines established in decision 12/CP.17 Section II and Annex, and following the Guidelines for National Greenhouse Gas Inventories by the Intergovernmental Panel on Climate Change (IPCC, 2006). This document also includes the assumptions used in the National Greenhouse Gas Inventory (INGEI for its initials in Spanish) of Chile for the time period 1990-2010, consigned to the Secretariat of the Convention in 2014 through the first Biennial Update Report (BUR).

This submission was conducted on a subnational scale which included 5 regions of the country with a high native forest coverage. Additionally, the same area was used in the Emissions Reduction Program, which Chile is currently developing to be submitted to the Forest Carbon Partnership Facility.

A "step-wise" approach has been applied that will allow for improvements and expansion of the FREL/FRL to a national scale as methods are optimized and new information is developed.

The submission has been developed in consistency and congruency with INGEI of Chile, and presents all the information and methods in a transparent, complete and precise manner including:

- The definition of forest used by Chile for the purpose of REDD+ activities, as well as a definition for each of the 5 REDD+ activities;
- The resources and methodological protocols used to construct the Chilean subnational FREL/FRL;
- The carbon and other GHGs considered in the FREL/FRL of each REDD+ activity.

The FREL/FRL presented in this document has been developed by National Forest Corporation (CONAF) of Chile through a joint project headed by the Climate Change and Environmental Services Unit (UCCSA) and the Department of Forest Ecosystem Monitoring. Technical support was provided by the World Bank, who also acts as the Facility Management Team of the FCPF, and voluntary funds Chile in its progress with REDD+ activities. The technical team also received support from Winrock International, the Austral University of Chile (UACh), the Forest Institute (INFOR) and the agencies of the United Nations, FAO, UNEP, UNDP, affiliated with the United Nations Collaborative Programme on Reducing Emissions from Deforestation and Forest Degradation (UN-REDD), which Chile has participated in since 2014.

2. Background

a. National Circumstances

As the main focal point before the UNFCCC for REDD+ activities in Chile, the National Forest Corporation (CONAF) has decided to focus its efforts in developing the FREL/FRL in a subnational area of the central-southern zone of Chile. This area contains the highest concentration and largest variety of forests in the country, as well as a strong anthropogenic presence. This subnational segment is comprised of 5 administrative regions beginning with the region Maule to the region Los Lagos (Figure 1). The temperate rainforest ecosystem is found in this region, which has a large potential to reduce/absorb GHG emissions, and the capacity to produce non-carbon environmental benefits, such as: improving the water balance, soil preservation, maintaining biodiversity, and allowing communities dependent upon these ecosystems to access the positive ecological benefits of these services. These 5 regions represent 22% of the total surface area of Chile (16,522,077 hectares), and contain 41% of the native forests (5,853,387 hectares) which represents 11 of the 12 types of national forests.

i. Institutionalization

Following Chile's ratification of the UNFCCC in 1994 and joining the Kyoto Protocol in 2002, the institutionalization of climate change in the country has registered important advances that have been reflected in the implementation of the Council of Ministers for Sustainability and Climate Change (CMSCC) in 2014. CMSCC deliberates on public policies and general regulations regarding environmental material. The council is presided over by the Ministry of the Environment[1].

Since 2010, when the Ministry of the Environment of Chile was formed, it has been the Chilean focal point in the UNFCCC. This enables better coordination and orientation of governmental actions when tackling the challenges and opportunities imposed by climate change for public policies[2]. Prior to the creation of the Ministry of the Environment and following Chile's ratification of the UNFCCC, the National Advisory Committee for Global Change (CNACG) was established. It is comprised of representatives of the public sector and academia. In 2006, the CNACG developed the National Strategy for Climate Change[3] which establishes the main objectives of adaptation, mitigation, and the promotion of capacity-building. These are executed through the National Action

[1] The Ministries that make up this institution are Agriculture, Treasury, Health, Economy, Development and Reconstruction, Energy, Public Works, Housing and Urban Development, Transportation and Telecommunications, Mining, and Social Development.

[2] Ley 20.417, Article 70, sub-clause h, specifically states "(…) it be part of the MMA duties to propose policies and formulate plans of action in the matter of climate change."Original text in Spanish: "(…) le corresponderá especialmente al MMA el proponer políticas y formular los planes, programas y planes de acción en materia de cambio climático".

[3] Estrategia Nacional de Cambio Climático (National Strategy for Climate Change), http://www.bcn.cl/carpeta_temas_profundidad/temas_profundidad.2007-04-11.5841476988/Estrategia%20nacional%20_2006.pdf

Plan for Climate Change (PANCC) 2008-2012 which is currently in the process of being updated for the 2016-2021 term[4].

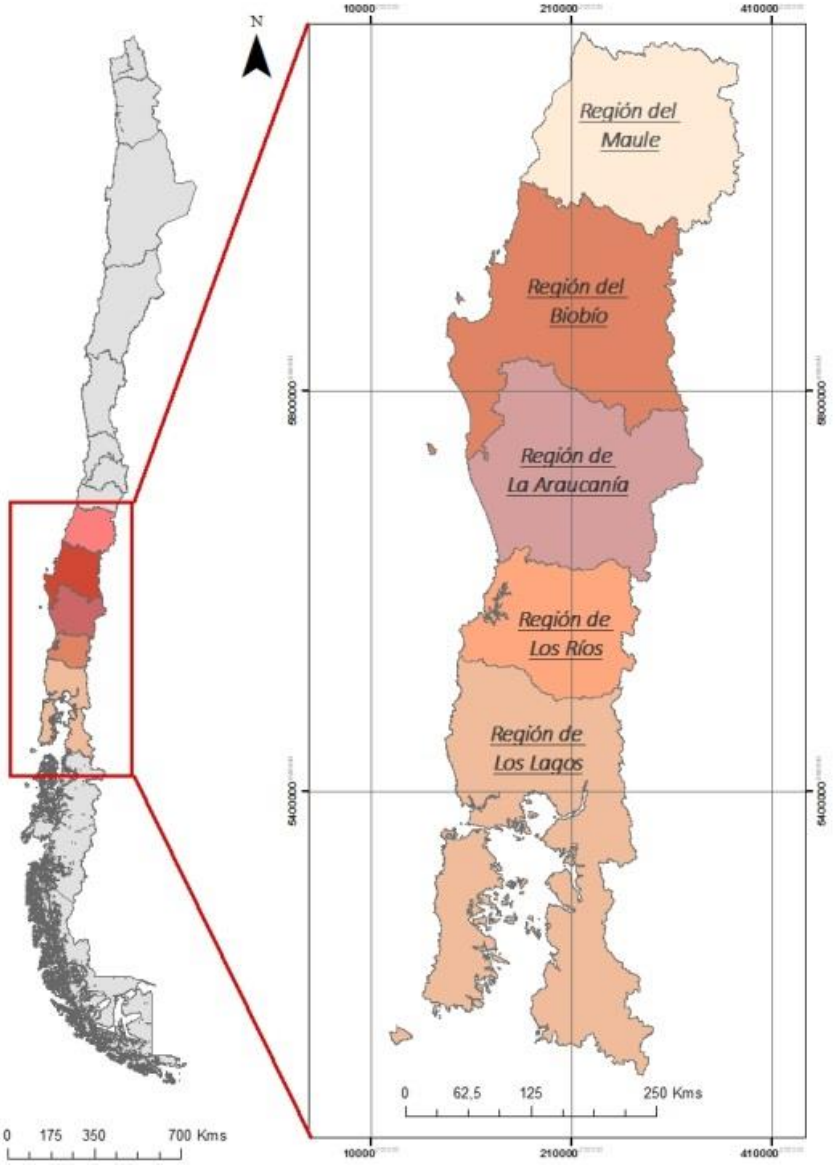

Figure 1: Area included in the subnational FREL/FRL of Chile.

To support the inter-agency working, particularly in the context of international climate change negotiations and national commitments that they evoke, in 2010, since the Ministry of Environment was formed, the Climate Change Office was created, with the mission to participate

[4] Proposal for structure and content for Plan de Acción Nacional de Cambio Climático 2016-2021 (National Plan of Action for Climate Change 2016-2021). http://portal.mma.gob.cl/wp-content/uploads/2015/08/Propuesta-contenidos-PANCC-2016-2021-Fase-II-Licitacion_con-anexos.pdf

actively in "the process of international negotiations associated with the implementation of the UNFCCC whose mandate is: to coordinate the Committee of the Designated National Authority (DNAA) of the Clean Development Mechanism (CDM), act as the focal point for the Intergovernmental Panel for Climate Change (IPCC) and to hold the post of technical secretariat in the inter-ministry committees on climate change" [5,6].

In this context and due to the complexity of the topics that are discussed in the UNFCCC regarding Land Use, Land Use-Change and Forestry (LULUCF), and those specifically related to the decisions of the Convention that promote establishing national strategies for reducing emissions caused by deforestation and forest degradation, and encouraging the role of conservation, sustainable management of forests and the enhancement of forest carbon stock (abbreviated as REDD+), the National Forest Corporation of Chile (CONAF), an independent institution of the Ministry of Agriculture (MINAGRI) was designated as the focal point for REDD+[7] activities in Chile. CONAF fulfills this role specifically though the Climate Change and Environmental Services Unit (UCCSA) of the Administration of Forest Promotion and Development (GEDEFF).

CONAF's mission is the sustainable management of native forests, xerophyte plants and forest plantations by fostering development, the enforcement of environmental and forestry-related legislations and the protection of vegetation resources, such as the conservation of biological diversity through the National System of Protected Wild Areas (SNASPE), for the benefit of society, having as strategic objectives:

1. Supervise and encourage the sustainable management of native forests, xerophyte plants and forest plantations and the protection of protected species, through the application and dissemination of forestry and environmental legislations;
2. Improve access for small and medium-sized producers of forestry products and indigenous people, for the benefits of forestry activities and conservation tourism, through the use of instruments that promote forestry and offer technical assistance for the valuation of their goods and services in accordance to other public services;
3. Encourage the development of environmental services through the promotion and care of urban trees, peri-urban parks, and natural infrastructure, and other types of plants with patrimonial and cultural value, and disseminating the benefits they provide for society;

[5] First BUR from Chile for the UNFCCC. MMA, 2014. Pag 55. http://portal.mma.gob.cl/wp-content/doc/2014_1IBA_Chile_Espanol-1.pdf.

[6] Original text in Spanish: "en los procesos de negociación internacional asociados a la implementación de la CMNUCC, cuyas funciones son: coordinar el Comité de la Autoridad Nacional Designada (AND) del Mecanismo de Desarrollo Limpio (MDL), actuar de punto focal del Grupo Intergubernamental de Expertos sobre el Cambio Climático (IPCC, por sus siglas en inglés) y ostentar el cargo de secretaría técnica de los comités interministeriales en cambio climático"

[7] This assignation was based on the decision accorded by the CoP-19 in Warsaw where countries were invited to nominate focal points or Designated National Entities for REDD+, through the Carta Oficial N°99 of February 19, 2014 the Ministry of Agriculture Mr. Luis Mayol, directed towards his counterpart in the Ministry of Foreign Affairs who formalized this assignation before the Secretariat of the Convention.

4. Protect society from the threat created by forest fires, forest pests, invasive forest tree species, and the effects of climate change affecting native forests, xerophyte plants, planted forests, and patrimonial components present in the SNASPE;
5. Preserve the biological diversity, through the reinforcement of SNASPE, other instruments of conservation and support of native forests and xerophyte plants contributing to a better quality of life for society and the local communities.

Due to its role as State's forest service, CONAF, in 1995, was appointed as the focal point for the United Nations Convention to Combat Desertification (UNCCD) in Chile. This appointment broadened the spectrum of CONAF's tasks, compelling the institution to integrate into their efforts the necessary actions to respond to the commitments rising out of both Conventions alongside the obligations imposed upon them in their institutional role. In addition, as the technical advisor for MINAGRI, CONAF must lead coordination with other ministry institutions that contain Chilean forest expertise.

In 2014, the Intraministerial Technical Committee on Climate Change (CTICC) was created. It is coordinated by the Office of Agrarian Studies and Policies (ODEPA), which unites the different services that comprises the MINAGRI[8], including CONAF. It is expected that soon CTICC will have representation in all 15 regions of the country, and be presided over by the Regional Ministerial Secretariat (SEREMI) of Agriculture with the participation of representatives of the diverse Agroforestry sector of public services.

In September 2015 Chile consigned before the Secretariat of the UNFCCC, its participation with the Intended Nationally Determined Contribution (INDC)[9], through this, acknowledging the importance of the agreements reached in the Conference of the Parties to the UNFCCC (CoP) held in Paris in December 2015 (CoP 21). As part of the specific commitments in the LULUCF sector, the country committed to the sustainable management of 100,000 hectares of forest, primarily native forests, as well as the reforestation of 100,000 hectares of primarily native species.

As the INDC documents indicate, the achievement of these commitments will be backed through the implementation of the National Strategy for Climate Change and Vegetation Resources (ENCCRV in Spanish) that impels CONAF to collaborate with different actors on a national and regional level in the forestry sector. As is the case with Information Center of Natural Resources (CIREN), which contributed to the development of the definitions of deforestation and degradation of native forests, INFOR, has contributed to the development of the FREL/FRL of Chile, as well as provided improvements to the measurement, reporting, and verification (MRV) required.

[8] Other institutions of the MINAGRI that have responsibalities regarding the forests are Oficina de Estudios y Políticas Agrarias (ODEPA), Instituto de Desarrollo Agropecuario (INDAP), Fundación para la Innovación Agraria (FIA), Instituto de Investigaciones Agropecuarias (INIA), Instituto Forestal (INFOR), Centro de Información de Recursos Naturales (CIREN), Servicio Agrícola y Ganadero (SAG).

[9] Intended Nationally Determined Contributions for Chile (INDC) Paris Climate Agreement 2015. Gobierno de Chile, 2015. http://portal.mma.gob.cl/wp-content/uploads/2015/09/INDC_1609c1.pdf

The objective of the ENCCRV is to "promote the restoration and protection of the native forests and xerophyte plants, as well as encourage the establishment of vegetation groupings in viable soils to be planted as measures for climate change mitigation and adaptation[10]"[11].

ENCCRV in concerned with the key elements in the area of adaptation to climate change and fights against desertification, degradation of the land and droughts, the objectives of UNCCD, as well as with the REDD+ related decisions of the UNFCCC. As such, within this framework, initiatives are developed to achieve the goals defined by the INDC for the LULUCF. These initiatives are then implemented, adjusted and registered to enables the maintenance and increase of forest reserves of GHG, how to avoid emissions by stabilizing and reducing the rates of deforestation and native forest degradation, and to later receive the benefits associated with the positive performance of the actions, which within the context of REDD+ is the exchange of payment for results. As such, in CoP 21 a definition of the international financial structure was provided in order to ensure the sustainability through time of these national initiatives given by the Green Climate Fund (GCF).

It is within this context that the work associated with ENCCRV coordinated by CONAF acquires relevance, as it represents a pilot element for the technical mechanisms and the national finances that must be achieved, by giving certainty to the conditions and elements that will need to be developed, in relation to payment schemes for replicable results on a national scale and equally valid internationally.

ii. Legislations

In the recent history of our country, different legal norms have directly and indirectly related to the protection of forests. The application and validity of these legal bodies have had significant impact on the development of the country, and dictate the current situation of forest resources, as summarized in the previous section.

The first legal norm pertinent to the forest sector with continued relevance to date is ***Ley de Bosques*** **(Forest Law)** (Decree-Law 656) of 1925 according to the consolidated text established by Supreme Decree 4363 of 1931 by the Ministry of Lands and Colonization. This law highlighted the importance of the forests, their protection and improvements of their lands, for the regulation of river flows, for the general conservation of water resources, as sources of primary materials for numerous industries and as a source of health for the population. Additionally, this law improved the norms regarding the use of fire, the application of sanctions, and the norms concerning National Parks and Forest Reserves. However, the most significant attribute of this law was the

[10] Original text in Spanish: "apoyar la recuperación y protección del bosque nativo y formaciones xerofíticas, además de potenciar el establecimiento de formaciones vegetacionales en suelos factibles de ser plantados como medidas de mitigación y adaptación al Cambio Climático. Para este fin se pretende diseñar e implementar un mecanismo estatal que facilite el acceso de las comunidades y propietarios a los beneficios asociados a los servicios ambientales que generan estos ecosistemas recuperados"

[11] Intended Nationally Determined Contributions for Chile (INDC) Paris Climate Agreement 2015. Gobierno de Chile, 2015. Pg. 13.

incorporation of prohibitions which are still applied to date, which prevents the cutting of native trees and shrubs close to springs or on terrain with an inclination of more than 45%.

The Forest Law upheld the ban on the use of fire to enable new forest areas, and established in regards to protected wild areas, the creation of Tourism National Parks and Forest Reserves, through the power of the President.

Lastly, the Forest Law established penalties for violations of these prohibitions, ranging from monetary fees to jail term (Saelzer, 1973).

The second legal norm and probably the most relevant for the forest sector, is the ***Decreto de Ley Nº 701 sobre Fomento Forestal*** (Decree-Law 701 on Forest Promotion). It was promulgated in 1974, starting a forestry policy supported on the two main pillars of incentive for forestation and the protection of the forest resources.

Within this framework, the appraisal of territories as *Aptitud Preferentemente Forestal* (APF) (Suitability for Forest Lands), through a technical-judicial amendment which decrees that a forester must appraise the land as un-arable land, through climate and soil conditions, and that its use in agriculture, fruticulture, or animal husbandry will lead to degradation. Once the appraisal of the land has been approved by the authorities, the landowner is granted rights such as tax exemptions, and the possibility of receiving monetary remunerations for forestation. This also generates, through Article 22, the obligation to replant after cutting or exploitation of the forests.

Moreover, an additional technical-judicial amendment *Plan de Manejo* (Management Plans) was incorporated in 1979 by Decree-Law 2565, which modified the Article 2 of Decree-Law 701 of 1974, declaring it a legal body to regulate the use and sustainable management of renewable natural resources in a determined area, with the objective of maximizing the benefits, assuring the preservation, conservation and increase of these natural resources and their ecosystem.

This legal body formed the central axis of the system and is a program for the sustainable use of forestry national resources of native forests or planted forests. As such, the management plans have two dimensions, a technical dimension which is written by a forester or a specialized agronomist who must, amongst other duties, provide a profile of the site and the forestry resources, define the objectives of the management plan and the silviculture treatment; and a judicial dimension, which once the appraisal and management plans are approved, are granted the power to impose sanctions on the landowner for noncompliance with the management plan.

The *Decreto Supremo* 259 (Supreme Decree 259) of 1980 modified DL 701 through a technical regulation that provided the legal definitions of the Forest Types for native forests in Chile, and also established the silvicultural methods that can be applied to each type.

The DL N°701 included three types of regulations, the right to property, tax incentive and economic incentives. The latter two regulations include a monetary remuneration given by the State for the reforestation and the initial management of planted forests in lands that have been labeled suitable

for forest lands in accordance to the previously approved management plans. The state "will reimburse, only once, a percentage of the net costs for every area where diverse activities such as forestation of fragile and degraded lands, activities of soil recovery or sand dune stabilization, planting of windbreak ridges, and the first pruning and thinning amongst others have been performed by small forest property owners[12].[13]" [14] The law does not include incentives for the sustainable management of native forests.

Due to DL 701 of 1974 with its many modifications, Chile has received recognition as one of the countries with the highest indices of forestation, in relation to its size and population. Due to these conditions, one of the biggest national industries of Chile is the production of cellulose and sawn timber of introduced fast-growing forest species.

The remuneration incentive for forestation activities under DL 701 expired in 1996, and in 1998 with Ley 19.561 these incentives were extended until 2011. In 2011, the law achieved its last extension until 2012 after which, the law no longer held an incentive component.

As of 2013, Chile no longer has any legal economic incentives for forestation. Chile is currently working on developing a new law using a different approach. The new law should aim to promote the establishment of planted forests of primarily native species for permanent cover, with balanced aspects between industries and the provision of environment services, such as water source protection, production of non-timber forest products, and the protection of biological diversity. Projections for the new Law of Promotion propose that by 2016, significant advances in the formulation and parliamentary processing would have taken place.

The most recent law, ***Ley 20.283*** *of* ***Recuperación del Bosque Nativo y Fomento Forestal*** (Recovery of Native Forest and Forest Promotion) was promulgated in 2008, following a 16 year debate, due to its intentions to include the interests of all parties regarding native forests.

This law calls for the protection, recovery and improvement of native forests; thus ensuring forestry sustainability and environmental policies. The law includes 26 definitions of concepts and elements aimed to unify criteria and improve understanding of the document. Many of the definitions in this document were modified from definitions used in previous documents. Amongst the most relevant definitions are the definitions for forest, native forest, small forest landowner, management plan, and environmental services.

For the definitions of the forest types and the methods to manage them, Law 20.283, looked to DL 701 from 1974 for the established definitions. However, the law states a need to create a new

[12] Before 1998 forestry companies for many years received a supplement pay for the trimming and thinning as well as payments for management. After Ley N° 19561 in 1998 this was given to small and medium properties.
[13] Original text in Spanish: "bonifica, por una sola vez en cada superficie un porcentaje de los costos netos de las diversas actividades como forestación en suelos frágiles y degradados, actividades de recuperación de suelos o de estabilización de dunas, establecimiento de cortinas cortavientos, y la primera poda o raleo realizadas por pequeños propietarios forestales, entre otras".
[14] http://www.leychile.cl/Navegar/index_html?idNorma=99208

typology based on scientific studies and validated by the public and private parties of the field. It has been six years since its promulgation, and this clause has yet to be updated.

Additionally, Law 20.283 established that CONAF will maintain a permanent forestry cadastre where it will identify and establish, cartographically, the types of forests found in each region, the state of the forest, and the location of forest with native forest ecosystems of special interest for conservation and preservation. The law established that the must be updated at least every 10 years and the information made available to the public. As such, CONAF has established the *Sistema de Información Territorial* (SIT) web site (System of Geographical Information) for the distribution of its updates.

Through Law 20.283 the concepts of the Management Plan of DL 701 are complemented with the onset of the *Plan de Manejo de Preservación* (Management Plan for Preservation). The new management plan is an alternative tool for forests aiming for preservation and recovery of native forests, with ordination management plans. Additionally, monetary incentives are proposed for projects that include methodologies for forest management that ensures the sustainable management of the land in the long run.

Law 20.283 proposed environmental protection norms for the conservation of biological diversity, and the prevention and suppression of forest fires. Under the law's regulation of soils, waters and wetlands, restrictions on logging and commercial exploitation are dependent on given conditions and resources; it includes measures for soil protection and the quality and quantity of flow rate in rivers.

As a means of accessing the incentives for native forest management the *Fondo de Conservación, Recuperación y Manejo Sustentable del Bosque Nativo* (FCRMSBN) (Fund for Conservation, Recovery, and Sustainable Management of Native Forests) was created. The Fund functions as a grant-fund destined for the conservation, recovery, or sustainable management of native forests. The remunerations are expected to contribute to the costs of regeneration, recovery or protection of xerophyte plants of high ecological value or the preservation of native forests for non-timber products, and the management and recovery of native forests used for timber production. Additionally, remuneration is granted for forestry management plans passed on ordination criteria.

Law 20.283 also established an annual fund of 8 million USD for the Fund. However, after six years, annual use of the funds has not exceeded 15%. Attempts to rectify this situation are underway through suggested changes to the law and changes in management and administration of the law through CONAF.

The *Fondo de Investigación del Bosque Nativo* (FIBN) (Fund for Native Forest Research), was created as a complementary fund to the FCRMSBN. The FIBN aims to promote and increase the understanding of forestry ecosystems.

The details for the operation and implementation of the funds were established in the regulations of Law 20.283, which have been modified twice since its promulgation.

During the seven years since the creation of the FIBN, 98 projects have received funding totaling $ 4,322,918,033 Chilean Peso (Table 1).

Requests For Proposals	Year	Number of Projects	Funding
I edition FIBN	2009/2010	23	$ 638.873.395
II edition FIBN	2010/2011	21	$ 798.298.409
III edition FIBN	2011/2012	18	$ 533.001.412
IV edition FIBN	2012/2013	13	$ 691.439.534
V edition FIBN	2013/2014	12	$ 808.430.751
VI edition FIBN	2014/2015	11	$ 852.874.532
Total		***98***	***$4.322.918.033***

Table 1. Number of projects and funding for the FIBN request for proposals by year. Source: CONAF.

Written in the investigation parameters for the request for proposals for FIBN VII of 2015, and relevant input in the framework of the ENCCRV, establishes in Line 5 "***Development of allometric equations for the calculation of carbon stocks in native forests at a national level;"***[15] and *"Developing allometric equations to determine the amount of carbon above and below ground for the calculation of carbon stock in the next update of the Greenhouse Gas Inventory (INGEI in Spanish) of Chile and for the monitoring of mitigation strategies for climate change with the State fosters through the National Forestry Corporation (CONAF in Spanish) to compliment initiatives developed on the matter in the sector…".*[16] The funding budget of $65,500,000 Chilean Pesos is also determined the document.

[15] Original text in Spanish: "***Desarrollar funciones alométricas para estimar existencias de carbono en bosque nativo a nivel nacional"***
http://www.investigacion.conaf.cl/ayuda/varios/2016/Lineas_Investigacion_VII_concurso_2016.pdf

[16] Original text in Spanish: *"Desarrollar funciones alométricas para determinar carbono bajo y sobre el suelo como sustento para la contabilidad de carbono a incluir en próximas actualizaciones del Inventario de Gases de Efecto Invernadero (INGEI) de Chile y para el monitoreo de las opciones estratégicas de mitigación al cambio climático que impulsa el Estado a través de la Corporación Nacional Forestal (CONAF), para complementar iniciativas equivalentes que se desarrollen en la materia, en el sector…"*
http://www.investigacion.conaf.cl/ayuda/varios/2016/Lineas_Investigacion_VII_concurso_2016.pdf

b. Description of national forest lands

Continental Chile possesses extensive and complex forest resources, which is determined by the wide latitudinal distribution which spans between latitudinal lines 18° and 56°. This geographical condition generates a climatic gradient that begins with arid and semi-arid environments dominated by desert climates in the extreme north, temperate environments dominated by a Mediterranean climate in the central zone, and humid, cold, oceanic and sub-Antarctic climates as the forest progresses to the south.

This gradient combined with the predominantly mountainous physiographic territory (80% of the national territory) has generated ideal conditions for the development of a rich diversity of native forest ecosystems composed of discrete and continuous communities that are distributed along the territory occupying 14 million hectares.

These same conditions combined with the historical process of the transformation of the landscape have also generated, in Chile, an extension of monoculture forestry of almost 3 million hectares, which is predominantly located in the temperate zone, the majority of which is dedicated to timber and the paper and pulp industry (Table 2).

Forestry Lands	Surface Area (ha)	%
Plantations	3,036,407[17]	17%
Native Forest	14,316,822	82%
Mixed Forest	167,620	1%
Total	***17,520,849***	***100%***

Table 2. Forestry lands in Chile. Source: sit.conaf.cl

Therefore, 23% of the national surface territory is forest lands. An additional portion of the surface area is composed of grassland and shrubland formations (27%) (Table 3). An important portion of the grasslands and shrublands are actually forests in an advanced stage of degradation which have the potential for restoration, as is the case with other degraded lands that are currently without tree vegetation and possess the potential for reforestation.

[17] This number is derived from the latest regional updates to the Cadastre and can be found in sit.conaf.cl, this data differs from the data register for INFOR in the Programa de Actualización Permanente de Plantaciones Forestales, where planted forests are considered to be 2,447,591 hectares. This variation is due to the different methodologies applied and the dates of updates of both reports.

Land use	Surface Area (ha)	%
Industrial and urban areas	354,135	0%
Agricultural lands	3,335,157	4%
Grasslands and shrublands	20,320,990	27%
Native forests and forest plantations	17,520,849	23%
Wetlands	3,596,533	5%
Areas without vegetation	24,675,320	33%
Snow and glaciers	4,156,261	6%
Bodies of water	1,343,762	2%
Unrecognized areas	283,198	0%
Total	***75,539,056***	***100%***

Table 3. The Uses of land in Chile by area of land 2015. Source: sit.conaf.cl

i. Native Forest

The important portion of the territory covered by native forest lands have been described and classified, and a wide classification of forest communities have been found within the country. Nonetheless, the system of categorization, established as the legal method for classification according to the current forestry legislation, defines 12 forest types for Chile (Table 4). This classification that has been present for three decades is a practical simplification of the enormous diversity of the conditions of the natural forests. This classification is used for the regulation of resources and functions that are the basis for the forestry management system.

The regions with the most forest coverage in Chile are located in the Southern and Austral zones including more than 80% of the native forests in the country. They also possess a large diversity of forest types, especially in the regions of Los Rios and Los Lagos which have 9 of the 12 described forest types.

The most prominent types of forests are the siempreverdes (evergreen) and the Lenga. Each one has a total surface area of 25% of native forests and are present in 8 and 7 regions respectively.

As seen in Figure 2, the forest types are distributed along a transitional gradient where the different forest types are incorporated, mixed and separated as the forest progresses through the latitudes.

In the Big North natural region, a small surface area is covered by a natural semi-wooded species, primarily xerophyte species (adapted to the arid climates) such as the Queñoa (*Polylepis tarapacana*) and other similar species which are isolated from the rest of the forests due to the Atacama Desert. These species have a total surface area of 54,451 hectares dispersed in small

groves (Teillier, 1999). In the region of Tarapacá, the protected National Reserve Pampa del Tamarugal covers an area of 27,000 ha of planted forests with species of the genus *Prosopis*. This was a reforestation initiative by the State that has prospered in the most arid desert of the world for many decades. This resource has generated an oasis of biological diversity in the zone, and a source of timber and non-wood products for the neighboring communities, primarily firewood and forage for the livestock. The large portion of the extraction of these goods is executed through formal plans managed and supported by CONAF.

To the south of Small North natural region begins the appearance of xerophytes and sclerophyll plants (hard leaves with sclerenchyma) in greater quantities. The latter ones give the name to the main forest type of these zones, and they are dominated by species that are adapted to the temperate Mediterranean climate, with periods of prolonged summers. In conditions with higher water availability and to the south of this zone, sclerophyll forests appear; in some sectors, these forests reach important scope and levels of coverage (Lubert y Pliscoff, 2006).

It is important to mention that Mediterranean ecosystems present the highest amount of biodiversity in the country, and also present strong anthropogenic alterations. This is due to the changes of forest land use for agricultural and urban purposes, fires, and overgrazing, and for the unsustainable use of the forests, grasslands and xerophyte plants that have been used as a source of combustion and other primary goods. The use of these resources occurs in an informal manner, which leads to difficulty in evaluating the degradation process.

Although there is potential for these ecosystems to generate timber-based products and non-timber chemical products of high value (e.g. Saponins from *Quillaja saponaria*; Boldinas of *Peumus boldus*) and conservation services that allow for sustainable management, conservation of these forests occurs on a small scale due to the current state of forest degradation and the small amount of public and private investment for the recovery of these resources, which are the last natural barriers against desertification (Honeyman *et al*, 2009).

In the South zone, the temperate humid climate gives way to forests dominated by deciduous species of the genus *Nothofagus* where the forest types Roble-Hualo (*Lophozonia Glauca*) and Roble-Rauli-Cohiue (*Lophozonia Alpina*) trees dominate the landscape and create complex ecotone transitions.

Most of these types of forests are in a state of removal. They are secondary forests generated subsequent to the process of overexploitation, forest fires, or reforestation of the lands abandoned by agriculture. Additionally, in the 1980s, many of these forests were lands that were converted into forest plantation (substitution) mostly in the regions of Maule and Biobío (Donoso *et al*, 2014).

Forests dominated by *Nothofagus* are dense forests, reaching great heights (more than 40 meters) with canopy coverage of over 100%. Most of these forests are coeval forests (meaning of the same age) and tend to form pure forests or forests with few dominant species, therefore, their management is simpler. These characteristics are largely due to the formal management of

forestry activities that are mostly conducted on these regrowth forest. Additionally, the forests' commercial use is marginal compared to the industry of introduced species of rapid growth.

The areas of high altitude in the forests of the South zone are dominated by the Lenga forest type. Forests of these deciduous species also belong to the genus *Nothofagus*, these grow in a shrub-like manner, an adaptation to the complex environmental conditions. At higher altitudes the Lenga shrinks and is dominant in the Austral zone until it reaches sea level (Donoso, 2015).

In the South Zone the forest areas are dominated by conifer trees, such as the *Araucaria Araucana* (Araucaria), the *Fitzroya cupressoides* (Alerce), and *Pilgerodendron uviferum* (Guaitecas Cypress), species that give origin to three forest types of similar names. The Araucaria forests, like the Alerce, are currently protected by law, due to their critical conservation condition that arose after decades of overexploitation, caused by the high wood quality and durability (Donoso, 2015). They are included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

Continuing towards the south the *Siempreverde* forest type appears, one of the two most important forest types in the area, which is dominated by perennial species of different genera and families. These make up forests such as the Valdivian Rainforest or Cold Rainforest due to its high biodiversity and stratification. These are big forests with thick density and coverage, accumulating high levels of biomass per hectare.

These forests are extensive, complex and of large variety, reasons for which five subtypes are identified: the forests on Ñadís soil, forests of Olivillo (*Aextoxicon punctatum*), the evergreen forests with intolerant emergents, evergreen forests with tolerants emergents, and the regrowths of Canelo, all of these cover a large area of the regions Los Lagos and Aysén, especially in the coastal zone of channels and archipelagos (Donoso, 2015).

The S*iempreverde* forests also experience anthropogenic alterations caused by overexploitation, forest fires, overgrazing and land use changes. On a smaller scale, conversion of forest lands to planted forests and the adaptation of the lands for agriculture and livestock also occur in these forest.

	Forest Type (ha)												
Region	**Alerce**	**Ciprés de las Guaitecas**	**Araucaria**	**Ciprés de la Cordillera**	**Lenga**	**Coihue de Magallanes**	**Roble-Hualo**	**Roble-Raulí-Coihue**	**Coihue-Raulí-Tepa**	**Sclerophyll**	**Siempreverde**	**Palma Chilena**	**Not classified***
Arica y Parinacota	-	-	-	-	-	-	-	-	-	-	-	-	47,151
Tarapacá	-	-	-	-	-	-	-	-	-	7,300	-	-	-
Antofagasta	-	-	-	-	-	-	-	-	-	-	-	-	-
Atacama	-	-	-	-	-	-	-	-	-	-	-	-	-
Coquimbo	-	-	-	-	-	-	-	-	-	31,096	170	-	-
Valparaíso	-	-	-	49	-	-	1,224	-	-	475,194		7,648	-
Metropolitana	-	-	-	76	-	-	10,348	-	-	350,437	-	3,094	-
O'Higgins	-	-	-	2,901	-	-	33,187	-	-	418,878	-	4,343	-
Maule	-	-	-	8,893	8.692	-	161,973	153,432	-	50,977	747	-	-
Biobío	-	-	39,918	18,233	136,472	-	13,724	480,840	47,875	19,205	12,285	-	-
La Araucanía	-	-	199,460	13,560	108,655	-	-	470,860	120,421	636	50,562	-	-
Los Ríos	7,770	83	13,961	-	143,023	4,337	-	252,801	280,321	203	206,032	-	-
Los Lagos	208,360	43,088	-	19,163	509.898	126,502	-	244,655	393,084	499	1,282,188	-	-
Aysén	-	159,334	-	-	1,400,376	939,166	-	-	-	-	1,899,869	-	-
Magallanes y La Antártida	-	377,462	-	-	1,314,089	929,346	-	-	-	-	50,697	-	-
TOTAL	**216,130**	**579,966**	**253,339**	**62,875**	**3,621,204**	**1,999,351**	**220,456**	**1,602,588**	**841,701**	**1,354,426**	**3,502,550**	**15,085**	**47.151**

Table 4. Regional distribution of the types of forest. Source: CONAF.

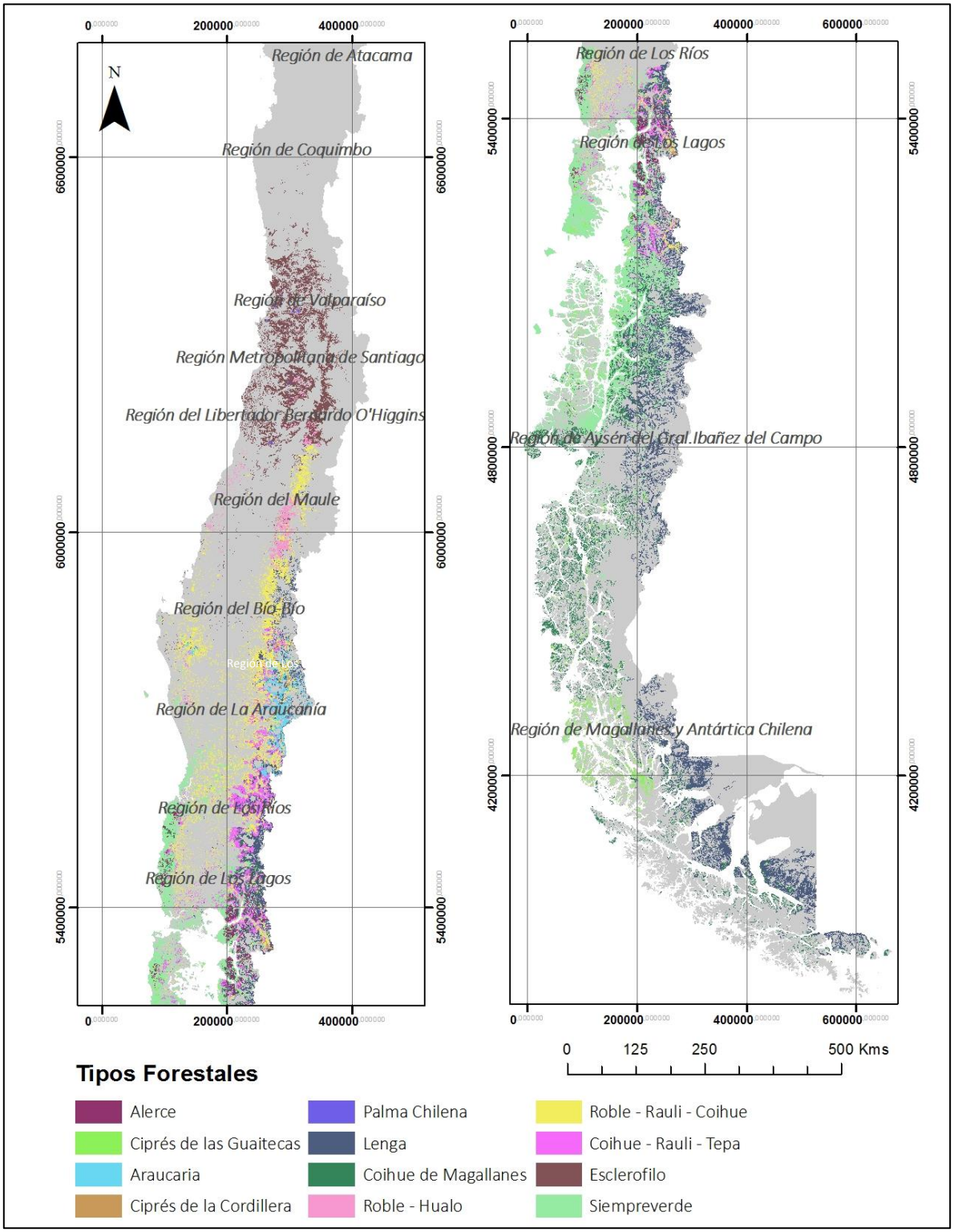

Figure 2. Map of forest type distributions. Source: Prepared by authors

Despite the Siempreverde forests complexity, these forests are also managed for the harvest of wood products, primarily firewood and non-timber. A frequent practice is also the selective extraction of individual trees of higher quality and bigger dimensions (described at the national level as *Floreo*) destined for the timber production industry. As with the previously mentioned types, the informality of these activities is a significant issue for the sustainable management and conservation of the resources (Donoso *et al*, 2014).

Lastly, in the Austral Zone the predominant forest types are Lenga (*Nothofagus pumilio*) and Cohiue de Magallanes (*Nothofagus betuloides*), with these species forming either pure or mixed forests. These forests can cover large areas of land and have high canopy coverage, however they have less biodiversity than other types of forests that are present in the temperate and Mediterranean zones. Forests in the Austral Zone cover a large expanse of territory where the anthropogenic effects are significantly less, due to low population density. However, forest fires that have affected the area in the past century have devastated a large portion of these forests and caused transformation into cattle farms (Donoso, 2015).

The management of these forests, particularly those dominated by Lenga, produces the largest amount of native sawn timber for exportation, highly valued products in foreign markets for the aesthetic and structural characteristics of the wood[18].

In conclusion, although Chile possesses an extensive and diverse national forest resources, its current use does not present a significant contribution to the Gross Domestic Product (GDP) (representing only 3% of the national forestry exportation sales for the country). Additionally, due to the informal nature of control and management, there is no accurate calculation of the use and exploitation of the resources. However, unofficial data suggest that the scope of use could be over 80%. Currently the providers of environmental services provide biomass for fuelwood, besides acting as a refuge for cattle. These last two services and fires have caused degradation on a significant surface area.

Due to the decades-long extensive mismanaged use of these forests, a significant portion of the ecological and economic value of these forests has been lost, diminishing the capacity of the forests to provide goods and services such as the capture and storage of carbon. This generates a substantial loss of natural capital and significant GHG emissions. This phenomenon has also encouraged the abandonment of the forests, deforestation and permanent land-use change to other private and higher production value uses, increasing emissions levels due to misuse of the resources (Donoso *et al*, 2014).

[18] www.infor.cl

ii. National System of Protected Wild Areas (SNASPE)

SNASPE possesses under its administration an area of 14.5 million hectares, a large amount by international standards, within which exists a representation of the native forests that are in an official state of conservation and preservation of lands such as wetlands, salt pans, and other zones of non-forest lands. (Parks and National Reserves) (Table 5 and Figure 4).

Region	Number of SNASPE areas	Area (ha)
Arica and Parinacota	5	366,073
Tarapacá	3	384,011
Antofagasta	11	355,355
Atacama	3	143,555
Coquimbo	4	14,286
Valparaíso	5	21,913
Metropolitana	3	22,065
O´Higgins	1	38,299
Maule	9	17,532
Biobío	7	127,121
Araucanía	13	277,326
Los Ríos	2	32,161
Los Lagos	11	869,178
Aysén	21	5,070,583
Magallanes	10	6,921,275
Total	***108***	***14,660,732***

Table 5. Regional distribution of SNASPE. Source: CONAF.

There has also been an increase of Private Protected Areas (APP in Spanish) which are created for different purposes ranging from altruism to ecotourism development.

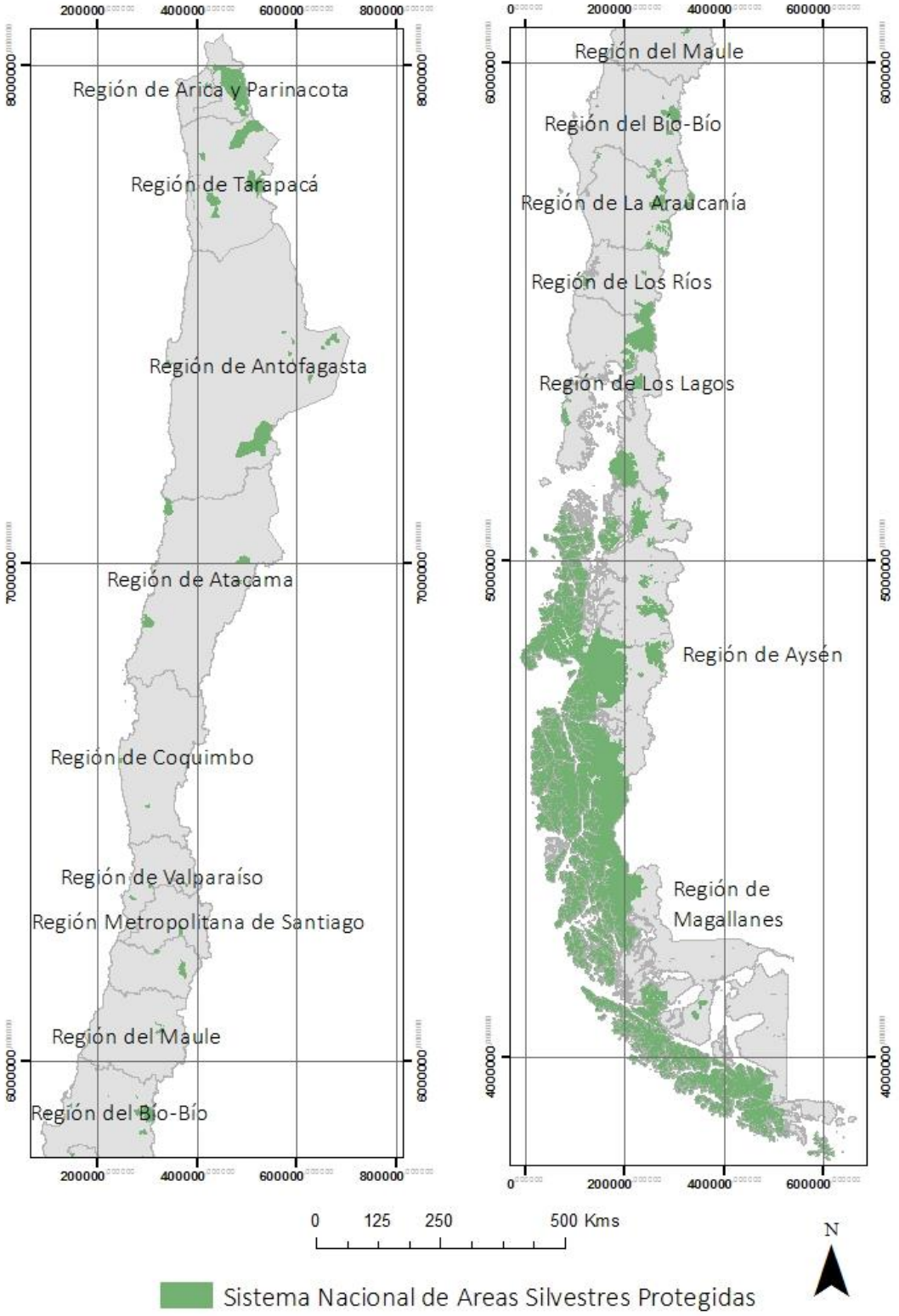

Figure 3. Map of SNASPE distribution. Source: Prepared by the authors

iii. Forest Plantations

In Chile, forest monocultures cover an area of 3 million hectares and they are predominantly located in the Central zone, mainly on the coastal mountain range and at the base of the Andes of Maule, Biobío, and Araucanía regions. This area hosts 80% of the planted forests (Table 6).

The two main species that make up the majority of planted forests are *Pinus radiata* and *Eucalyptus globules,* 60% and 23% of them occupy the plantation surface areas respectively. Both species are used in the industry of cellulose pulp production, sawmill, plywood and structural boards. All of these are the main exporting products of the national forestry sector, which represents the second strongest exporting power in the country following the copper industry[19].

There are productive plantations of other coniferous or eucalyptus trees in the Southern zone which jointly add up to 10% of the national surface area.

In the semi-arid zone, through a state effort spanning 10 years, 60,000 million hectares of forest plantations have been planted with shrubs from the genus *Atriplex*. The objective of these plantations was to recover the degraded lands and to deliver forage for the livestock of the region.

Compensatory and experimental plantations also exist in Chile, but these are not officially included in the Cadastre and their current proportions and aspects are unknown.

The current productive plantations are a result of policies enacted 40 years ago that encourage establishing forest plantations. This enabled the development of important industries, which as previously mentioned, make a significant contribution to national exportations[20].

	Arica and Parinacota	Tarapacá	Antofagasta	Atacama	Coquimbo	Valparaíso	Metropolitana	O´Higgins
Area (ha)	-	26,974.9	3,411.2	-	2,936.8	68,757.9	9,181.0	130,536.4
Percentage	0.0%	0.9%	0.1%	0.0%	0.1%	2.3%	0.3%	4.3%

	Maule	Biobío	Araucanía	Los Ríos	Los Lagos	Aisén	Magallanes	Chile
Area (ha)	597,117.4	1,227,788.6	632,289.0	208,775.2	96,598.8	32,017.3	22.8	**3,036,407.3**
Percentage	19.7%	40.4%	20.8%	6.9%	3.2%	1.1%	0.0%	**100.0%**

Table 6. Regional distribution of forest plantations. Source: CONAF.

[19] www.infor.cl
[20] www.conaf.cl

3. Definition of Forest and REDD+ Concepts[21]

a. Definition of Forest

Law 20.283[22], enacted in 2008 defines **Forest** as a: *"a place populated with plant formations in which trees predominate and which cover a surface area of at least 5,000 square meters, with a minimum width of 40 meters, with arboreal canopy cover that surpasses 10% of the surface area in arid and semi-arid conditions and 25% in more favorable conditions."* [23]

The same Law 20.283 states the following definition for **Native Forest**: *"forest composed of indigenous species deriving from natural production, natural reproduction, or planted under the same canopy with the same species in the area of original distribution, which can exhibit the presence of randomly distributed introduced species."*[24]

This law, as well as the DL 701, of 1974 and its updates, does not stipulate a definition for Planted Forests. Nonetheless, based on international categories, it is important to analyze the definition provided by the FAO (2015)[25], which defines **Planted Forest as:** *"Forest predominantly composed of trees established through planting and/or deliberate seeding. Explanatory notes: 1) In this context, predominantly means that the planted/seeded trees are expected to constitute more than 50 percent of the growing stock at maturity; 2) Includes coppice from trees that were originally planted or seeded; 3) Includes rubberwood, cork oak and Christmas tree plantations; 4) Excludes self-sown trees of introduced species."*

In the same document **Planted forest of introduced species** is defined as *"Planted forest, where the planted/seeded trees are predominantly of introduced species. Explanatory note: 1)In this*

[21] The definition for Forest and REDD+ activities was determined by means of an initiative between CONAF and panel of national and international experts who commented continuously through the original proposal and all succeeding versions. Definitions were submitted for revision in the "Segundo Taller Internacional para la elaboración de Niveles de Referencia de Carbono Forestal – Niveles de Referencia Forestal y Análisis de MRV, contexto Chileno" (Second International Workshop for the elaboration of Reference Levels for Carbon Stock and Analysis of MRV in the Chilean context) where the final modification and definitions were agreed upon. UCCSA members, and the Department of Forest Ecosystem Monitoring of CONAF, INFOR investigators, academics from Universidad Austral de Chile and Universidad Mayor, experts from the World Bank and Winrock International and the team from the National Forest Commission (CONAFOR) of México (who had already completed their respective FREL/FRL levels for UNFCCC in 2015) were members of the second workshop.

[22] http://www.conaf.cl/cms/editorweb/transparencia/potestades/Ley-20283_bn.pdf

[23] Original definition of forests in Ley 20.283: "*sitio poblado con formaciones vegetales en las que predominan árboles y que ocupa una superficie de por lo menos 5.000 metros cuadrados, con un ancho mínimo de 40 metros, con cobertura de copa arbórea que supere el 10% de dicha superficie total en condiciones áridas y semiáridas y el 25% en circunstancias más favorables*".

[24] Original definition of Nativs Forests in Ley 20.283: *"bosque formado por especies autóctonas, provenientes de generación natural, regeneración natural, o plantación bajo dosel con las mismas especies existentes en el área de distribución original, que pueden tener presencia accidental de especies exóticas distribuidas al azar*".

[25] www.fao.org/docrep/017/ap862e/ap862e00.pdf

context, predominantly means that the planted/seeded trees of introduced species are expected to constitute more than 50 percent of the growing stock at maturity."

The combination of the previously stated definitions represent the current national reality, including planted forests and planted forests with introduced species, which are classified in Forest Plantations according to the nomenclature of the Cadastre and Evaluation of the Native Vegetation Resources of Chile), referred to as Cadastre for this document.

Currently, practically all of the planted forests in Chile are industrial, single-species and composed of introduced species, with significantly less planted forests composed of native species[26]. Of the few native species planted forests is the planted forest of the native species *tamarugo*, found the regions of Tarapacá and Antofagasta[27].

Therefore for practical reasons, based on the available data to date (historical reference period), all planted forests registered up to the last update of the Cadastre will be considered as a uniform group, since single-species planted forests of introduced species intended for wood production make up the majority of planted forests in the country.

Nonetheless, the intent for stratification of plantations with the purpose of identifying conclusively in upcoming milestones of monitoring, planted forest of native species and those with objective and processes oriented towards the mitigation and adaptation to climate change, fight against desertification and conservation of the biological diversity with the objective to quantify their contributions in the capture of carbon with their respective intentions for future interventions, based on the potential strategic options of the ENCCRV. These objective can include the establishment and significant increase of surface area and the number planted forests, even more so when the goals set by Chile in its Intended Nationally Determined Contributions (INDC) refer to a forestation of 100,000 hectares which are to be primarily planted with national species, according for which it was validated when submitted to public inquiry and for which it receive approval from the *Consejo de Ministros para la Sustentabilidad y el Cambio Climático* (Council of Ministers for Sustainability and Climate Change)(CMSCC).

For the context of REDD+, which dictates the FREL/FRL for Native Forests in Chile, a forest will be considered as all lands that are defined as Native Forest under the current Chilean legislation.

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[26] According to the INFOR Continuous Inventory Report (2014) forests plantations covered, in 2013, 2.447.591 hectares. 60.772 hectares, 2,5%, correspond to Atriplex, mainly the exotic species *Atriplex nummularia*, which despite being a forage bush, it was subsidizes as tree planting and are located entirely in the Region of Coquimbo; 2.319.799 hectares, 94.7%, correspond to *Pinus ponderosa*, *Pinus radiata, Eucaliptus globulus, Eucaliptus nitens* y *Psedotsuga menziesii*, all exotic species. The remaining 2,7% corresponds to other species, including both exotic and native. Fuente: INFOR.
http://mapaforestal.infor.cl/phocadownload/Informe_Inventario_Continuo_2014.pdf

[27] It is noteworthy report that INFOR Continuous Inventory no does not collect data form the regions located at the north of Coquimbo, and, because of methodological difference and timing of the information there is a gap between this data and Cadatre This information comes from the Monitoring and Updating of Cadastre 2015 of the Region of Antofagasta. Fuente: CONAF.

Observations:

1. From an operational point of view, all lands that are defined as Native Forest r Mixed Forest by the Cadastre will be considered forests.

2. In order to create a uniform definition, lands that are defined by the Cadastre as arborescent shrublands for the Updates of the Cadastre for the Mediterranean Eco-region (Region of Valparaíso, Metropolitana and Libertador Bernardo O´Higgins) prior to 2013, and the Updates of the Cadastre of Ecoregions located towards the south prior to 2015[28].

3. Given the environment aims that the ENCCRV hopes to promote, the reference level of CO2 flux due to lands that the Cadastre considered Plantation Use, which are associated with planted forests of introduced species for industrial harvested-wood purposes.

4. So as to follow the concept of completeness the CO2 flux in planted forests will continue to be reported on by the INGEI.

5. New planted forests will be included into the calculation if the future, so long as they are planted forests that are destined for permanent cover and are consistent with the goals set by the INDC.

The definition applied to the FREL/FRL for native forest in Chile is different to the definition applied to the INGEI for Forestry Territories, in which both native forest and planted forests are included. This was done in order to comply with the safeguards set for the REDD+ agreed on in the CoP-16, Cancun[29], Appendix 1 sub clauses 2.e[30] and 2.a[31]. As a result it is becomes imperative to follow the objectives of the ENCCRV, which aims to encourage the recovery and protection of the native forest and xerophyte plants, as well as advance the establishment of vegetation formations in viable lands planted as measures of mitigation and adaptation to the effects of climate change and against desertification. The previously mentioned goals are to be achieved through the design and implementation of a state mechanism that will facilitate access to communities and landowners of forest lands, xerophyte plants, and viable lands for planting, to the benefits associated to the environmental services of these ecosystems, additionally satisfying the international commitments that Chile has made in the matter of climate change and against desertification.

[28] As of 2015, the updates to the Cadastre conider native forests to be area that in previous updates were considered arborescent shrubland. In the regions of Valparaíso, Metropolitana and Libertador Bernardo O´Higgins, this change has been included in the updates since 2013.

[29] http://unfccc.int/resource/docs/2010/cop16/spa/07a01s.pdf

[30] *"La compatibilidad de las medidas con la conservación de los bosques naturales y la diversidad biológica, velando por que las que se indican en el párrafo 70 de la presente decisión no se utilicen para la conversión de bosques naturales, sino que sirvan, en cambio, para incentivar la protección y la conservación de esos bosques y los servicios derivados de sus ecosistemas y para potenciar otros beneficios sociales y ambientales."*

[31] "La complementariedad o compatibilidad de las medidas con los objetivos de los programas forestales nacionales y de las convenciones y los acuerdos internacionales sobre la materia"

As such, and as it deviated from the results of the "*Talleres de Formulación y Participación de la* ENCCRV" ("Workshop for Formulation and Participation in the ENCCRV"), there is a generalized approach amongst the different actors of the territory towards the encouragement and promotion to increase the surface areas of native forest through sustainable management, as well as the areas already covered by this resource. Industrial planted forests of introduced species are not encouraged, as these are controlled by businesses for autonomous profitable gains.

b. REDD+ Activities

The FREL/FRL of Chile describes the emissions and removals in the temperate native forests during the reference period due to the activities of deforestation, forest degradation, forest conservation and enhancement of forest carbon stock. These are based on the concepts found in Figure 4.

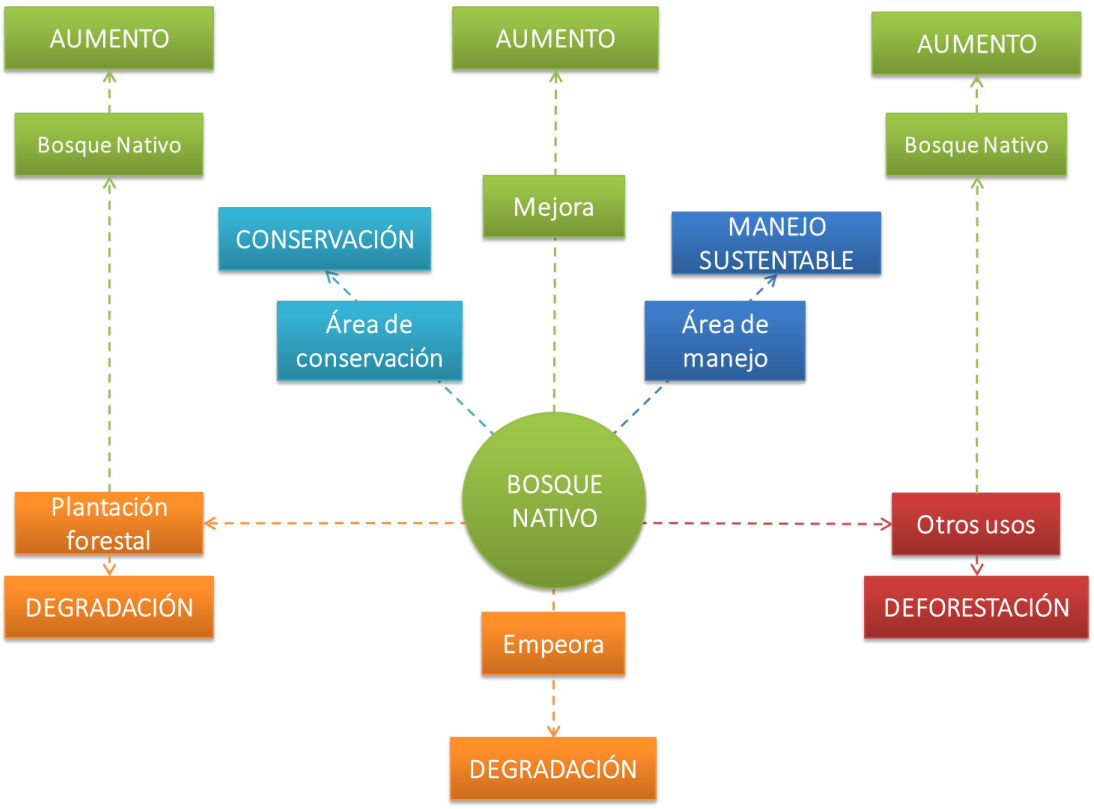


Figure 4. REDD+ activities.

As will be explained further on, the FREL/FRL for sustainable forest management has not been calculated due to the current lack of official data that would enable an accurate calculation of the

area where the activity occurs. Nonetheless, an ad hoc program is being developed in order to be able to include this activity in the future.

i. Deforestation

Conversion of forest lands into non-forest lands permanently or without knowing when or how they will be restored.

Notes:

1. In accordance with the previously provided definition, it will not be considered deforestation when forest lands are converted into plantations. This change will be reported under forest degradation to maintain consistency with INGEI.

2. Based on the criteria for the Cadastre, it will not be considered deforestation when forest lands are converted to arborescent shrublands[32], and will hence be considered forest degradation.

3. It will not be considered deforestation when areas are temporarily stripped of stock and revegetation has been planned, reported, and documented as a natural or assisted regenerative process.

ii. Forest Degradation

All forms of carbon reduction in a forest induced by human activity to such an extensive degree that a halt of all regular forestry activities are required, and an additional investment is needed to maintain the forest's permanence and resilience, but does not provoke a change in land-use.

Notes:

1. The emissions produced by forest lands that remain forest lands subjected to processes of sustainable forest management or conservation will not be considered as part of the FREL/FRL of forest degradation, as these are accounted for in the other defined activities by the UNFCCC for REDD+ according to what has been stipulated in the present document.

2. All conversions of forest lands to forest plantations will be considered forest degradation.

3. All conversions of native forest lands to arborescent shrublands, as defined by the Cadastre, will be considered forest degradation.

[32] As of the 2013 updates to the Cadastre in the Mediterranean Ecoregion and 2015 for the rest of the Ecoregions, the Use of Native Forest will include those places previously classified as Arborescent Shrubland.

iii. Enhancement of forest carbon stock

Enhancement of forest carbon stocks in areas subject to land-use change from non-forest lands to forest lands, and the increase of forest carbon stocks in forest lands that remain forest lands.

Notes:

1. Increases in forest carbon stock in forest lands that remain forest lands that are subjected to official processes of sustainable management or conservation, will not be considered enhancement of forest carbon stocks, since such increases are considered in the other REDD+ activities as per the information stated in this document.

2. Increases produced in areas converted from forest lands to forest plantations will not be considered enhancement of forest carbon stocks since these are considered degradation activities (as has been previously stated).

3. All changes from a forest plantation to a native forest will be considered as enhancement of forest carbon stocks, regardless if carbon content is temporarily or permanently low. This is due to a holistic view where a native forest improves the services of the ecosystem in comparison to forest plantations. Additionally, the emissions caused by the substitution of the plantations are not considered as recognitions for the non-carbon related benefits of native forests which form an integral part of the ENCCRV. It is assumed that the substitution of plantations for forests occurs in the moment of the productive cycle closest to the next planned harvest.

iv. Sustainable Forest Management

Changes in carbon stock in areas of forest lands that have been subject to official sustainable management process.

Notes:

1. Sustainable forest management methods are activities that are conducted under the following mechanisms:

    a. Forest Management Plan of Native forests (Plan de Manejo Forestal de Bosque Nativo)(including plans structured for specific forest types),

    b. Management Plan of Native Forests Management (Plan de Manejo de Ordenación de Bosque Nativo),

    c. Forest Management Plan for Small Areas (Plan de Manejo Forestal para Pequeñas Superficies),

2. In the future, institutional mechanisms will need to be developed and legally stipulated as tools for sustainable forest management, specifically those developed by the Strategies for Native Forest Sustainability[33], the ENCCRV and other institutions that may arise.

3. Included in the planning mechanisms considered to be methods for sustainable management are the mechanisms directed at Forest Restoration.

It is currently not possible to locate and delineate areas of forest that are subject to forest management processes stipulated in Clause 1 through official maps of the country. The ENCCRV is looking to develop tools and capabilities that will enable the location and delineation of these areas for the identification and monitoring of present and future forest observations. In the meantime the stock variation through management actions have been included in the reference levels for degradation and enhancement of forest carbon stocks. Once the necessary area data is processed, the reference level for sustainable forest management will be presented.

v. Conservation

Stock changes in native forest areas subjected to official conservation methods.

Notes:

1. For practical applications and given the available information regarding native forests that are subjected to conservation methods are considered those which have the presence of species under conservation (Chilean Palm, Alerce, and Araucaria), as well as the forest areas that are part of SNASPE and lands registered as Protected Areas of Private Property of Forest Conservation characteristics (APP in Spanish).

2. The possibility will be considered of including, in the future, areas and lands that are officially labeled as native forests subject to conservation methods through the declaration of native forest for preservation and application of management plans for preservation and/or other measures present or legally designed in the future.

vi. Conclusion

Figure 5 explains the different possibilities of forest changes that determine the REDD+ activities according to the previously explained definitions.

It should be noted that improvements and deterioration of the initial condition of the forests will be measured using remote sensing techniques combined with the information provided by INFOR and backed by the Cadastre. Due to this condition, the structure for activities regarding

[33] La Estrategia de Sustentabilidad del Bosque Nativo, en desarrollo por CONAF bajo mandato del Director Ejecutivo pretende la generación de nuevas herramientas que fomenten el manejo sostenible del Bosque Nativo

degradation and enhancement of forest carbon stocks for all forest lands that remain forest lands cannot be described in the figure depiction bellow.

It is also important to note that conservation and sustainable forest management activities (the latter depending on the availability of information) will be measuring carbon net-emissions and removals in the historical period used in the study. These changes will be calculated using the same method that will enable the identification of the improvement or deterioration of the initial condition of the native forests.

For this FREL/FRL it is not possible to apply the same methodology to calculate variations in arborescent shrubland as these lands are not identified as a forest type, which is necessary for the application of algorithmic equations. Furthermore, there are no plots of arborescent shrubland in INFOR's Continuous Inventory to determine the effects of degradation and enhancement on this land use.

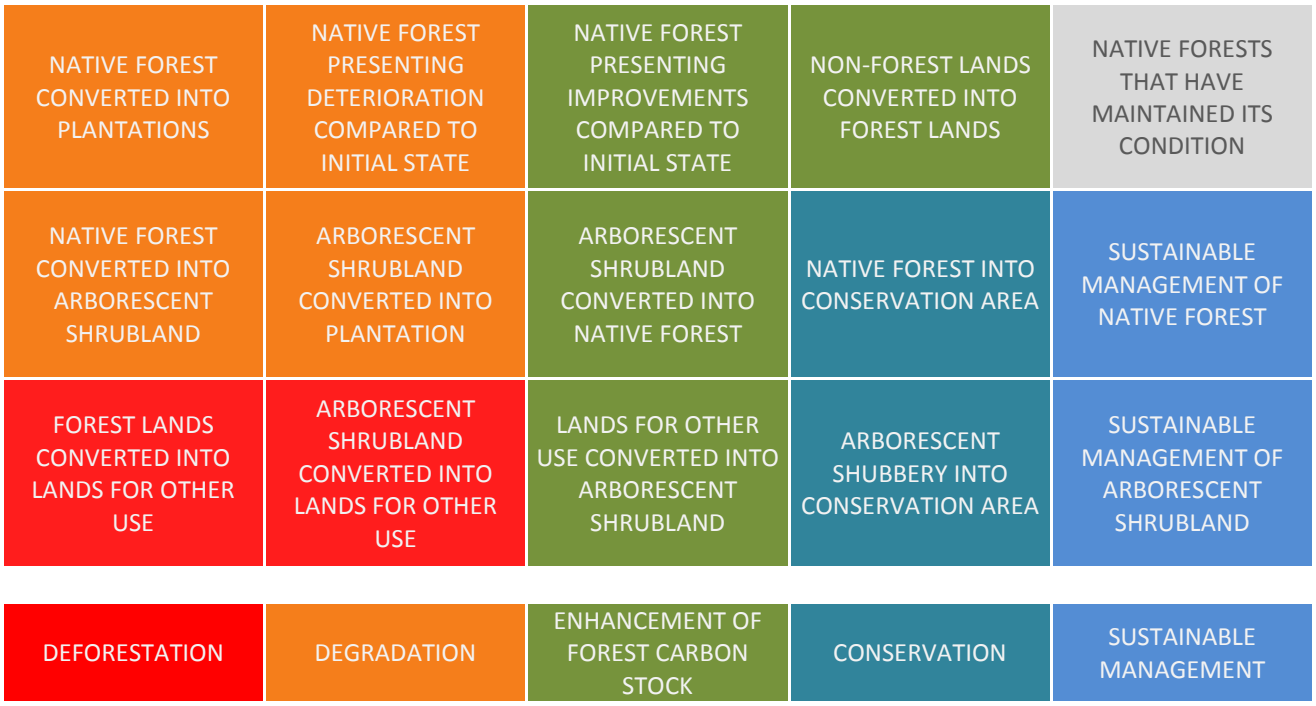


Figure 5. Descriptive graph of REDD+ activities

4. Subnational FREL/FRL and INGEI Correlation

The FRL/FRL of native forests in Chile presented in this document maintains a high level of congruency with Chile's INGEI. However, it is important to be aware of the intrinsic differences between a reference level and a GHG inventory.

It should be noted that the institution responsible for the AFOLU sector for Chile's INGEI is the Ministry of Agriculture and that those responsible for the calculation for the LULUCF sector are CONAF and INFOR. Both of these institutions had responsibilities in the development of the FREL/FRL for the Chilean native forests. The variations from the INGEI presented in the FREL/FRL are due to improvements in the availability of data and the use of more accurate methodologies, which will be included in the biennial update reports of the INGEI in 2018[34].

The following section will present the similarities and differences between INGEI and FREL/FRL. It is important to note that the activities degradation and a portion of the enhancements of forest carbon stocks would fall under the category of emissions and removals produced by forest lands that remain forest lands in INGEI. Deforestation and the remaining portion of the enhancements of forest carbon stocks would be included in the land-use change calculations, forest lands converted to other land uses and other land uses converted forest lands respectively. In the case of conservation of forest carbon stocks, the same criteria and data as the ones used for the previously mentioned activities will be used, and as such will not be included in the following section.

a. Deforestation

For the computation of activity data, the same source of information used by the INGEI, the Cadastre, has been used.

For Emission Factors:

- The same data source used by the INGEI was used to determine carbon stocks in forests before deforestation.
- The carbon stocks after deforestation are considered to be "0" for the FREL since these lands are not considered forest lands. In contrast, the INGEI uses the default values provided by IPCC for these parameters as these are supposed to represent the net-total CO_2 in the country.

[34] Debido a la complejidad de las metodologías y la poca disponibilidad de tiempo las mejoras integradas en el NREF/NRF del bosque nativo de Chile no han podido ser integradas en el Informe Bienal de Actualización 2016 del INGEI de Chile, cuya elaboración técnica ha sido elaborada durante el año 2015.

- For changes in carbon stocks aside from the actual deforestation event, the INGEI and FREL/FRL consider the losses caused by the harvested wood products, extraction of firewood, and disturbances considered to be zero (0) in areas of deforestation.

b. Forest Degradation

To calculate forest degradation, the INGEI uses a gain-loss method based on Equation 2.7 of the IPCC (2006), while the FREL/FRL uses a stock-difference method based on Equation 2.8 of the IPCC (2006).

The data used by the INGEI are tables created by INFOR of log harvests, statistics by INFOR and MINENERGIA for firewood, and tables on the surface area of fires in native forests and forest plantations created by CONAF for disturbances.

Data regarding the extraction of firewood is difficult to gather, due to the irregularities of the extraction complicating the precision and validity of the gathered information. As a result, the methodology for calculating the reference level for degradation was different, as described in the Annex: Methodological Protocols.

This methodology does not calculate the three sub-activities separately; rather it calculates the carbon stock for two different points in time.

To calculate non-CO_2 GHGs produced by combustion due to forest fires, the same method of calculation used by INGEI Chile.

c. Enhancement of forest carbon stocks

For stock enhancements due to the growth of forests, the INGEI used Equation 2.9 of IPCC 2006 for calculation of Tiers 2-3. However, the INGEI only uses this methodology for lands converted to forest lands during the year of conversion. After this stage, the areas fall under the category of lands in transition where their stock enhancement is calculated.

In the FRL for enhancements of forest carbon stocks, removals in lands that were converted into forest lands during the reference period are included in calculations for this same activity throughout the entire reference period.

For example, an area that was converted into forest lands on the first year of the reference period continues to remove carbon during the second, third, and following years of the reference period. The removals in the second year in lands that were sown/restored the previous year are calculated in the second year along with the enhancements of areas that were sown/restored in the second year. In this manner, the enhancements continue to accumulate and continue to be calculated as enhancements of forest carbon stocks activity.

In the INGEI, the activity data for the enhancement of forest carbon stocks due to non-forest lands converted into forest lands and forest lands that remain forest lands come from the Cadastre, which is also used for calculation of the FRL for enhancement of forest carbon stocks.

The values for the net annual average growth, used as removal factors, are the same as the ones used by INGEI, based on INFOR data. There are values for the following forest types: Alerce, Ciprés de las Guaitecas, Araucaria, Ciprés de la Cordillera (Chilean cedar), Lenga, Coihue de Magallanes (Magellan's Beech), Roble Hualo, Roble-Rauli-Coihue, Coihue-Raulí-Tepa (laureliopsis), Esclerofilo (Sclerophyll), and Siempreverde (Evergreen).

The same values are used by both the INGEI and the FRL to convert net annual growth (including bark) into aboveground biomass growth for a forest type. In addition, the biomass expansion factors and the value of basic wood density used in FRL calculation come from the INGEI.

5. Information Sources

a. National GHG Inventory of Chile

In order to comply with Chile's commitment to report on GHGs, in 2012 the Office for Climate Change of the MMA (OCC) designed, implemented and coordinates the National System of Inventories of GHGs (INGEI) of Chile. This Office administrates the institutional, judicial, and procedural measures established for the biennial updates of the INGEI. In this manner it guarantees the sustainability of the GHG inventory preparation for the country in relation to the changes in known GHGs and the quality of the results.

The structure of SNICHILE (Figure 1) consists of a decentralized organization where the INGEI is the result of the collective efforts of different public services offices that comprise the national team of GHG inventories, including the Ministry of Agriculture, Energy, and the Environment. Additionally with the cooperation of national and international experts that offer their expertise in the topics related to the INGEI.

Chile's INGEI is part of the first Biennial Update Report of Chile [35] and the first National Inventory of GHG report [36] presented before the UNFCCC on December 10, 2014 and February 5, 2015 respectively.

Chile's INGEI was produced following the Guidelines of the IPCC 2006 for GHG inventories[37]. All of the national territory was included (continental, insular and Antarctic territories); it also included CO_2, CH_4, and N2O, HFC and PFC emissions and CO_2 removals in the reference period from 1990 to 2010.

Chile's INGEI, produced during 2013 and 2014, is the result of the compilation of GHG inventories generated from the following sectors: Energy, Industrial Processes, the Use of Dissolvent and Other Products, Agriculture, Land Use Land Use Change and Forestry (LULUCF) and residues (Figure 1).

The LULUCF was provided by MINAGRI, through which Office for agriculture studies and politics (ODEPA) coordinated with CONAF regarding the changes of land use, and information regarding forest lands was provided by INFOR. Primary data comes from Monitoring Systems of Changes in Land use and Vegetation and the Continuous Forest Inventory. For the most part emissions and

[35] http://www.snichile.cl/sites/default/files/documentos/2014_1iba_chile_espanol.pdf
[36] http://www.snichile.cl/sites/default/files/documentos/2014_iin_cl.pdf
[37] http://www.ipcc-nggip.iges.or.jp/public/2006gl/spanish/index.html

removals were calculated using country-specific emission factors, whereas for the other land uses the emission factors used were default factors from the IPCC Guidelines. The results are separated into regions in order to accurately represent the different environmental conditions in the country.

The activity data and the emissions factors used in Chile's INGEI can be downloaded from the Chile INGEI database[38].

The LULUCF is the only body that reports CO_2 removals in the country. In 2010 the GHG balance calculated removals of -49,877.4 $GgCO_2e$. Throughout the reference period the GHG flux has been favorable for GHG removals, even though it has declined in 1.9% since 1990 (Figure 6).

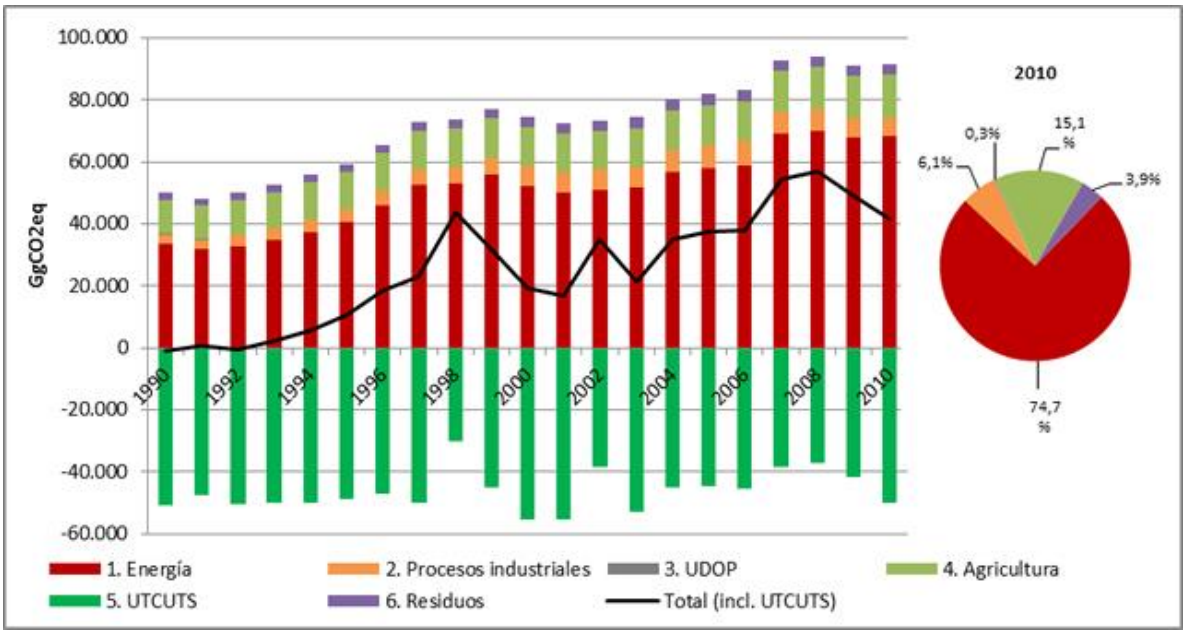


Figure 6. Chile INGEI: emission and removal tendencies of GHG by sector, 1990-2010. Source: SNICHILE.

[38] http://www.snichile.cl/documento/base-datos-ingei-chile

b. Monitoring System of changes in land use and vegetation based on the Cadastre of the Native Forest

The Cadastre and Evaluation of Vegetation Resources in Chile, henceforth referred to as the Cadastre, was enacted in 1993. The Cadastre's main objective was the elaboration of a National Cadastre of the use of lands and vegetation groupings, especially those related to the native forest, forest plantations and grasslands, constituting the baseline for vegetation mapping in Chile.

The information provided by the Cadastre is periodically updated by the Forest Ecosystem Monitoring Unit of CONAF through regional projects that have the following objectives:

- **Monitor** the changes and analyze the different process that affect the land and land use with an emphasis on vegetation.
- **Map** and label the forests including the land use associated with forest plantations, other vegetation groupings and the general use of the land (cities, crop lands, bodies of water, snow glaciers, wetlands and deserts).
- **Provide** a database of digitally geo-referenced locations in a system for public use for managing and decision-making.

Article 4 of Law of Recuperation of Native Forest and Forest Promotion (Ley N°20.283) reinforces the Monitoring System establishing that "the corporation (CONAF) will maintain a permanent forest cadastre, through which it will identify and establish, at least cartographically, the types of existing forests in each region of the country, their state and the areas where there is an existence of ecosystems of native forests with interest for conversation or preservation, according to the criteria established in the ruling of this law," and "…that it will be updated every 10 years and its information will be available to the public."

The official publication of the reference period of the Cadastre was in September 1997 with monitoring and updating procedures beginning in 1998 (Table 77). The improvements of technology enabled the changes to the methodology that enabled the correction of errors and defects caused by the instruments used in the first interpretation, specifically the lack of accuracy and precision in the limits of the states.

The methodology used to classify the use of lands and the distinct vegetations is called *Carta de Ocupación de Tierras* (COT) developed by the *Centro de Estudios Fitosociológicos y Ecológicos Louis Emberger* (CEPE of Montpellier) and adapted by Etienne and Prado in 1982.

This methodology describes vegetation through the vegetation grouping's form of life, structure, canopy coverage, height and species. The classified land use corresponds to the anthropogenic or natural land use that is present by at the moment of detection, either my remote sensing or on

site, such as: bodies of water, wetlands, snow, urban areas, crop lands, lands without vegetation. These classifications are objective observations as they do not judge the quality of the land (for example: degraded, wood harvest forests, or protected).

The Cadastre describes 9 uses and 20 sub-uses and within these subuses are other subsections for height, coverage and structure.

The process of monitoring and updating (Table 7) conducted since 1998, has enabled the understanding of the types of changes that have occurred on the different land uses, the direction of these changes and the reasons for these changes.

	Reference Year	First Update	Second Update	Third Update
Arica y Parinacota	1997	2014		
Tarapacá		2015[40]		
Antofagasta		2009[39]		
Atacama		2008[39]		
Coquimbo		2003	2008[39]	2015[40]
Valparaíso		2001	2013	
Metropolitana		2001	2013	
O'Higgins		2001	2005	2013
Maule		1999	2009	2015[40]
Biobío		1998	2008	2015[40]
La Araucanía		2007	2014	
Los Ríos		1998	2006	2014
Los Lagos		1998	2006	2013
Aysén		2010-2011		
Magallanes		2005		

Table 7. Cadastre publication date and update dates by region.

For the definition of the FREL/FRL of native forest, only the Cadastre updates that have been adjusted and rectified using improved technology are used for the regions composing the subnational area selected (Table 8), enabling consistent, complete and detailed information of the changes in land use.

[39] Update developed only in the Biodiversity Conservation Priority Sites.
[40] Update in procces.

The public interface of the Cadastre information according to the Native Forest Law (art. 4), is found in SIT-CONAF[41], through the use of a webmapping consultation of the Cadastre and its process of monitoring and updates. SIT-CONAF has 1400 registered users, and received more than 2000 visits in 2015. The most viewed information was in regards to the surface area and distribution of native Chilean vegetation species.

Region and year Cadastre/Update used		
Maule	1999	2009
Biobío	1998	2008
La Araucanía	2007	2013
Los Ríos	2006	2013
Los Lagos Norte	2006	2013
Los Lagos Sur	1998	2013

Table 8. Dates of Cadastre and/or update of relevant regions, used in the construction of FREL/FRL.

c. Continuous Inventory of Forestry Ecosystems

[41] http://sit.conaf.cl/ En el Anexo: *Protocolo de Acceso a SIT CONAF,* se incluye "Manual de Usuario" y "Manual de otras funcionalidades de la Plataforma".

The Inventario Continuo de Ecosistemas Forestales (Continuous Inventory of Forestry Ecosystems), henceforth referred to as the *Inventario Continuo*, managed by INFOR, has been operational since 2000. The purpose of this inventory is to support decision-making related to international processes and different areas of interest for the present and future.

The *Inventario Continuo* was designed under a statistical bi-stage design in three circular sample plot clusters in an area equivalent to 500m^2 distributed in a systematic area of 5x7km (Figure 7).

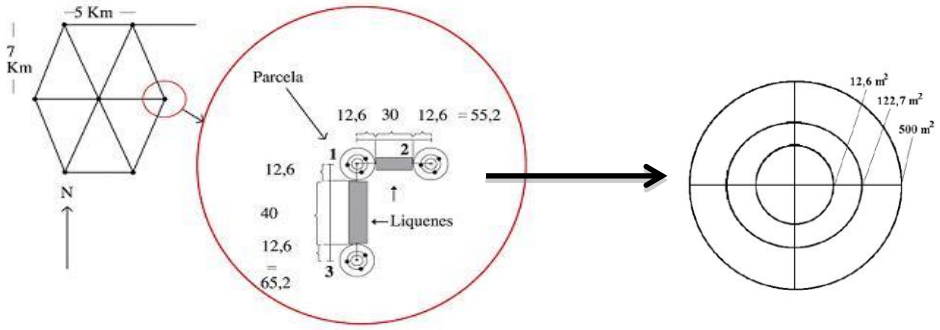


Figure 7. Design of the *Inventario Continuo* sample plots. Source: INFOR.

The *Inventario Continuo* is based on the generation of first cycle measurements of permanent sample plots that cover 9.38 million hectares of native forest between the regions of Coquimbo and Magallanes established for the years 2001 to 2010. The second cycle of measurements is partially-updated annually with the support of growth projections.

The *Inventario Continuo* gathers information for trees that have a diameter at breast height (DBH) equal to or greater than 25cm in the 500m2 plots, DBH equal to or greater than 8cm in 122m^2 plots, and DBH equal to or greater than 4cm in 12.6m^2 plots.

Each tree is registered under species, DBH, bark thickness, canopy diameter, and health state. More detailed information is taken from a subsample of each plot, such as total height, base canopy height, height of the tree stump etc.

For each plot, a 1m^2 subplot is delineated in order to measure all vegetation present: regeneration, firewood residues, dead trees, etc.

For each plot cluster, general descriptions of the observed state of the three plots regarding the degree of anthropogenic interventions, presences of public works, degradation and its evolutionary state are noted.

d. LANDSAT satellite images

The calculation of variations in carbon stock in forest lands that remain forest lands for the Degradation FREL, Forest Carbon Stock Enhancement FRL, and Conservation of carbon stocks FREL was computed by the *Inventario Continuo* and the application of remote sensing data techniques on LANDSAT satellite images.

The LANDSAT observation program has obtained images of land coverage beginning with the LANDSAT 1 in 1972 and most recently the LANDSAT 8. These images are of great public interest particularly dealing with climatic phenomenon, as has been depicted in various publications. The images of the different LANDSAT satellites are available to the public free of charge through different platforms such as Glovis, Earthexplorer (United States Geological Survey) or INPE *(Instituto Nacional de Pesquisas Espaciais).*

The images used for the reference period were obtained from the Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) onboard of the LANDSAT 5 and the LANDSAT 7 respectively. The technical characteristics of each sensor are described in Table 9 and Table 10.

LANDSAT 5 – TM Spectral Bands	Wavelength	Resolution
Band 1 – Blue	0.45 – 0.52 µm	30 m
Band 2 - Green	0.52 – 0.60 µm	30 m
Band 3 - Red	0.63 – 0.69 µm	30 m
Band 4 – Near Infrared	0.76 – 0.90 µm	30 m
Band 5 – Short-wave Infrared	1.55 – 1.75 µm	30 m
Band 6 – Thermal Infrared	10.4 – 12.5 µm	120 m
Band 7 – Short-wave Infrared	2.08 – 2.35 µm	30 m

Table 9. Characteristics of the LANDSAT 5 Thematic Mapper. Source: LCDM Press Kit. NASA.

LANDSAT 7 ETM+ Spectral Bands	Wavelength	Resolution
Band 1 – Blue	0.45 – 0.52 µm	30 m
Band 2 - Green	0.52 – 0.60 µm	30 m
Band 3 – Red	0.63 – 0.69 µm	30 m
Band 4 – Near Infrared	0.76 – 0.90 µm	30 m
Band 5 – Short-wave Infrared	1.55 – 1.75 µm	30 m
Band 6 – Thermal Infrared	10.4 – 12.5 µm	60 m
Band 7 – Short-wave Infrared	2.08 – 2.35 µm	30 m
Band 8 – Panchromatic	0.50 – 0.90 µm	15 m

Table 10. Characteristics of the Landsat7 Enhanced Thematic Mapper Plus. Source: LCDM Press Kit. NASA.

6. Methodology

The Methodological Protocols Annex describes in detail the steps taken to calculate the activity data and the emissions factors that enable the calculation of FREL/FRL of native forests in subnational Chile.

a. Tier levels and Approaches used

The IPCC Guidelines for GHG Inventories present different Approaches and Tier levels to represent the different levels of complexity in the methodology.

The IPCC (2003) provides the following descriptions of approaches to represent the activity data:

- Approach 1: This data only presents net changes in land use in the registered area over time, but it does not provide any explicit information, exact locations, or patterns of change in land use. The changes from one land use category to another are not registered either.
- Approach 2: This data requires national and regional information of losses and gains in the area of specific land use categories and what these changes represent. This includes data on the conversions between categories; however, it does not include data of explicit locations.
- Approach 3: This data requires observations of explicit spatial observation of the land use of and land use changes. This is achieved through the registering of differences in location and using detailed maps like those derived from radar data sources.

The IPCC (2003) also describes the different Tier levels used to describe the complexity of the methods used to calculate emissions:

- Tier 1: Default emission factors, facilitated through the EFDB or alternatively through the IPCC Guidelines. The IPCC suggests that this method should be viable for all countries.
- Tier 2: Use of specific emission factors for the country or other emission factors that are more specific than the default factors.
- Tier 3: the use of higher order methods including models and inventories specifically designed for the countries necessities, repeated over time, and driven by high-resolution activity data and disaggregated into subnational sub scales. If implemented accurately, Tiers 2 and 3 can produce calculation that is more exact than Tier 1.

All activates in the proposed FREL/FRL are derived using information from Approach 3 of the IPCC, meaning geographically-explicit information. A mixture of Tiers 2 and 3 were used, given that Tier 2 was used when the necessary information needed to reach Tier 3 specification was unavailable. For example the calculation of soil carbon stocks for the deforestation activity is not based on specific data from soil samples collected in-situ, so in this sense the emission factor corresponds to Tier 2. Table 1 summarized the Tiers used for reach activity for the FREL/FRL proposal. A brief description of these methods is given in the following sections and more details are included in the: Methodological Protocols Annex.

b. Carbon pools and GHG considered

The different REDD+ activities affect the carbon pools in different manners. While the change of forest lands to crop lands through deforestation causes disturbances and provokes carbon emissions in the soil, forest degradation due to extraction of firewood does not.

In a similar manner, different activities cause emissions that release different GHGs. Nitrous Oxide and Methane are released as a result of combustion due to forest fires, but are not emitted due to timber extraction.

Hence, the FREL/FRL of subnational Chilean native forests is converted into CO_2 emissions derived from aboveground and belowground biomass for all activities; CO_2 emissions for deadwood and litter in the activities of deforestation, degradation and conservation of forest carbon stocks; and the emissions of CO_2 from soil organic carbon for deforestation.

Methane (CH_4) and Nitrous Oxide (N_2O) emissions are only calculated for forest degradation as a source of emission due to forest fires.

Table 11 presents the different carbon stocks and GHG emissions calculated for each REDD+ activities for this subnational FREL/FRL proposal.

REDD+ Activities	Level	Carbon deposits	GHG included
Deforestation	**3** **2** **3** **1**	• **Above-ground Biomass** • **Below-ground Biomass** • **Dead organic material** • **Soil organic carbon**	**CO2**
Degradation	**3** **2** **3**	• **Above-ground Biomass** • **Below-ground Biomass** • **Dead organic material**	**CO2** **CH4** **N2O**
Conservation of Forest Carbon Stocks	**3** **2** **3** **1**	• **Above-ground Biomass** • **Below-ground Biomass** • **Dead organic material** • **Soil organic carbon**	**CO2**
Enhancement of Forest Carbon Stocks	**3** **3**	• **Above-ground Biomass** • **Below-ground Biomass**	**CO2**

Table 11. Levels, CO_2 deposits, and included GHGs for each REDD+ activity included in the subnational FREL/FRL Chilean proposal.

c. Reference Period

The reference period used for Chile's subnational FREL/FRL of native forests is determined by the availability of the necessary information to construct the reference level.

This dependency on available information affects in a spatial level, providing different reference periods for each region, and also in the REDD+ activity level, depending on the different reference periods which are dependent on the information used for the application of the methodological process.

The following is the reference period detailed by activity, region and method:

i. Deforestation

The activity data for Deforestation FREL was calculated using the data provided by the Cadastre. For calculation purposes, the dates that are presented and used for the updates are the image dates rather than the publication dates (Table 12).

Region	Historical Period
Maule	1998-2008
Biobío	1997-2007
Araucanía	2006-2012
Los Ríos	2005-2012
Los Lagos Sur	1997-2012
Los Lagos Norte	2005-2012

Table 12. Historical dates of the Cadastre for deforested areas. The years of the table correspond to image dates, with publication occurring the following year.

The Cadastre conducts updates on a regional level which is why it is not possible to use only one reference period for the FREL/FRL; even though the methodology used is uniform for all regions. With the objective to maintain consistency between the different calculations and taking into consideration the deforestation reported in the FREL consists of average historical projections without adjustments, the reference period for the Deforestation FREL is 1997 to 2012. This period corresponds with the oldest and most recent images available for all regions.

ii. Forest Degradation

For the calculation of Forest Degradation FREL, different methodologies were used for forest lands that remain forest lands and for registered conversions in Cadastre, including native forests that were converted into plantation, and native forests converted into arborescent shrubland (according to the Sub-use of the Cadastre).

Forest lands that remain forest lands

The FREL for forest degradation was calculated following the methodology detailed by Bahamóndez *et* al. (2009), which is based on the data collected from the plots of the *Inventario Continuo* and LANDSAT images.

The measurement period for the *Inventario Continuo*, although scheduled to occur every five years, uses two updates corresponding to the years 2001 and 2010. Consequently the reference period for the degradation of forests that remain forests is 2001-2010.

With the objective of avoiding double-counting of data, the emission of non-CO_2 gases as a product of combustion in forest fires were calculated separately using spreadsheet data from the time series of Chile's INGEI for the time period 2001-2010.

Transformations registered by the Cadastre

To calculate degradation due to conversion of native forest lands into plantations or arborescent shrubland the matrix of land use changes of Cadastre were used. As such, the reference period for each region varies between 1997 and 2012, as previously explained in the Forest Degradation section.

iii. Enhancement of forest carbon stocks

The enhancement of forest carbon stocks FRL used the same data sources and methodologies as those used for the forest degradation FREL.

As such, the reference period for forest lands that remain forest lands is 2001-2010, and those areas subject to transformations in the reference period will vary depending on the region they are located in between 1997 and 2012, as previously explained in the Forest Degradation section.

iv. Conservation of forest carbon stock

For the calculation of conservation of forest carbon stocks FREL/FRL the same methodology was used as for the forest degradation FREL, and enhancement of forest carbon stocks FRL for forest lands that remain forest lands, as such the reference period coincides with the period 2001-2010.

d. Activity Data

As previously explained, the activity data was calculated using the different sources of information available with the objective of applying the methodologies as precisely and completely as possible. The following is a description of the computation methods for the activity data for each of the REDD+ activities for the Chilean subnational FREL/FRL.

i. Deforestation

The area of forest lands converted into other uses (crop lands, grasslands and/or settlements), were calculated using the matrices for land use change computed by the Cadastre (Figure 8). For La Araucanía, the only region with maps for three points in time, only the two most recent maps were used, to maintain with the other regions, but also due to the reduced accuracy and precision of the earliest Cadastre map in the region. The total area of forest lands that were converted into lands for other uses were divided by the span of time between the two land use maps to estimate the annual rate of change.

In Table 13 information regarding deforested surface area is disaggregated by year and region. The deforested areas are represented in Figure 8. It is worth noting that the deforested land for the reference period in the Los Lagos Sur region is 14,164 hectares, of which 10,711 hectares correspond to forest lands that were converted into lands devoid of vegetation and forests lands that were converted into grasslands and shurblands, due to the eruption of the Chaitén volcano in May 2008 and the potential recovery post eruption.

Region	Deforested Area (ha/year -1)
Maule	225
Biobío	775
Araucanía	232
Los Ríos	467
Los Lagos Sur	943
Los Lagos Norte	321
Total	***2,963***

Table 13. Deforested area by year and region.

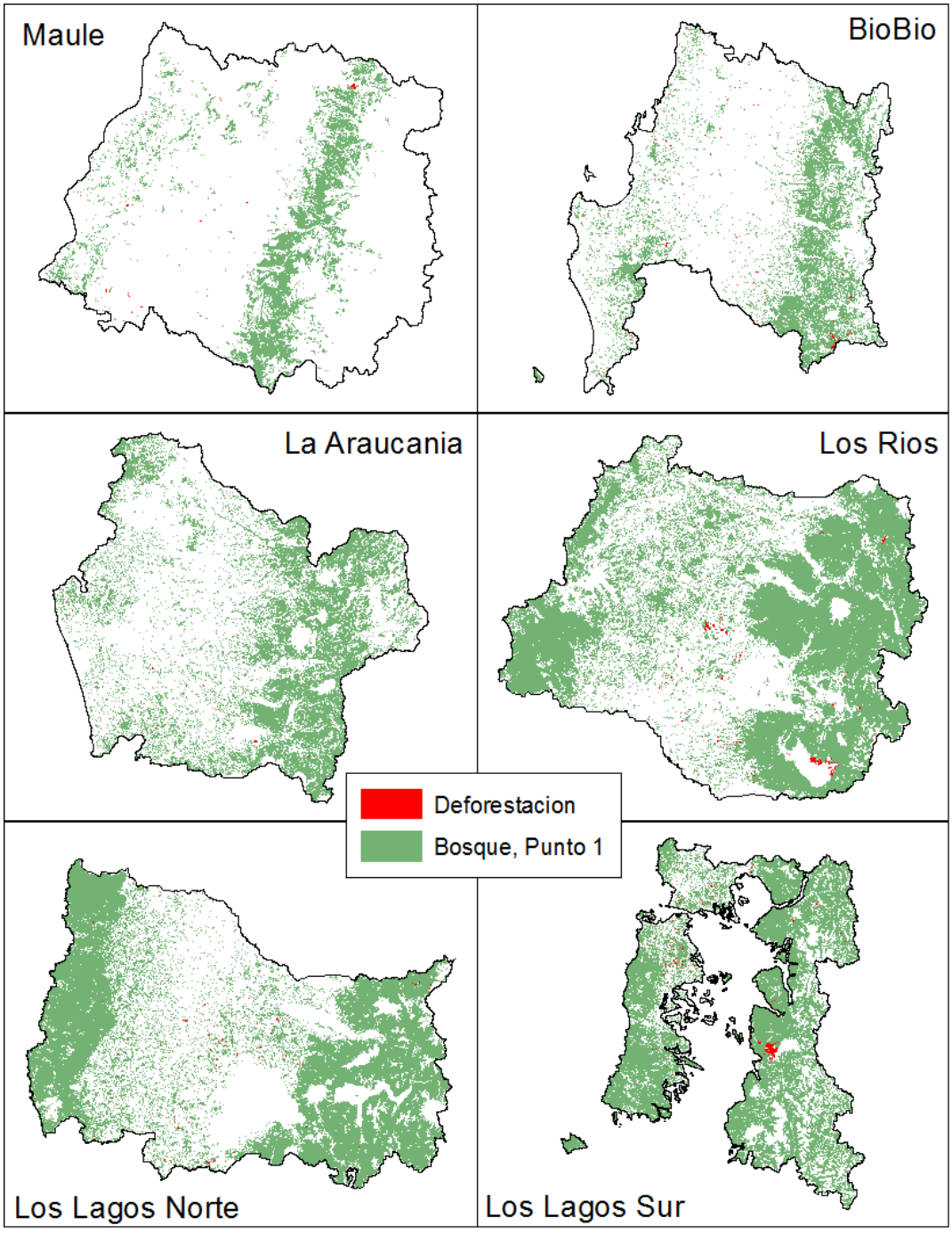


Figure 8. Deforestation in each region

ii. Forest degradation

The activity data the for forest degradation FREL was calculated using different methodologies for forests lands that remain forest lands, emissions due to combustion of forest fires, and for the identification of degraded areas due to registered conversions in the Cadastre.

Forest lands that remain forest lands

To estimate the surface area affected by forest degradation in forest lands that remain forest lands, a methodology based on the number of trees and the basal area of the plots in the *Inventario Continuo* was used. Using this information a graph depicting the density of the plots can be created to show the plots where degradation is occurring (Bahamondez, 2009).

The identified plots in a state of degradation are located on satellite images and are used as training areas for the application of the *K-nn* algorithm, which determines the distance between the spectral response of each pixel of the image and the spectral response of known pixels in the training areas (Bahamondez, 2009).

The result obtained is an image where the estimated number of trees and basal area are registered for each pixel in the image. This enables a graphic identification of the density of an area in order to determine if that area is in a state of degradation.

This process is repeated for the corresponding years of the updates of plot data by the *Inventario Continuo* through 2001-2010. This process enables the calculation of movement of every pixel on the image and the identification of areas in a process of degradation.

The computation of activity data for forest lands that remain forest lands is described in more detail in the Methodological Protocols Annex.

In Table 14, information regarding areas of forest degradation is displayed for the reference period 2001-2010. In Figure 9, the forest areas in a degraded state are presented.

Region	Area (ha)
Maule	18,726
Biobío	35,537
La Araucanía	27,672
Los Ríos	40,853
Los Lagos	261,028
Total	***383,816***

Table 14. Area of degradation in forest that remains forest for each region between 2001 and 2010.

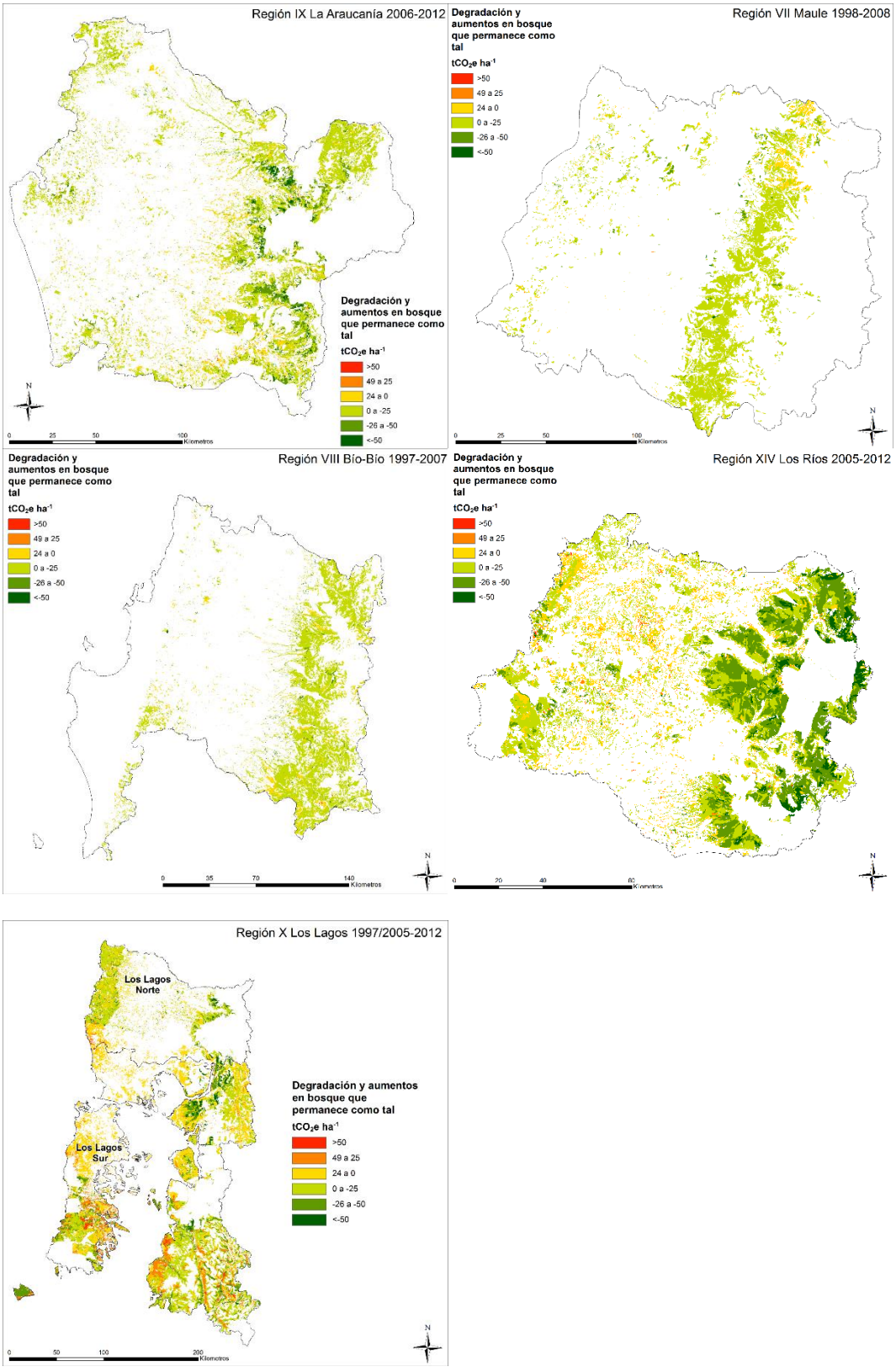
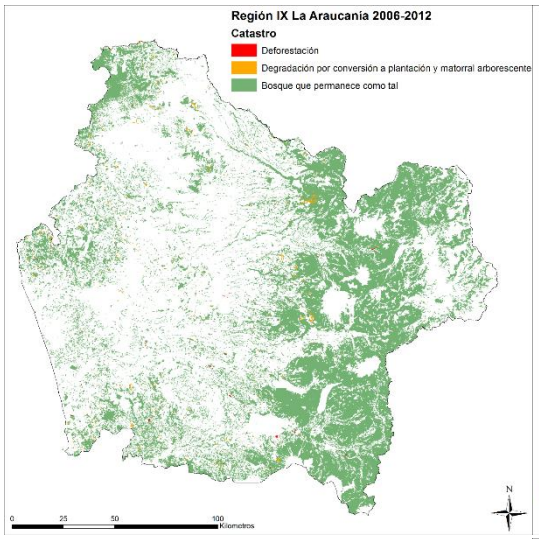
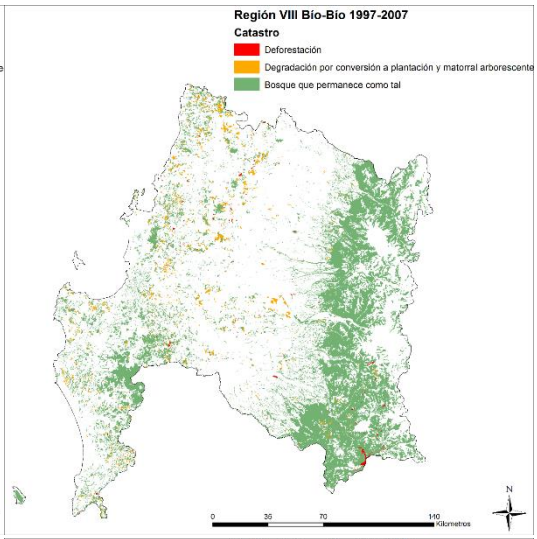
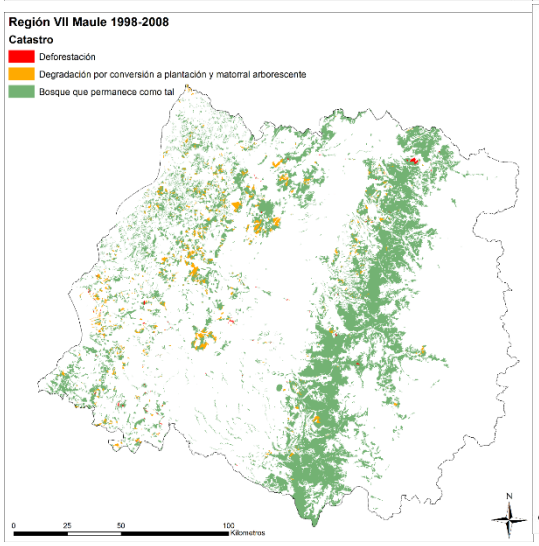
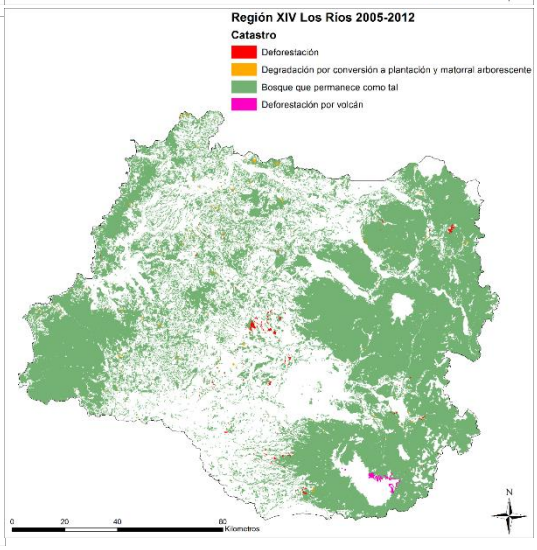


Figure 9. **Forest degradation and increase of carbon stock in forests that remain forests**


Región IX La Araucanía 2006-2012
Catastro
Deforestación
Degradación por conversión a plantación y matorral arborescente
Bosque que permanece como tal
0 25 50 100
Kilometros
N


Región VIII Bío-Bío 1997-2007
Catastro
Deforestación
Degradación por conversión a plantación y matorral arborescente
Bosque que permanece como tal
0 35 70 140
Kilometros
N


Región VII Maule 1998-2008
Catastro
Deforestación
Degradación por conversión a plantación y matorral arborescente
Bosque que permanece como tal
0 25 50 100
Kilometros
N


Región XIV Los Ríos 2005-2012
Catastro
Deforestación
Degradación por conversión a plantación y matorral arborescente
Bosque que permanece como tal
Deforestación por volcán
0 20 40 60
Kilometros
N

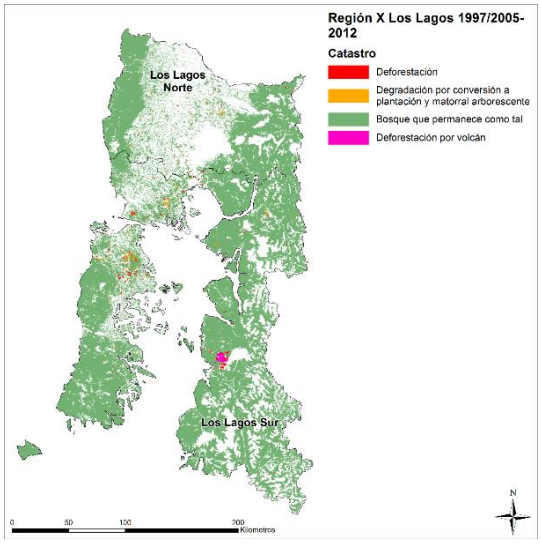

Región X Los Lagos 1997/2005-2012
Catastro
Deforestación
Degradación por conversión a plantación y matorral arborescente
Bosque que permanece como tal
Deforestación por volcán
Los Lagos Norte
Los Lagos Sur
0 50 100 200
Kilometros
N

Figure 10. **Degradation by transformations registered in Cadastre.**

Forest Fires

To compute the non-CO_2 emissions, tabular data concerning the affected areas due to forest fires in the annexes of INGEI 2015 were used. The original source of this data is the Estadísticas Históricas Forestales (Historical Forestry Statistics) of CONAF 1985-2012[42]. This data includes the annual surface area totals for forest fires in each region from 1971 to 2012. However, for the FREL only the data for 2001 to 2010 is used in order to maintain consistency with the reference period of the forest degradation in forest lands that remain forest lands.

In Table 15, information regarding the surface area degraded by forest fires for each region for the reference period 2001-2010 is presented. Figure 2 depicts the areas affected by forest degradation.

	Burned Area 2001	Burned Area 2002	Burned Area 2003	Burned Area 2004	Burned Area 2005	Burned Area 2006	Burned Area 2007	Burned Area 2008	Burned Area 2009	Burned Area 2010
Region	**ha**	**ha**	**ha**	**ha**	**ha**	**ha**	**ha**	**ha**	**ha**	**ha**
Maule	25.5	147.2	504.4	170.8	140.0	62.4	9.4	464.1	4,029.7	432.0
Biobío	89.4	7,560.2	159.3	211.3	395.7	147.7	946.8	266.6	957.7	1,634.7
La Araucanía	63.6	18,764.6	226.2	369.0	212.3	73.6	41.3	351.2	1,012.2	41.8
Los Ríos	0.9	904.1	2.9	184.1	18.7	6.9	4.8	118.8	271.4	0.8
Los Lagos	9.4	2,551.9	27.5	90.9	47.3	207.4	52.2	4,233.9	598.1	0.6
Total	***188.7***	***29,927.9***	***920.2***	***1,026.1***	***813.9***	***498***	***1,054.4***	***5,434.6***	***6,869.1***	***2,109.8***

Table 15. Area affected by forest fires per region between 2001 and 2010.

It should be noted that in the summer of 2002, a large occurrence of forest fires caused by lightening affected Reserves, National Forests, and private lands with Araucaria and *Nothofagus* forests in the region of the Araucanía (González, M.E. *et al,* 2010)[43] which also affected the region of Biobío. Due to the forest fires which occurred in 2002, 14,536 hectares of the Malleco Forest Reserve were consumed in a period of 74 days[44].

Transformations register by the Cadastre

The Cadastre provides the maps for the activity data of land use changes, which vary in years depending on the region.

The distribution of emissions due to native forest land conversions into plantations of arborescent shrubland were mapped by the Cadastre.

[42] http://www.conaf.cl/incendios-forestales/incendios-forestales-en-chile/estadisticas-historicas/
[43] http://www.bosquenativo.cl/descargas/Revista_Bosque_Nativo/RBN_46_art_tec2web.pdf
[44] http://www.lignum.cl/2015/02/17/grandes-e-historicos-incendios-forestales-que-debes-conocer/

Table 16 presents data on the surface area of forest degradation by region and year for registered transformations by the Cadastre, which are also depicted in Figure 10.

Region	Substitution of plantations (ha year^{-1})	Transformation into arborescent shrubland (ha year^{-1})	Total (ha year^{-1})
Maule	3,112	175	3,287
Biobío	5,272	248	5,520
La Araucanía	1,633	54	1,687
Los Ríos	390	40	430
Los Lagos Sur	296	544	850
Los Lagos Norte	431	82	513
Total	***11,132***	***1,142***	***12,274***

Table 16. Degraded area by year and region according to transformation recorded in Cadastre.

iii. Enhancement of forest carbon stocks

In the same manner of forest degradation FREL, the activity data for enhancement of forest carbon stocks FRL is calculated using a different methodology for forest lands that remain forest lands and for the identification of forest degradation in areas that experience a registered transformation in the Cadastre.

Forests lands that remain forest lands

Using the same methodology used for forest degradation, which uses plot-level information provided by the *Inventario Continuo* and satellite images, the pixels that experience movements in the density chart that indicate an increase in the carbon stocks based on the increase of trees in the base area between 2001-2010 are considered as areas of carbon stock enhancement. Table 17 shows the area of forest lands that remain forest lands where there has been an increase in the carbon stocks during the reference period of 2001-2010, which is also depicted in Figure 9.

Region	Area (ha)
Maule	49,427
Biobío	87,749
La Araucanía	58,803
Los Ríos	77,141
Los Lagos	263,055
Total	***536,175***

Table 17. The area of forest lands that remain forest lands with enhancement of forest carbon stocks per region between 2001 and 2010.

Registered transformation by the Cadastre

The data activity is derived from the land use transition matrices taken from the Cadastre. As such the reference period varies by region, due to the irregular update intervals of the Cadastre.

Table 18 presents the surface area with increases of forest carbon stocks for 1) reforestation, non-forest lands converted to forest lands; 2) Restoration, plantations changed into forest lands; 3) Natural Growth, arborescent shrubland into forest lands; by region and year, which are also presented in Figure 11.

Region	Restoration (ha year^{-1})	Reforestation (ha year^{-1})	Natural Growth (ha year^{-1})	Total (ha year^{-1})
Maule	82	465	1201	1748
Biobío	707	561	574	1842
La Araucanía	3	821	962	1786
Los Ríos	86	332	528	946
Los Lagos Sur	0	66	84	151
Los Lagos Norte	0	60	23	83
Total	***879***	***2304***	***3372***	***6555***

Table 18. Areas with enhancement of forest carbon stock per year and region according to transformations registered in the Cadastre.

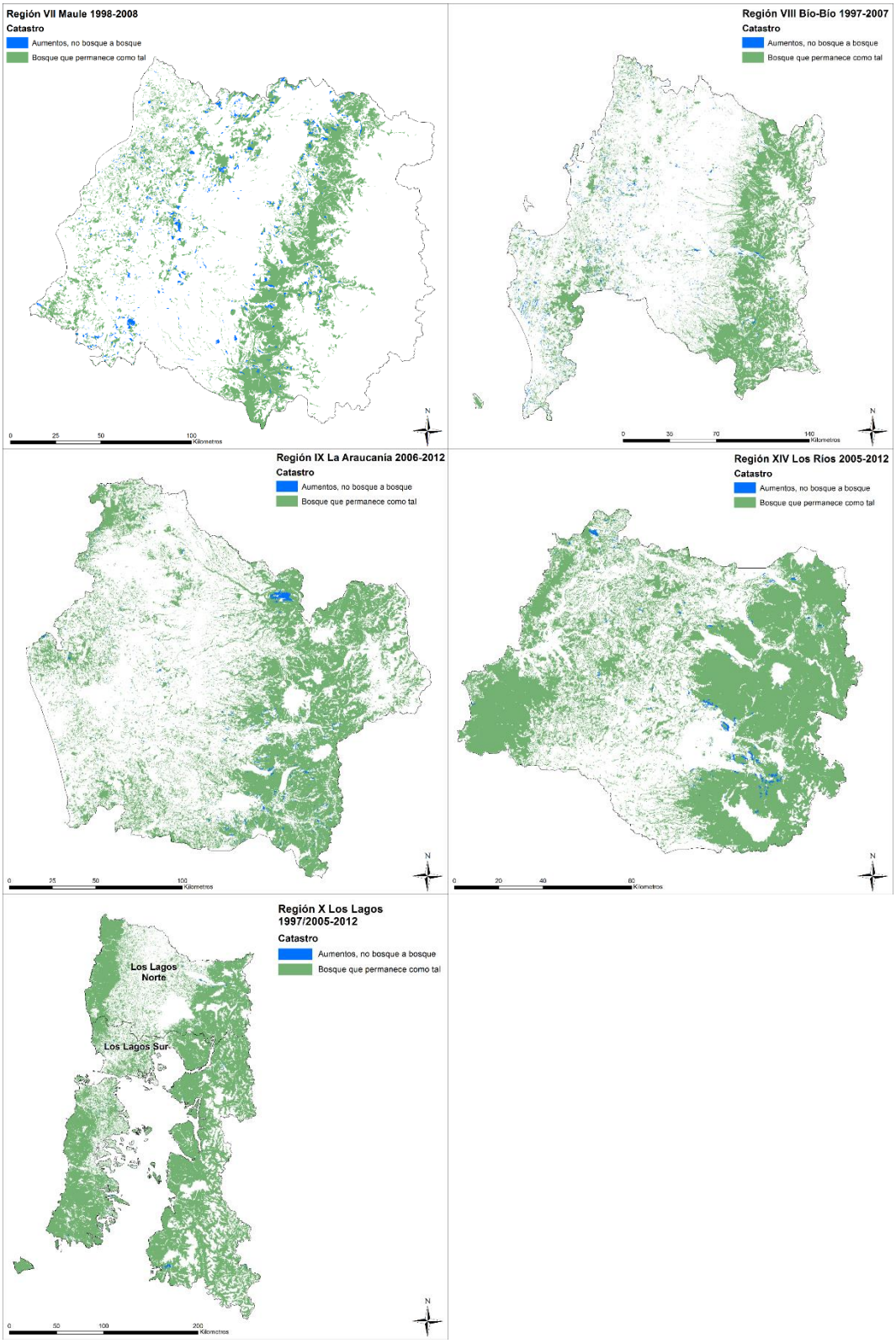


Figure 11. **Enhancement of forest carbon stock based on registered conversions in the Cadastre.**

i. Conservation of forest carbon stocks

In this activity the gain and loss of forest carbon stocks within areas of conservation, private and public, as well as within the forest type Araucaria and Alerce, are calculated.

These gains and losses can be caused by legal and illegal selective cutting, extraction of firewood, natural regeneration, or anthropogenic and enrichment plantations.

To define the area of the conservation activity, polygons provided by SNASPE were used, along with all private conservation areas as defined by the Initiative for Private Conservation, in addition to Araucaria and Alerce forest types.

Within these areas, the emissions and removals were computed using the same methodology used in forest degradation and enhancement of forest carbon stocks of forest lands that remain forest lands. Consequently, activity data was derived from LANDSAT images in 2001 and 2010.

The emissions due to forest deforestation in areas for conservation are not included because the definition of an area for conservation is based on mitigating available opportunities for conservation. Due to the inability to label an area without trees as "conserved" in the MRV stage, if an area is deforested inside a protected area during the reference period it is eliminated from the calculations for the conservation activity and included in the deforestation activity.

Error! Reference source not found. presents, according to regions, the areas for conservation, the areas where net emissions were observed, and areas where net removals were observed. These can also be found in Figure 12.

Region	Total Area (ha)	Areas with net emissions (ha)	Areas with net removals (ha)
Maule	5,651	153	710
Biobío	50,276	2,945	6,588
La Araucanía	190,277	5,337	12,850
Los Ríos	209,800	14,486	31,235
Los Lagos	702,107	75,970	99,963
Total	***1,158,111***	***98,891***	***151,346***

Table 19. Total area of conservation, emissions and removals of forest carbon stock in areas of forest conservation per region for the reference period 2001-2010.

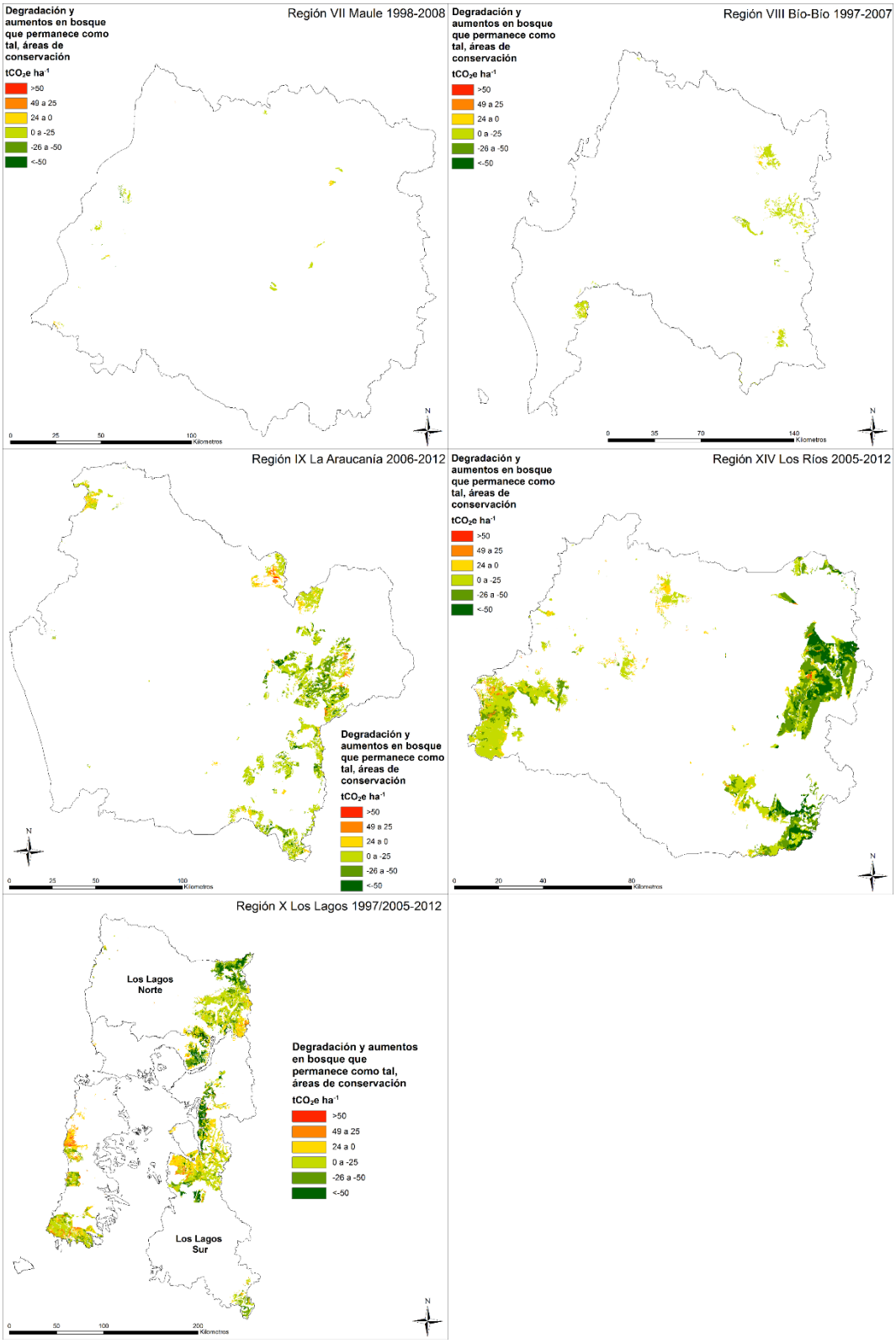


Figure 12. **Carbon stocks in areas of conservation.**

e. Emission factors

i. Deforestation

The emission factors applied to the deforestation FREL were derived from different data of different Tier levels.

For aboveground biomass the emission factors used were Tier level 3 from the calculation of aboveground biomass of the *Inventario Continuo* that presents different carbon stocks per region, consistent with INGEI.

Belowground biomass is calculated based on a root-shoot relationship developed in Chile (Gayoso, 2002)[45].

For dead organic matter, Tier level 2 emission factors from INGEI 2015 and the *Inventario Continuo* were used.

Tier level 1 emission factors for soil organic carbon were derived from the Harmonized World Soil Database. Average regional weighted soil organic carbon amounts were calculated for the uppermost 30 cm of different types of soil.

Table 20 presents the emission factors used for the forest degradation FREL presented by region and pool.

		Deforestation FREL ($tCO_2e\ year^{-1}$)			
Region	**Deforested Area (ha)**	**Biomass**	**Dead organic matter**	**Above-ground organic matter**	**Total**
Maule	225	-30,111	-3,720	-4,998	**-38,829**
Biobío	775	-204,031	-28,417	-27,935	**-260,383**
La Araucanía	2,585	-1,151,521	-444,545	-55,536	**-1,651,602**
Los Ríos	691	-255,508	-297,198	-81,695	**-634,402**
Los Lagos Sur	1,297	-626,901	-330,002	-45,299	**-1,002,202**
Los Lagos Norte	321	-114,860	-81,573	-12,896	**-209,329**
Total	5,894	-2,382,932	-1,185,456	-228,359	**-3,796,747**

Table 20. Analysis of regional emission factors disaggregated by carbon pool

ii. Forest Degradation

[45] Existencias de biomasa subterránea ya fueron calculadas para praderas, matorrales, matorrales arborescentes y formaciones suculentas en Gayoso (2006). Sin embargo, este artículo también aplicó una proporción raíz/tallo para identificar esos valores estimados aéreos.

Forests lands that remain forest lands

These values were calculated by assessing the volume and carbon stock of each pixel in the 2001 and 2010 images. The carbon stocks are converted into emission factors using a stock-difference approach to determine the specific emissions for each pixel that 1) experienced a carbon stock loss between 2001 and 2010; and 2) was in a state of forest degradation or at risk of forest degradation in 2010, as determined by the carbon stock of the types of native forests.

The Methodological Protocols Annex includes a detailed description of the forest states used in this methodology.

This analysis was only conducted for forest lands that remained forest lands as has been explained in the calculation of Activity Data section.

The emission factors for biomass available for combustion are the same as the factors employed for the emissions factors for the forest degradation FREL. The factors for combustion, emission and conversion are defaults provided by IPCC (2006), as shown in Table 21.

GHG	Conversion factor to CO_2e	Combustion factor	Emission factor
CH_4	28	0.45	4.70
N_2O	265	0.45	0.26

Table 21. Emission, combustion, and conversion factors for Non-CO_2 gases

Registered conversions by the Cadastre

Values for forest carbon stocks for types of forests were determined in the same manner as the previously discussed methodology for forest degradation; regional rates were provided by Chile's INGEI.

With the objective of safeguarding the non-carbon benefits in native forests, exotic species plantations were assigned a carbon stock of zero, even though the plantations might have a higher carbon stock than the native forests.

With the objective of maintaining the principle of completeness, the carbon stock flux for forest plantations for the reference area have been included in the Forest Plantations Annex.

iii. Enhancement of forest carbon stocks

Forest lands that remain forest lands

The methodology applied for forest degradation in forest lands that remain forest lands is also used for carbon stock enhancement in the same areas. This methodology calculates the stock-difference to determine the specific removal of each pixel that 1) experience an increase in forest carbon stock between 2001 and 2010; and 2) is in a state of degradation or at risk of degradation in 2001.

Registered conversions by the Cadastre

The Tier 3 removal factors for the different types of forests were derived from INGEI, which were, with the exception of the Araucaria, gathered from the *Inventario Continuo* (Table 22). The rate of growth for the Araucaria is derived from regional data collected for a dissertation about the *Araucaria auracana* in southern Chile (Mujica, 2000).

The rate of annual growth for secondary forests was also applied to mixed adult-secondary forests. The rates of growth for adult forests was also applied to stunted forests, because of the belief that these forests have reached maturity and are probably going to have slower growth than young or secondary forests.

The rate of growth for adult Sclerophyll forests was applied to arborescent shrublands due to their physiological similarities in the forest types. This is a conservative assumption due to the slower rate of growth of adult Sclerophyll compared to other forests. The net average growth for mixed forests in each region was calculated by taking the net average growth of each type of forest that exists in the region as identified by the Cadastre.

Type of forest	Removal	Adult (Old Growth)
	(m3/ha/year)	
Alerce	0.45	0.45
Ciprés de Las Guaitecas	3.9	3.9
Araucaria	4.6	4.6
Ciprés de La Cordillera	4.7	3.9
Lenga	6.0	5.2
Coihue de Magallanes	6.1	4.6
Roble Hualo	4.6	3.0
Roble-Raulí-Coihue	6.1	5.0
Coihue-Raulí-Tepa	5.1	4.0
Esclerófilo	2.2	1.9
Siempreverde	5.8	3.2

Table 22. Annual average growth of secondary and primary forests depending on type of forest. Source: Annex unpublished by INGEI

iv. Conservation of forest carbon stocks

The methodology used to calculate the FREL/FRL of conservation of forest carbon stocks is based on the carbon flux in areas of conservation. The areas of conservation are composed of forest lands that remain forest lands therefore have the same emission factors as the calculations used for forest degradation FREL and enhancement of forest carbon stocks FRL.

7. Subnational FREL/FRL in Chile

a. Deforestation

The average annual emission levels due to deforestation in the proposed subnational FREL are 1.8 million t CO_2 $year^{-1}$ (Table 23).

Deforestation FREL					
Region	**Deforested Area (ha $year^{-1}$)**	**Living Biomass (tCO_2e $year^{-1}$)**	**Dead biomass (tCO_2e $year^{-1}$)**	**Organic soil CO_2 (tCO_2e $year^{-1}$)**	**Total (tCO_2e $year^{-1}$)**
Maule	225	23	2	5	30
Biobío	775	180	14	28	222
La Araucanía	232	121	20	26	167
Los Ríos	467	307	100	42	449
Los Lagos Sur	943	541	120	14	675
Los Lagos Norte	321	184	41	13	238
Total	***2,963***	***1,356,484***	***297,336***	***128,005***	***1,781,825***

Table 23. Total emissions due to deforestation of the area in Chile's subnational FREL

b. Forest Degradation

CO_2 emissions in forest lands that remain forest lands, native forests that become arborescent shrublands (according to the Cadastre), the conversion of native forests and arborescent shrublands to forest plantations, and the emissions of non-CO_2 gases produced by forest fires are calculated independently of one another. All of the different sources are added to form the FREL for forest degradation, equivalent to 6.4 million tCO_2e $year^{-1}$ (Table 24).

Degradation FREL (tCO_2e)				
	CO_2	**CH_4**	**N_2O**	**Total tCO_2e**
Maule	270,008	3,008	1,575	274,590
Biobío	786,708	11,712	6,132	804,552
La Araucanía	1,042,778	38,473	20,143	1,101,394
Los Ríos	737,775	3,994	2,091	743,861
Los Lagos	3,476,397	15,737	8,239	3,500,373
Total	***6,313,667***	***72,924***	***38,180***	***6,424,771***

Table 24: Greenhouse gas emissions due to forest degradation of territories considered for FREL

The following section elaborates on the emissions from forest degradation based on the different methodologies and sources of information used for their assessments.

i. Forest lands that remain forest lands

The annual emissions of forest lands that remain as forest lands (for example, fuelwood collection, selective logging, etc) are approximately 3.7 million tCO_2e, as shown in Table 25.

Emissions		
Region	**Degraded Area (ha)**	**Emissions (tCO_2e $year^{-1}$)**
Maule	18,726	65,367
Biobío	35,537	104,758
La Araucanía	27,672	309,063
Los Ríos	40,853	458,365
Los Lagos	261,028	2,816,398
Total	***383,816***	***3,753,950***

Table 25: Annual emissions in forest lands that remain forest lands by region.

ii. Forest Fires

The annual emissions of non-CO_2 gases due to forest fires are approximately 0.1 million tCO_2e, as shown in Table 26. This number is small because it only considers the emissions of methane (CH_4) and nitrous oxide (N_2O). CO_2 emissions have been estimated and recorded in the previous category (as shown above) of the degradation in forest lands that remain as forest lands.

Emissions		
Region	**Degraded Area (ha)**	**Emissions (tCO_2e $year^{-1}$)**
Maule	599	4,582
Biobío	1,237	17,843
La Araucanía	2,116	58,616
Los Ríos	151	6,085
Los Lagos	782	23,977
Total	***4,884***	***111,103***

Table 26. Emissions of non-CO_2 gases by region.

The distribution of the annual data of forest fires (Figure 13) illustrates the significant impact of 2002, with emission levels significantly higher than the rest of the years of the reference period.

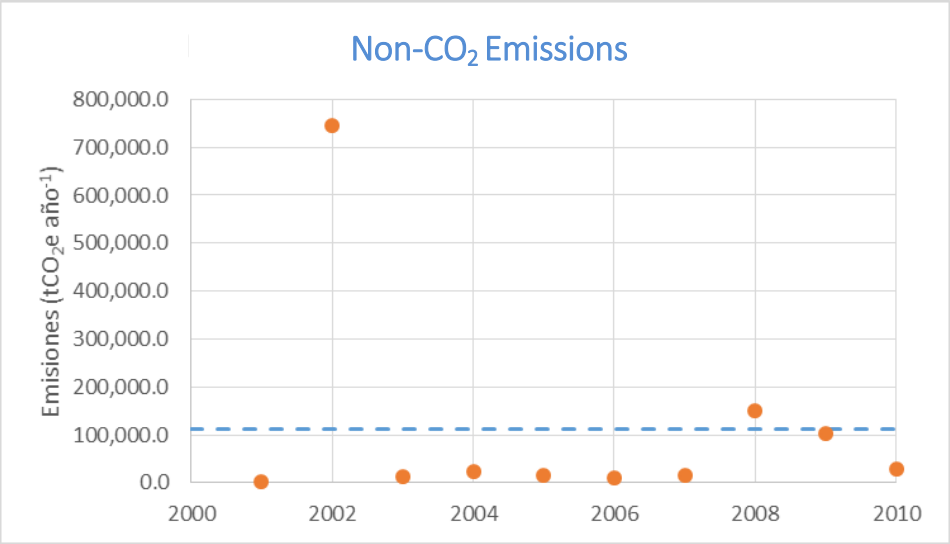


Figure 13. Non-CO_2 gas emissions as presented by year.

iii. Native forests converted to plantations and arborescent shrublands

The annual emission levels due to the conversion of native forests to forest plantations and arborescent shrublands are approximately 2.6 million tCO_2e, as shown in Table 27, with Biobío and La Araucanía as the major contributors due to the significant presence of exotic plantations in those regions.

Emissions				
Region	**Degraded Area (ha year^{-1})**	**Living Biomass (tCO_2e year^{-1})**	**Dead Biomass (tCO_2e year^{-1})**	**Total Emissions (tCO_2e year^{-1})**
Maule	3,287	178,399	26,243	204,642
Biobío	5,520	585,301	96,650	681,951
La Araucanía	1,687	593,276	140,440	733,715
Los Ríos	429	195,518	83,893	279,410
Los Lagos Sur	839	366,514	37,625	404,139
Los Lagos Norte	513	201,017	54,842	255,860
Total	***12,275***	***2,120,024***	***439,693***	***2,559,717***

Table 27. Chilean subnational FREL/FRL CO_2 emissions due to the conversion of native forests into arborescent shrublands and exotic forest plantations.

c. Enhancements of forest carbon stocks

Removals in forest lands that remain forest lands are calculated independently from removals due to the conversion of other land uses to forest lands, including the transformation of arborescent shrublandsinto native forests and forest plantations into native forests and arborescent

shrublands (according to Cadastre). The different sources are added together to integrate the FRL for enhancement of forest carbon stock equivalent to 7.9 million tCO_2e $year^{-1}$ (Table 28).

Total enhancement of forest carbon stocks (FRL)			
Average removal of CO_2e per year			
Region	**Other lands to forest lands**	**Forest lands that remain forest lands**	**Total**
	ton CO_2e $year^{-1}$	**ton CO_2e $year^{-1}$**	**ton CO_2e $year^{-1}$**
Maule	-98,814	-656,862	-755,677
Biobío	-107,441	-805,681	-913,123
Araucanía	-84,789	-1,118,618	-1,203,408
Los Ríos	-49,696	-1,583,854	-1,633,550
Los Lagos Sur	-22,477	-3,352,095	-3,381,331
Los Lagos Norte	-6,759		
Total	***-369,977***	***-7,517,111***	***-7,887,089***

Table 28. Removal of CO_2 due to enhancements in the designated area for the Chilean subnational FRL.

The following elaborates on the removals due to enhancement of forest carbon stock based on the different methodologies and sources of information used for their assessments:

i. Forest lands that remain as forest lands

The average annual removal amounts due to the enhancement of forest carbon stock in forest lands that remain as forest lands is approximately 7.5 million tCO_2 $year^{-1}$. The majority of the removals emerges from the regions Los Lagos and Los Rios (Table 29).

Removals	
Region	**Removals (tCO_2e $year^{-1}$)**
Maule	-656,863
Biobío	-805,681
La Araucanía	-1,118,618
Los Ríos	-1,583,854
Los Lagos	-3,352,095
Total	***-7,517,111***

Table 29. Removal of CO_2 in forest lands that remained forest lands in the area of the Chilean subnational FRL.

ii. Change in land use

The average annual removal by enhancement of forest carbon stocks due to the change of non-forest lands into forest lands, the transformation of arborescent shrubland into forest lands, and the transformation of forest plantations into native forests and arborescent shrubland is approximately 370,000 tCO_2 $year^{-1}$ (Table 30).

Increase in the conversion of non-forest lands to forest lands: Average annual removal of CO_2e			
Region	**Historical Period (years)**	**Increase of Area (ha $year^{-1}$)**	**Tones of CO_2e $year^{-1}$**
Maule	10	34,671	-98,814
Biobío	10	25,783	-107,441
La Araucanía	6	14,266	-84,789
Los Ríos	7	8,210	-49,696
Los Lagos Sur	15	5,799	-22,477
Los Lagos Norte	7	1,783	-6,759
Total	**-**	***90,514***	***-369,977***

Table 30. CO_2 removal due to the conversion of non-forest lands into forest lands in the area of the Chilean subnational FRL.

d. Conservation of forest carbon stocks

The FREL/FRL of conservation of forest carbon stocks consists of the net emissions and removals produced in areas of conservation and is approximately 1.8 million tCO_2e of annual net removals (Table 31).

Reference level of CO_2		
Region	**Total area (ha)**	**CO_2 stock (tCO_2e $year^{-1}$)**
Maule	14,704	-5,868
Biobío	89,747	-29,029
La Araucanía	168,851	-275,310
Los Ríos	227,173	-513,922
Los Lagos	941,506	-1,014,698
Total	***1,441,980***	***-1,838,828***

Table 31. Conservation of forest CO_2 stock in FREL/FRL disaggregated by region.

The annual total emissions of forest lands that remain as forest lands occurring in areas of conservation are approximately 1 million tCO_2e (Table 32).

Emissions		
Region	**Total Area (ha)**	**Emissions ($tCO_2e\ year^{-1}$)**
Maule	153	903
Biobío	2,945	6,057
La Araucanía	5,337	77,334
Los Ríos	14,486	150,947
Los Lagos	75,970	788,866
Total	***98,891***	***1,024,106***

Table 32. Forest emissions in areas of conservation per region

The amount of annual GHG removals that occur within areas of conservation is approximately 2.9 million de tCO_2e (Table 33).

Removals		
Region	**Total Area (ha)**	**Removals ($tCO_2e\ year^{-1}$)**
Maule	710	-6,771
Biobío	6,588	-35,085
La Araucanía	12,850	-352,644
Los Ríos	31,235	-664,869
Los Lagos	99,963	-1.803,564
Total	***151,346***	***-2,862,934***

Table 33: Removal of carbon in forests in conservation areas per region

e. Chilean subnational FREL/FRL for native forests

As previously stated, Chile presents a FREL/FRL at the subnational scale for native forests in four REDD+ activities with annual emissions of 1.78 million tCO_2e for deforestation, 6.42 million tCO_2e for degradation and annual removals of -1.8 million tCO_2e for conservation of forest carbon stocks and -7.9 million tCO_2e for enhancement of forest carbon stocks, as shown in Table 34.

FREL/FRL				
REDD+ Activities	**Deforestation**	**Degradation**	**Conservation**	**Enhancement**
Maule	29,862	274,590	-5,868	-755,677
Biobío	222,431	804,552	-29,029	-913,123
La Araucanía	167,427	1,101,394	-275,310	-1,203,408
Los Ríos	448,906	743,861	-513,922	-1,633,550
Los Lagos	913,199	3,500,374	-1,014,698	-3,381,331
Total	***1,781,825***	***6,424,771***	***-1,838,828***	***-7,887,089***

Table 34. Chilean subnational FREL/FRL

8. Uncertainty calculations

a. Deforestation

The uncertainty of the FREL for Deforestation was calculated according to the method of propagation of errors following equation 3.2 of the IPCC (2006). The uncertainty for the Deforestation FREL only includes sampling error and not allometric equation errors.

For the calculation of uncertainty in the Deforestation FREL through the propagation of errors, the factors described in Table 35 will be used, which represent the compiled data of the uncertainty calculations Chile's INGEI, as well as respective weighting of each factor.

The uncertainty estimated for the Deforestation FREL is equivalent to 4.9%.

Emission Factors			
Item	**Error (%)**	**Source**	**Weights**
Accumulated Biomass of Native Forest	**10**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Existing aerial biomass (tC/ha)
Standing dead matter)	**28**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Half of the existing dead biomass (tC/ha)
Lying dead matter	**24**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Half of the existing dead biomass (tC/ha)
R Factor of Native Forest	**40**	Calculation error based on the statistical data of the biomass inventory and carbon accounting of the UACh.	Existing belowground biomass (tC/ha)
Activity Data			
Item	**Error (%)**	**Source**	

La Araucanía (land use and under use)	**8.2**	Universidad Austral de Chile and Universidad de la Frontera. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de La Araucanía.	Deforested area in La Araucanía (ha)
Los Ríos (land use and under use)	**0.4**	Universidad Austral de Chile. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de Los Ríos.	Deforested area in Los Ríos (ha)
Los Lagos (land use and under use)	**8.2**	CONAF/UACh. 2014. Monitoreo de cambios, corrección cartográfica y actualización del catastro de recursos Vegetacionales Nativos de la Región de Los Lagos.	Deforested area in Los Lagos (ha)

Table 35: Resources used in the propagation of errors for the estimation of uncertainty for the deforestation FREL/FRL. Source: INGEI Chile 1990-2010

b. Degradation

The uncertainty calculation for the Degradation FREL was calculated using the method for propagation of errors described by the equation 3.2 of the IPCC (2006). The uncertainty calculation for the Degradation FREL is created by combining the uncertainty of degradation due to extraction of forest biomass, conversion of native forests to exotic plant plantations and arborescent shrubland, and forest fires. The uncertainty calculations for Degradation FREL include the errors of sampling and modeling.

The uncertainty calculations for Degradation FREL are calculated using the factors described in Table 36, which represent the compiled data of uncertainty calculations from INGEI Chile, as well as the respective weighting of each factor.

The uncertainty calculation for the Degradation FREL is equivalent to 29.6%.

Degradation of forest lands that remain forest lands				
Item	**Error (%)**	**Source**	**Weights**	**Uncertainty**

Estimation of basal area	**50.5**	Bahamondez, 2015 (Methodological Protocols Annex)	Existing aboveground biomass (tC/ha)	50.5%
Degradation of forest land to plantation and arborescent shrubland				
Item	**Error (%)**	**Source**	**Weights**	**Uncertainty**
La Araucanía (land use and under use)	**8.20**	Universidad Austral de Chile and Universidad de la Frontera. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de La Araucanía.	Deforested Area in La Araucanía (ha)	4.5%
Los Ríos (land use and under use)	**0.4**	Universidad Austral de Chile. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de Los Ríos.	Deforested Area in Los Ríos (ha)	
Los Lagos (land use and under use)	**8.2**	CONAF/UACh. 2014. Monitoreo de cambios, corrección cartográfica y actualización del catastro de recursos Vegetacionales Nativos de la Región de Los Lagos	Deforested Area in Los Lagos (ha)	
Accumulated Biomass of Native Forest	**10.0**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Existing aerial biomass (tC/ha)	
Standing dead matter)	**28.4**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Half of the existing dead matter (tC/ha)	
Lying dead matter	**24**	Estimated error of the permanent sample plots of the Continuous Forest Inventory of INFOR.	Half of the existing dead matter (tC/ha)	
Degradation due to forest fires				
Item	**Error**	**Source**	**Weights**	**Uncertainty**

	(%)			
Accumulated Biomass of Native Forest	**10.0**	Estimated error of the permanent sample plots of the Continuous Forest Inventoryof INFOR.	Existing aerial biomass (tC/ha)	35.4%
Standing dead matter)	**28.4**	Estimated error of the permanent sample plots of the Continuous Forest Inventoryof INFOR.	Half of the existing dead matter (tC/ha)	
Lying dead matter	**24.2**	Estimated error of the permanent sample plots of the Continuous Forest Inventoryof INFOR.	Half of the existing dead matter (tC/ha)	
Combustion Factor by regions	**36.0**	Estimated error due to the standard deviation and mean of the combustion factor caused by error in the GL-2006	CO_2 emissions caused by burning biomass (tCO_2)	
Emission factors CH_4	**29.0**	Estimated error due to the standard deviation and mean of the combustion factor caused by error in the GL-2006	CH_4 emissions caused by burning biomass (tCO_2)	
Emission factors N_2O	**43.8**	Estimated error due to the standard deviation and mean of the combustion factor caused by error in the GL-2006	N_2O emissions caused by burning biomass (tCO_2)	

Table 36: Resources used in the propagation of errors for estimating the uncertainty of the degradation of forests in the areas used in FREL

c. Enhancement of forest carbon stocks

The uncertainty calculation for the enhancement of forest carbon stocks FRL was calculated using the method for propagation of errors described by the equation 3.2 of the IPCC (2006). The uncertainty calculation for the enhancement of forest carbon stocks FRL is the combination of the uncertainty calculations for the enhancement of forest carbon stocks in lands converted into

native forest lands and the increase in carbon stocks of forest lands that remain as forest lands. The uncertainty calculations for the enhancement of forest carbon stocks FRL include sampling and modeling errors.

For the uncertainty calculation of the enhancement of forest carbon stocks FRL, the factors described in Table 37 which represent the compiled data of the calculations for uncertainty of Chile's INGEI as well as the respective weighting of each factor.

The uncertainty calculation for the enhancement of forest carbon stocks FRL is equivalent to 48.3%.

Forest lands that remain forest lands				
Item	**Error (%)**	**Source**	**Weights**	**Uncertainty**
Estimation of basal area	**50.5**	Bahamondez, 2015	Existing aboveground biomass (tC/ha)	50.5%
Lands converted into forest lands				
Item	**Error (%)**	**Source**	**Weights**	**Uncertainty**
La Araucanía (land use and under use)	**8.20**	Universidad Austral de Chile and Universidad de la Frontera. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de La Araucanía.	Deforested Area in La Araucanía (ha)	5.6%
Los Ríos (land use and under use)	**0.4**	Universidad Austral de Chile. 2014. Monitoreo de Cambios, Corrección Cartográfica y Actualización del Catastro de los Recursos Vegetacionales Nativos de la región de Los Ríos.	Deforested Area in Los Ríos (ha)	
Los Lagos (land use and under use)	**8.2**	CONAF/UACh. 2014. Monitoreo de cambios, corrección cartográfica y actualización del catastro de recursos Vegetacionales Nativos de la Región de Los Lagos	Deforested Area in Los Lagos (ha)	
Standing dead matter	**28.4**	Estimated error of the permanent sample plots of the Continuous Forest Inventoryof INFOR.	Half of the existing dead matter (tC/ha)	

Lying dead matter	**24**	Estimated error of the permanent sample plots of the Continuous Forest Inventoryof INFOR.	Half of the existing dead matter (tC/ha)	
R Factor of Native Forest	**40**	Calculation error based on the statistical data of the Inventario de Biomasa y contabilidad de carbono of the UACh.	Existing belowground biomass (tC/ha)	

Table 37: Resources used for propagation of errors for the estimation of uncertainty for FRL and the enhancement of forest CO_2 stocks

d. Conservation of forest carbon stocks

The uncertainty calculation for the conservation of the forest carbon stocks FREL/FRL was calculated using the method for propagation of errors described by the equation 3.2 of the IPCC (2006). The uncertainty calculations of the conservation of forest carbon stocks FREL/FRL only include modeling error factors.

For the uncertainty calculations for the conservation of forest carbon stocks FREL/FRL , the factors described in Table 38 were used.

The uncertainty calculations for the conservation of forest carbon stocks FREL/FRL are 50.5%.

Degradation/enhancement of CO_2 in area of conservation			
Item	**Error (%)**	**Source**	**Weights**
Estimation of basal area	**50.5**	Bahamondez, 2015 (Anexo Protocolos metodológicos)	Existing aboveground biomass (tC/ha)

Table 38: Resources used in the propagation of errors to estimate the uncertainty of the conservation of forest carbon stocks FREL/FRL.

e. Propagation of errors

The analysis of uncertainty for the FREL/FRL of Chilean native forests on a subnational scale has been calculated using Equation 3.2 of the method for the propagation of error proposed by the IPCC (2006) (Equation 1).

$$U_{total} = \frac{\sqrt{(U_1 * x_1)^2 + (U_2 * x_2)^2 + \cdots + (U_n * x_n)^2}}{|x_1 + x_2 + \cdots + x_n|}$$

EQN. 1 (EQN. 3.2 of IPCC

(2006))

Where:

U_{total} = the percentage uncertainty in the sum of the quantities (half the 95 percent confidence
interval divided by the total (i.e., mean) and expressed as a percentage). This term 'uncertainty' is thus based upon the 95 percent confidence interval;
x_i and U_i = the uncertain quantities and the percentage uncertainties associated with them, respectively.

The uncertainty calculation consists of the propagation of error of the combined uncertainties of the deforestation FREL o, forest degradation FREL, conservation FREL/FRL, and enhancement of forest carbon stocks FRL . As explained in Table 39 the propagation of uncertainty is calculated for the FREL/FRL of the native forest at a subnational scale in Chile is 24.3%.

Uncertainty Total			
	Parameters	**Uncertainty**	**Weights**
Deforestation	$U_{deforestation}$	4.9%	1,781,825
Degradation	$U_{degradation}$	29.6%	6,424,771
Conservation	$C_{onservation}$	50.5%	-1,838,828
Enhancement of forest carbon stock	$U_{enhancement\ of\ forest\ CO2\ stock}$	48.3%	-7,883,790
TOTAL	U_{TOTAL}	***24.3%***	***N.A.***

Table 39. Total uncertainty of the proposed subnational FREL/FRL in Chile.

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