Forest Carbon Partnership Facility (FCPF) Carbon Fund **ER Monitoring Report (ER-MR)**	
ER Program Name and Country:	Chile Emission Reduction Program
Reporting Period covered in this report:	05-12-2019 to 31-12-2021
Number of FCPF ERs:	1,026,024
Quantity of ERs allocated to the Uncertainty Buffer:	301,771
Quantity of ERs to allocated to the Reversal Buffer:	598,514
Quantity of ERs to allocated to the Reversal Pooled Reversal buffer:	85,501
Date of Submission:	29-dic-2023
Version	

Acronyms

AFOLU: Agriculture, Forestry and Other Land Use
AGCID: Agency for International Development Cooperation
ASP: Protected Wild Areas
BSP: Benefit Sharing Plan
CAPR: Rural Drinking Water Committees
CATS: Carbon Assets Tracking System
CONADI: National Indigenous Development Corporation
CONAF: National Forestry Corporation
CORECC: Regional Climate Change Committees
COSOC: CONAF Civil Society Council
MRS: Mechanisms for Complaints and Suggestions
CTICC: Interministerial Technical Committee on Climate Change
CTR-CC: Technical Coordinator of MINAGRI's Regional Technical Committee on Climate Change
DBOCC: Climate Change and Forest Departments
DCCSE: Climate Change and Ecosystem Services Department
DMECC: Climate Change and Ecosystem Monitoring Department
ENCCRV: National Strategy on Climate Change and Vegetation Resources
ERPA: Emissions Reduction Program Agreement
ERPD: Emissions Reduction Program Document
ESMP: Environmental and Social Management Plan
FAO: Food and Agriculture Organization
FCBN: Native Forest Conservation, Recovery and Sustainable Management Fund
FCPF: Forest Carbon Partnership Facility
FGRM: Feedback and Grievance Redress Mechanism
FIA: Foundation for Agricultural Innovation
FIBN: Native Forest Research Fund
FMT: Fund Management Team
FPIC: Free Prior and Informed Consent
FREL/FRL: Forest Reference Emission Level/ Forest Reference Level
GASP: Protected Wilderness Areas Management
GCEBX: Forest and Xerophytic Ecosystems Conservation Management
GEF MST: GEF/Sustainable Land Management Project (MST)
GEF: Environmental Evaluation and Oversight Management
GEFA: Finance and Administration Management
GEPRIF: Forest Fire Protection Management
GCF: Green Climate Fund
IFN: National Forest Inventory
INDAP: Institute for Agricultural Development
INFOR: National Forest Monitoring System
INGEI: Forest Reference Level and the National Greenhouse Gas Inventory
IPCC: Intergovernmental Panel on Climate Change
LEMU: Logging and Extraction Monitoring Unit
MGAS: Environmental and Social Management Framework
MINAGRI: Ministry of Agriculture
MINENERGIA: Ministry of Energy
MMA: Ministry of the Environment
MOFIM: Intercultural Mapuche Forestry Model
NDC: National Determined Contribution
NFMS: National Forest Monitoring System
ODEPA: Office of Agricultural Studies and Policies
OIRS: Information, Complaints and Suggestions Office

PAT: Biomass Territorial Supply Program
PES: Payment for Environmental Services
PMST: Sustainable Land Management Project
PSM: Project Management System
PTN: National Technical Proposal
PTR: Regional Technical Proposal
SAFF: Forestry Administration and Control System
SAG: Livestock Agricultural Service
SAIS: Secretariat of Indigenous and Social Affairs
SAQ: Burn Assistance System
SAT: Early Warning System
SEA: Environmental Assessment Service
SEGEGOB: Ministry General Secretariat of Government
SEIA: Environmental Impact Assessment System
SEREMI: Ministerial Regional Secretary
SESA: Strategic Environmental and Social Assessment
SIAC: Public Environmental Information System
SIDCO: Digital Information System for Operations Control
SIGEFOR: Forestry Promotion and Development Management System
SIGI: Institutional Management Information System
SIS: Safeguards Information System
SIT: Territorial Information System
SMM: Monitoring and Measurement System
SNASPE: National System of State-Protected Wilderness Areas
SNIChile: Chilean National Greenhouse Gases Inventory System
SPF: Secretariat for Forest Policy
SVS: Soil Conservation Service (USDA)
TNC: The Nature Conservancy
UACh: Universidad Austral de Chile
UAIS: Indigenous and Social Affairs Unit
UNCCD: United Nations Convention to Combat Desertification
UNFCCC: United Nations Framework Convention on Climate Change
UN-REDD: United Nation Reducing Emissions from Deforestation and forest Degradation
UPCT: Public Participation and Transparency Unit
UTRE: Specialized Regional Technical Units

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1 IMPLEMENTATION AND OPERATION OF THE ER PROGRAM DURING THE REPORTING PERIOD

1.1 Implementation status of the ER Program and changes compared to the ER-PD

The Chilean Emissions Reduction Program (ERP) corresponds to the activities carried out within the framework of the implementation of the National Strategy on Climate Change and Vegetation Resources (ENCCRV). In turn, the ENCCRV is a public policy instrument that aims to "Reduce the social, environmental and economic vulnerability generated by Climate Change, Desertification, Land Degradation and Drought on vegetation resources and human communities that depend on them, in order to increase the resilience of ecosystems and contribute to mitigating climate change by promoting the reduction and capture of greenhouse gas emissions in Chile".

In order to meet this objective, seven direct action measures and 19 facilitation measures were established through various technical analyses and participatory processes at the national level. These measures are organized and strengthened through the different programs, plans and activities carried out by the National Forestry Corporation (CONAF), and are technically and financially supported by other international climate initiatives (FCPF, Green Climate Fund, UN-REDD, GEF MST Project, Swiss Cooperation, and the Chile-Mexico Fund, among others).

This chapter presents the main advances in ERP actions and interventions during the 2020-2021 period.

Progress on Chile´s ER Program actions and interventions

The activities developed by the ERP in the 2020-2021 period included actions related to the management of CONAF that were carried out with state financing and funding from multilateral organizations directly administered by CONAF. The activities were mainly focused on the execution of pilot or demonstration projects, actions to strengthen capacities and environmental education at the territorial level.

It should be noted that, on 8 August 2020, the ENCCRV's first payment-by-results project began, through its +Bosques project, which is financed by the Green Climate Fund.

Activities executed with national budget

Below is a summary of the results of the ERP activities carried out by CONAF in the reporting period (2020-2021) in the AA. These activities are related to the ENCCRV and seek to address the causes of deforestation, forest degradation and the non increase of forest carbon stocks.

- Within the framework of the Native Forest and Forest Promotion Law No. 20,283, administered by CONAF, sustainable management was implemented in more than 3.720 ha of forest. It should be noted that, in the period 2020-2021, 100 percent of the budget allocated through a competitive process to the Native Forest Conservation, Recovery and Sustainable Management Fund (FCBN) and the Native Forest Research Fund (FIBN) included in Law 20,283 was executed.

- In terms of forest supervision: 1,223 property inspections were carried out; compliance with 907 Forest Management Plans was verified; 1,587 complaints from third parties were received; 209 collection points and 287 logging trucks were inspected; 498 patrols were carried out; 385 judicial requests were processed; 87 preventive activities (talks and dissemination activities) were carried out, and 176 tree marking and Alerce stock verification activities were carried out.

- In 2020, CONAF was awarded three programs under the Temporary Emergency Fund (FET) for the 2021-2022 period (Law 21,288 of 2020), for an amount totalling M$ 27,252,181 chilean pesos, which is intended to cover expenses and meet the needs derived from the health crisis caused by the COVID-19 pandemic.

  - ➢ Economic reactivation program for small and medium-sized forest owners with a total area of 24,130 ha and a budget allocation of 21,895,786,000 pesos.
  - ➢ Infrastructure maintenance and repair plan for 91 brigade bases of the Forest Fire Program, with a budget allocation of 3,466,275,000 pesos.
  - ➢ Construction of the plant nursery in the Paine Grande sector of the Torres del Paine National Park, with an investment of 1,890,120,000 pesos.

- In 2021, CONAF, through the Economic Reactivation Program for small and medium-sized forest owners, executed ERP activities in more than 33,000 ha of forest throughout the country. In addition, in the AA activities involving afforestation, restoration and sustainable management of forests and forest plantations were carried out in an area covering more than 19,000 ha.

- On 22 December 2020, the CONAF board, chaired by the Minister of Agriculture, unanimously approved the creation of the Forest and Climate Change Management Unit. This decision reflects the strategic vision of CONAF's management in strengthening and aligning institutional capacities, in order to ensure the sustainable management of forests and their contribution to reducing emissions globally. CONAF has aligned its capabilities, within the framework of the National Strategy on Climate Change and Vegetation Resources, to help achieve the goal of making Chile carbon neutral by 2050, as well as ensuring compliance with the country's National Determined Contribution (NDC), established in the 2015 Paris Agreement, regarding climate change mitigation.

- At the legislative level, progress was made on the bill to create the National Forest Service, which would establish a decentralized public service to replace the current private entity, seeking to promote the conservation, restoration, development, management and sustainable use of forests and other vegetation formations in the country. The bill is currently in the second constitutional process in the Senate.

- In terms of oversight, progress was made with the incorporation of technology, with drones and medium- and high-resolution satellite images to increase the coverage and efficiency of oversight, and improve internal management and that of users: access to the virtual office with a unique key and interoperability with other public services of the State, institutional strengthening for the application of procedures under the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) and the updating of the Environmental Evaluation Guide and the Guide for Requesting Exceptions to the Native Forest Law.

- Execution of 100% of the budget allocated in the Native Forest Conservation, Recuperation and Sustainable Management Fund (FCBN) and the Native Forest Research Fund (FIBN) contained in Law 20,283.

- The Post-Wildfire Recovery Program facilitated the recovery of approximately 10,000 ha of forest by 2020.

Activities funded by international agencies.

- In June 2021, the FPCF II/Implementation of the Specialized Regional Technical Units (UTRE) project was completed. These units were established in each of the ERP regions to provide expert advice on the implementation of best practices for the management of natural resources within the framework of the action measures of the ENCCRV. The UTREs were implemented in the ERP regions to strengthen the technical capacities of the institution and local beneficiaries (mainly small and medium-sized owners).

To achieve the objectives defined in the UTRE, seven activities were carried out as described below:

1. Design and manage a model intervention program that promotes the sustainable management of native forest (with emphasis on its degradation) to increase the offer of sustainable products and/or services, considering the productive chain and the business models associated with the resource.

2. Contribute to the improvement of the Forest Extension Program carried out by CONAF, in the context of climate change, desertification, land degradation and drought.

Activities 1 and 2 are linked to the development of two action measures of the ENCCRV: MT.4 Afforestation and revegetation program in prioritized districts/areas, and US.1 Institutional Forest Management Program focused on public and private land.

3. Prepare technical proposals to obtain financing aimed at the implementation of action measures at the national, regional and/or community level, involved public and/or private entities. This activity is linked transversally to the direct action measures[1] of the ENCCRV.

4. Support CONAF's provision of technical advice aimed at foresters and farmers to promote actions that prevent forest fires. These activities are linked to three action measures of the ENCCRV: IF.4 Strengthening of the forest fire community preparedness program; IF.3 Forest fire prevention program with emphasis on the urban-rural interface; and IF.5 Inclusion of forest fire prevention management and post-fire restoration elements in Law No. 20,283 and its regulations.

5. Design and test a Biomass Territorial Supply Program (PAT) that guarantees the supply of sustainable biomass. This activity is linked to action measure US.3 Strengthening the wood energy program and the country's energy matrix.

6. Strengthen oversight institutional capacity through training in the use of monitoring and early detection systems developed under the ENCCRV, with emphasis on the districts with the highest risk of deforestation and degradation. This activity is linked to two action measures: MT.7 Strengthening of forestry and environmental inspection programs, and MT.6 Environmental education and dissemination program.

7. Review and implementation of environmental and social safeguards in the activities mentioned above. This activity is transversal in nature as it covers all the elements of the ENCCRV and implies the use of safeguard instruments developed in the Environmental and Social Management Framework.

Specifically, in the period 2020-2021, the most important milestones are related to the following elements:

- Preparation and approval of the 4th edition of the Benefit Sharing Plan (BSP) for the ENCCRV and the Operational Manual for the implementation of the BSP in the specific framework of the ERP.
- Development and strengthening of capacities in various aspects related to the ENCCRV action measures, including legal aspects associated with REDD+ to strengthen the legal unit of CONAF, and other training elements related to the ENCCRV platform and its different systems.
- Preparation of the Environmental Education Program and the Communication Strategy of the ENCCRV.
- Dissemination plan at the central and regional level.
- Regional dissemination of UTRE activities in the Magallanes, O'Higgins, Maule, Biobío, Araucanía, Los Ríos and Los Lagos Regions, including five of the six AA regions.

[1] **Direct action measures**: Those that directly generate environmental, social and economic benefits in the territory given their operational nature.

- In June 2021, the GEF/Sustainable Land Management Project (MST) ended. This project was implemented in five regions of the country, including the Araucanía Region, which is part of the AA of the ERP. In this region, sustainable management practices were implemented in an area totalling 3,843 ha with a total of 550 direct beneficiaries. This includes the implementation of biological conservation corridors in more than 3,000 ha and the restoration, reforestation and management of an area equivalent to 840 ha through sustainable management plans, which allowed the capture of -29,397 tonCO2eq. Additionally, the project generated a strategic plan for the sustainability of the initiative, degraded areas were identified and a total of 100 property plans were generated. In terms of the ENCCRV Education Program (MT.6) in the region, 200 forest users were trained on issues of environmental education and climate change.

- In December 2021, the UN-REDD National Program/Support Program for the National Strategy on Climate Change and Vegetation Resources (ENCCRV) ended. The program included the evaluation, implementation and compilation of lessons learned from operational action measures seeking to establish new replicable and scalable sustainable forest management models, including the execution of projects for the implementation of Payment for Environmental Services (PES). Specifically, the project was developed in five regions of the country, of which two correspond to AA regions (La Araucanía and Los Ríos):

  In these regions, restoration and reforestation actions were carried out within the framework of the REDD+ activities established in the action measures of the ENCCRV. At the end of the project, progress was made in the implementation of the Adaptation Program for the management of vegetation resources in the framework of climate change, desertification, land degradation and droughts (G.A.1) and in the Ecological Restoration Program with native species (MT.5.), both defined in the ENCCRV, through the construction of nurseries, greenhouses and restoration activities in an area totalling 285 ha. In addition, under the Payment for Environmental Services (PES) model, two pilot projects were developed, together with Rural Drinking Water Committees (CAPR), in the towns of Mashue, Niebla-Los Molinos and Liquiñe in the Los Ríos Region based on the strengthening and implementation of a remuneration model for the ecosystem service of water supply. Another project was implemented focused on recovering ancestral harvesting practices for pine nuts (*piñon*) to improve climate change adaptation and mitigation actions in the indigenous community of Quinquén in the Araucanía Region. The objective of this project is to support the adoption of ancestral sustainable management practices through the cultivation of a portion of the seeds harvested and the subsequent use of the seedlings for revegetation in prioritized sites.

  • Advances in Carbon Accounting: Methodological and territorial scope improvements have been developed in the Reference Level of Forest Emissions/Forest Reference Level (NREF/FRL), improvements in the National Forest Monitoring System (NFMS), and improvements in the Safeguards Information System (SIS). Details of all these advances are presented in Annex 4 of this report.

Other technical advancements

- Advances in safeguards: during the reporting period, there have been advances related to the technical design of the Safeguards Information System (SIS) for its subsequent implementation. This system was developed with a multi-scale approach – local, operational, administrative, and national – to ensure respect for REDD+ safeguards in the execution of the ENCCRV. For its part, the World Bank announced a change from the Environmental and Social Management System to the Environmental and Social Framework , which offers broad and systematic coverage of environmental and social risks with advances in transparency, non-discrimination, public participation and accountability. Coordination with CONAF's Information, Complaints and Suggestions Office (OIRS) was strengthened through the inclusion and improvement of the procedure associated with the ERP's Complaints and Suggestions Mechanisms (CSM). Finally, a National Safeguards Approach Proposal for the ENCCRV has been developed and socialized by the

UCCSA safeguards specialists, in line with the commitments made by the country within the framework of the ENCCRV. More details of these advances are presented in Annex 1.

- Advances in the payment by results phase:

i. The country's first results-based payment project, called the +Bosques project, began in August 2020. During the period 2020-2021, the project began its preparation stage with the hiring of professionals – at the central and regional level – for the implementation of the project, in addition to defining the basic arrangements and guidelines for its implementation. In 2021, progress was made in the implementation of three projects in the Maule Region, with a total of 43 ha benefitting from afforestation activities, 10.1 ha from restoration, and 63.4 ha from post-forest fire restoration activities.

ii. In parallel, in June 2021, the 4th edition of the ENCCRV Benefit Sharing Plan (BSP) was published, and the Operational Manual for the implementation of the BSP was developed within the specific framework for the ERP, which constitutes the basic framework for the implementation of the payment by results phase of the ENCCRV and the ERP. This ensured the country's compliance with the effectiveness conditions established for the validation of the ERP Payment Agreement (ERPA).

Strategy Update to mitigate/and or minimize potential displacements

The ERPD 2016 document from Chile proposed that the most important way for ENCCRV to avoid displacements would be to implement action measures at the national level. Under this approach, the likelihood of displacements becomes significantly lower. This way remains the most relevant in the ER Program reporting period, as ENCCRV actions are effectively being implemented across all regions of Chile and not just those in the AA. Nevertheless, the ERPD mentioned possible local displacements could occur inside the AA, for which measures associated to some of the main drivers identified were proposed.

In 2018, the document "Additional background for the update of the Chilean ER Program, according to recommendations by the Chair´s Summary in the 15th Meeting of the Carbon Fund", does not refer to any changes in the strategy for mitigating and/or minimizing these possible displacements. If that is so, the strategy used to mitigate displacements inside the AA remains as such, i.e., through measures designed for some of the main causes or drivers associated to forest degradation and deforestation, which have been updated as such for the period of this report:

DD cause/driver	ERPD proposed strategy to reduce displacement risks (2016)	Strategy update for report period (2020-2021)
Unsustainable use of vegetation resources.	With the forestry management actions proposed by the ENCCRV to address this driver, a risk of emission displacement is generated due to the reduction of the potential extraction volume by forest owners under planning criteria. The strategy proposed to reduce or avoid such displacements consists in increasing sale prices under a higher valuation for sustainably sources wood. In this manner, owners can extract less wood without impacting their revenue. This is achieved through improved productive chains, moving forward in the sustainable firewood and wood certification process for obtaining better	Multiple support activities for productive chains, oversight and planning in sustainable management have been carried out within the ER Program, so this strategy remains current and active. The only component of the strategy without developments has been the tax reduction for sustainable producers.

DD cause/driver	ERPD proposed strategy to reduce displacement risks (2016)	Strategy update for report period (2020-2021)
	prices. On the other hand, the ENCCRV will seek to lower production costs for owners through tax reductions and improved monitoring to promote sustainable forest management.	
Forest fires	With the fire prevention actions proposed by ENCCRV to address this driver, such as preventive silviculture, there is a risk of emissions displacement by promoting forest biomass extraction actions (Fire and fuel gaps). The strategy proposed to avoid and reduce such emissions entails, on one hand, detailed planning of each activity to identify the best way to remove a minimum amount of biomass with the greatest impact on fire risk reduction, and on the other, using the extracted biomass in wood – based products that fix carbon in longer terms.	Multiple training activities in fire prevention silviculture and productive linkage for owners and producers have been conducted within the framework of the ER Program and ENCCRV. Pilot experiences have also been developed, making it possible to advance in the technical validation of fire prevention silviculture and include the costs of such projects in the value table of Law No. 20,283. Given this, it can be said that this strategy is current and active for this risk.
Forest being used for livestock farming	Establishing buffer zones for livestock farming in forest areas is one of the measures proposed by the ENCCRV for addressing this driver. There is a risk of this measure generating emissions displacement, as cattle will have to be moved to other grazing areas and cause degradation. The strategy for reducing such risk is based on supporting the development of global livestock management plans, leading to a more efficient use of plains, forest grazing systems and summer grazing management.	Property planning activities have been conducted in the framework of the ER Program and ENCCRV integrating various land uses and productive activities (Livestock and forestry). UTREs have also developed such property plans for various pilot properties. On the other hand, the GEF MST project, which includes one of the AA regions, has generated pilot experiences and capabilities in management at a property scale, maximizing productive efficiency and the structured use of State promotion instruments. Given this, it may be stated that this strategy is current and active for this displacement risk, which is considered to be medium. Reinforcing such actions through training instances in other regions will be evaluated.
Agriculture and livestock expansion	In order to mitigate the potential of deforestation emissions due to this driver to transition towards forest degradation, the proposal is to promote the conservation of native forests with financial support through the incorporation of forest conservation variables in Law 18,450 on irrigation promotion and Law 20,412 on sustainability of agricultural lands. Then, farmers and livestock owners will have another sustainable source of revenue to compensate for the potential loss of their previous livelihood if changes to forest conversion promotion by means of Laws No. 18,450 and 20,412 were to deter them from expanding their agriculture lands over natural vegetation.	There have been no developments in the incorporation of forest conservation variables to Laws No. 18,450 and 20,412; therefore, this strategy is neither current nor active. The viability of achieving such regulatory adjustments during the period of the Emission Reduction Payment Agreement (ERPA) is on an evaluation process and failing this, a new strategy will be explored for this risk of displacement as it is considered low.

Effectiveness of organizational arrangements and involvement of partner agencies

CONAF possesses a governance structure at the national and regional level that has allowed it to effectively implement the ER Program and ENCCRV actions. The organizational structure of CONAF is based on a clear chain of command with well-defined instances and roles, also including agile information systems. It has allowed for the generation of governance instances along with internal functional arrangements to institutionalize and operationalize ENCCRV actions in the regions of the ER Program. As an institution spread across various territories, CONAF has a central office led by an Executive Directorate, Management, Advisory Units and Department which all contribute to the implementation of the strategy at the regional level. The Forest and Xerophytic Ecosystems Conservation Management (GCEBX, acronym in Spanish) is responsible for directing and leading the ENCCRV.

The units and departments associated with the ER Program in the reporting period are, from the central level, the Climate Change and Ecosystem Services Department (DCCSE, previously UCCSA acronym in Spanish) as the leading technical entity, the Secretariat of Indigenous and Social Affairs (SAIS, acronym in Spanish), the Prosecution Office, and the Environmental Assessment Department. Also, the Interagency Committee on Climate Change of CONAF, permanent instance with the function of coordinating all institutional actions associated to the ENCCRV, has ensured the institutionalization of both the technical activities and safeguards treatment. This structure has allowed for the development of the Strategy to be systematic, efficient and be progressively inserted in the institutional work for the scope of the proposed goals and objectives. DCCSE has also been a key instance at the central level for enabling the ENCCRV result – based payment phase. Acting as a Focal Point for REDD+, it has coordinated international cooperation associated with REDD+, also being in charge of the administrative, financial and technical aspects of projects, including the approach towards consideration and compliance with safeguards.

In addition, the CONAF Civil Society Council (COSOC, acronym in Spanish) has also participated, being a citizen participation mechanism that is advisory in nature (non - binding), whose actions are reported to and its recommendations incorporated to each of the areas of technical work, including developments in the implementation of ENCCRV. In Meeting #2 of 2019, besides from applications to the Green Climate Fund (GCF) and the FCPF Carbon Fund being informed, treatment of safeguards for project implementation in the ER Program area was also presented.

At the local level, and as a way of ensuring the effectiveness of institutional management in the implementation of ENCCRV at the regional level, there are DCCSE representation offices in all regions that are part of the ER Program. This role is fulfilled by a Coordinator of Climate Change and Ecosystem Services, who reports administratively to the Climate Change and Forest Departments (DBOCC, acronym in Spanish). These are professionals with a long-standing institutional track record, with experience in project management and community relationships. In those regions where ENCCRV pilots and/or projects have been developed, these coordinators actions have been reinforced by support professionals, who contributes towards management of projects in general and safeguard follow up, monitoring and reporting, as is the case for Regional Managers for Indigenous and Social Affairs.

Regarding the efficiency of institutional arrangements for the generation, reporting and integration of information with other State agencies, it is worth mentioning that the sources of basic information for the implementation of the ER Program Monitoring Plan, based on the National Forest Monitoring System, have been, i) Cadastre of Vegetation Resources and statistics on forest fires developed by CONAF, ii) the Continuous Forestry Inventory developed by the National Forestry Institute (INFOR, acronym in Spanish), both institutions part of the Chilean Ministry of Agriculture (MINAGRI, acronym in Spanish). Statistics on areas affected by forest fires have been permanently updated through the Digital Information System for Operations Control (SIDCO, acronym in Spanish) and reported in a yearly basis for each season in the period. Besides the aforementioned basic information, there is a set of second order information, which has to be generated within the ER Program Monitoring Plan framework, such as density plot or stock charts for estimating degradation in all AA forest types, which is being worked on through a specific agreement between CONAF and INFOR.

Regarding consistency between the Forest Reference Level and the National Greenhouse Gas Inventory (INGEI, acronym in Spanish) developed by the Ministry of the Environment (MMA, acronym in Spanish), the CONAF and

INFOR technical teams have been the technical entities in charge of building the greenhouse gases inventory for the Silviculture and Other Land Uses sectors along with ensuring the alignment between the methods applied, with the purpose of improving and maintaining the consistency of both instances. The necessary institutional arrangements to formalize the joint work between services and ministries have been made, such as the Intra – Ministry Technical Committee on Climate Change (CTICC, acronym in Spanish), instance coordinated by the Office of Agricultural Studies and Policies (ODEPA, acronym in Spanish) and composed of all MINAGRI services acting as reviewers for the ER Program and all ENCCRV initiatives, strategic and technical orientation, decision reinforcement and progress report review.

Finally, as international cooperation from different sources has continued and intensified (Section 1.1.1), CONAF has generated and enhanced an internal governance structure to manage international cooperation and strategic partnerships with implementing agencies that provide administrative and technical support, principal among them being the relationship with the Food and Agriculture Organization of the United Nations (FAO).

Financial Plan Updates

It was proposed in the ERPD Chilean document of 2016 that the ENCCRV implementation would require an estimated budget of $174 million dollars for 9 years, 30% of which would be unconditional and the remaining 70% ($121 million dollars) would be conditional on the management and obtention of external resources by CONAF. Then, in the document titled "Additional background for the update of the Chilean ER Program, according to recommendations by the Chair´s Summary in the 15th Meeting of the Carbon Fund" in 2018, an update is proposed for the Initial Plan.

This update has defined the budget for a nine-year period, considering available experiences and better information about the costs of action measures, variations between region and forest types, among other aspects. Therefore, to finance all ENCCRV action measures, the new financial estimate including conditional and currently available factors amounts to $357 million dollars. This includes international bilateral and multilateral contributions, donations, and results – based payments, along with national private and government contributions. Out of all this, 23% come from international sources while the remaining 77% is national. In addition, 40% is unconditional and the remaining 60% is conditional. From the already mentioned financial sources, to meet the goals of the ENCCRV it will be critical to establish a public – private partnership work, aside from promoting regional initiatives of local funds, on which progress has been made due to the reinforcement of capabilities installed in the various regions of Chile through preparation funds.

It is important to consider that the ENCCRV non – conditional budget corresponds to state resources allocated to CONAF through the Budget Law, and that such funds have and will continue to reinforce the compliance of ENCCRV goals. Some of the actions financed through this government source during the ER program report period in order to reinforce activities associated to reducing deforestation and forest degradation have been: i) reinforcement of the firewood energy promoters program; ii) the interoperability of the platforms of the Forestry Promotion and Development Management System (SIGEFOR, acronym in Spanish) with other CONAF platforms to enhance operability; iii) the capability of on-site teams; iv) reinforcement of the Early Warning System (SAT, acronym in Spanish) for the detection of unauthorized forest felling using satellite images and drones, v) the development of a mobile app for the detection of unauthorized forest felling, and vi) a traceability system for native forest primary products. Also, the "Communities Prepared against Forest Fires" program has been strengthened, doubling its impact on 2018 along with the development of manuals and programs for the technical implementation of 7 ENCCRV direct action measures.

As part of the new financial plan, CONAF has been working with the Agency of Sustainability and Climate Change to establish similar public – private synergies and guide actions to leverage resources for actions aligned with the ENCCRV and the ER Program. These actions correspond to fire prevention, forest planning and restoration of areas affected by forest fires through compensation mechanisms that must be applied by private companies, mainly from the real estate and mining sectors. In line with this, financial instruments are being formulated together with CORFO, with such instruments being used to attract private investments for native forest management mainly for wood and energy purposes. From the business sector, an agreement has been made by forestry companies, with technical support by CONAF, to direct efforts towards restoring native forests affected by massive forest fires in the 2017 season, encompassing two of the five AA regions. Also, financial resources provided by the Undersecretary of Agriculture have been added, along with a redirection of funds managed by the Foundation for Agricultural Innovation (FIA, acronym in Spanish) and the MMA through its Environmental Protection Fund (FPA, acronym in Spanish). In this context, companies have invested nearly $80 million dollars, which implied a 60% increase in relation to the average historical expenditure on such issues.

This new financial plan, in line with the Benefit – Sharing Plan (BSP) (See Annex 2), specifically mentions that 20% of the total founds obtained under ER Program payments ($5.2 million dollars) will be used during the implementation period of the Program, with the implementation possibly being extended beyond 2025. These resources will be used to cover and develop those actions that either provide sustainability to the system or correspond to ENCCRV facilitating action measures such as inspection, regularization of property titles of ownership, environmental education, aspects related to the communication, dissemination, and reinforcement of CONAF institutional programs, among others.

Finally, the ER Program considers that 80% ($20.8 million dollars) out of the total resources will be directed towards the population as non – monetary benefits, through technical assistance by strengthening Forestry Extension and forestry management actions where the main focus will be on lands belonging to small and medium scale forest owners, along with public lands. This dynamic applies to all payments perceived by Chile from emission reductions as established in the BSP.

1.2 Update on major drivers and lessons learned

Update on major drivers of deforestation, degradation and non – increase of forestry sinks in the Accounting Area.

The Chilean ERPD document of 2016 detailed the process of the identification, prioritization and characterization of the main drivers or causes of forest degradation, deforestation and non – increase of causal sinks for the PRE. This information was used as a basis for the proposal of the strategic actions which formed the ENCCRV action measures. For the 2020 – 2021 reporting period, no significant changes were identified in the drivers that affect native vegetation resources in the AA. Actually, the document titled "Additional background for the update of the Chilean ER Program, according to recommendations by the Chair´s Summary in the 15th Meeting of the Carbon Fund" from October 2018, does not mention any aspects regarding changes or updates on this issue.

The drivers analysis presented in the Chilean ERPD was conducted with a methodology that included the collection and systematization of information about participative processes and specialized consulting. These analyses have not been conducted again in the reporting period, therefore, the update on the status of the drivers presented below corresponds to a proposal based on updated statistical data, technical analysis of professional teams, and sectorial trends in the reporting period.

Causes or Drivers of forest degradation, deforestation and non – increase of sinks	Relevance defined in ERPD 2016	Relevance 2020-2021 reporting period	Observations/sources of information
DIRECT CAUSES[2]			
Forest fires	Very high	Very high	Remains the most important cause of degradation and deforestation in the AA, according to statistics from CONAF.
Unsustainable use of vegetation resources for production	Very high	Very high	Remains a cause of very high relevance, as there is still a significant amount of informality and unsustainable exploitation of native forests (Above 80%), mainly for firewood extraction, as its use is above 9 million cubic

2 The names of the causes have been updated as per the official ENCCRV document from 2016.

Causes or Drivers of forest degradation, deforestation and non – increase of sinks	Relevance defined in ERPD 2016	Relevance 2020-2021 reporting period	Observations/sources of information
			meters per year in the AA, according to firewood consumption data for 2018 and 2019 by INFOR.
Unsustainable use of vegetation resources for livestock	High	High	Remains a driver of high relevance, as grazing still persists in native forests for all ER Program regions in the AA. There are no systematized statistics, but it is a widely recognized reality.
Forest monoculture expansion	High	Low	The degree of relevance of this driver has decreased, as annual surfaces where native forests are replaced with forest monocultures have decreased since 2014, according to statistics on changes in land use in the CONAF Cadastre and the analysis of emissions caused by the degradation from the transformation of native forests into forest plantation, as in the REDD+ Annex for Chile in 2018.
Agriculture and livestock activity expansion	Medium	Low	The degree of relevance of this driver is decreased, as the annual surface of areas with native forests where agriculture is allowed has decreased since 2014, according to statistics on changes in land use in the CONAF Cadastre and the analysis of emissions caused by deforestation from the REDD+ Annex for Chile in 2018.
Urban and industrial activity expansion	Medium	High	The degree of relevance of this driver has increased, as even though statistics of deforestation and changes in land use have declined in general for the AA, there is an important regional trend towards the increase of property subdivisions for plots and property divisions with the aim of developing real estate projects in forest areas. There are no systematized statistics, but it is a widely recognized reality.
Industrial activity expansion	Low	Low	The degree of relevance of this driver has remained low, since the statistics of deforestation and changes in land use due to the expansion of the industry continue to be in insignificant areas of the AA. according to statistics on changes in land use in the CONAF Cadastre (REDD+ Annex for Chile in 2018).
Effects of climate change, desertification, land degradation and drought	Medium	High	The degree of relevance of this driver has increased, as it has become clear that the impacts of the Megadrought affecting a large part of Chile have intensified. Such effects have been stronger in the native forests of the regions to the north of the ER Program and associated to a Mediterranean climate (Miranda et al., 2020; Garreaud et al., 2017). Also, risk scenarios projected in the Climate Change Risk Atlas (ARCLIM, acronym in Spanish), indicate that this scenario will be permanent in nature due to climate change, even moving towards southernmost territories. These projections, together with the raise in temperature and heat waves, will increase the likelihood of forest fires (Gonzalez et al., 2018). CONAF is planning to conduct relevant studies to determine the magnitude and repercussions of this phenomenon in the ER Program.
Plagues and diseases	Low	Medium	The degree of relevance of this driver has increased, as the risks of new pests entering Chile or existing ones propagating due to recurring climate phenomena are increasing (SAG, 2019).
Effects of contamination	Low	Low	These drivers were not described in detail in the ERPD, since they were not prioritized according to the analysis
Overexploitation of water	Low	Low	

Causes or Drivers of forest degradation, deforestation and non – increase of sinks	Relevance defined in ERPD 2016	Relevance 2020-2021 reporting period	Observations/sources of information
Soil erosion	Low	Low	carried out by the ENCCRV and there was a significant uncertainty from the sources of information to characterize them. It is assumed that they maintain their low relevance.
INDIRECT CAUSES			
Public policy deficiencies for regulation	Very high	Very high	The level of relevance of this driver remains very high to medium, as ven though efforts have been made to advance in the improvement and promotion of regulatory instruments for the forestry sector, a large gap still persists, and the existing instruments are neither sufficient nor adequate for meeting goals and achieving sectorial climate challenges.
Deficiency in public policies due to promotion or enforcement	Medium	Medium	The level of relevance of this driver remains high, as even though efforts have been made to advance in the improvement and promotion of regulatory instruments for the forestry sector, a large gap still persists, and the existing instruments are neither sufficient nor adequate for meeting goals and achieving sectorial climate challenges.
Poor knowledge and cultural valuation of vegetation Resources	Very high	Very high	The level of relevance of this driver remains very high relevance driver, as even though many actions focused on environmental education, awareness, and training under the ER Program and the ENCCRV have been implemented, there is an important gap represented by bad practices and unsustainable actions still occuring in native forests.
Informality in firewood markets	High	High	The level of relevance of this driver remains high, as a significant amount of informality and unsustainable exploitation of native forests for firewood extraction persists (over 80%), since its use is above 9 million cubic meters per year in the AA regions, according to firewood consumption data for [2018 and 2019 provided by INFOR].
Rural poverty, lack of opportunities	High	High	The level of relevance of this driver remains high, as rural poverty and vulnerability still persist in AA regions.
Deficiency in public policies due to limited oversight capabilities	Medium	Medium	The level of relevance of this driver remains medium, as even though many actions focused on training, improvement of technical and technological capabilities and awareness have been present under the influence of the ER Program and the ENCCRV, there is an important gap that needs to be addressed, and CONAF oversight capabilities are limited in scope.
Low profitability, opportunity costs	Medium	Medium	The level of relevance of these drivers remains medium, since there have been no significant changes in financial returns and opportunities associated with the management of native forests.
Economic Model Deficiency for the Use of the Native Forest (NF)	Medium	Medium	
Disputes or problems due to fragmentation of property	Medium	High	The degree of relevance of this driver has increased, since there is a significant trend in the AA regions towards an increase in property plot subdivisions and divisions with the aim of developing real estate projects in wooded areas. There are no systematized statistics, but it is a widely recognized reality.
Disputes or problems due to property tenure	Low	Medium	Land tenure problems have been and continue to be a relevant issue in the AA regions, and its impact as a driver has increased, considering that most of the forest

Causes or Drivers of forest degradation, deforestation and non – increase of sinks	Relevance defined in ERPD 2016	Relevance 2020-2021 reporting period	Observations/sources of information
			promotion programs and implementation projects within the framework of the Climate action, require forest owners to have their land tenure situation regularized. This situation leaves many potential beneficiaries out of these programs.
Deficiency of the forest institutional framework	Low	Low	It continues to be a driver of low relevance since although there are still important gaps to improve and consolidate forestry and environmental institutions in Chile, these gaps should not have a significant impact on the processes of degradation, deforestation, and the non-increase of sinks.
Lack of association for farmers	Low	Low	It continues to be a driver of low relevance since although there is still low productive associativity among forest owners, this gap should not have a significant impact on the processes of degradation, deforestation, and the non-increase of sinks.
Stigmatization of forest plantations	Low	Low	It continues to be a driver of low relevance since although the stigmatization of forest plantations has increased, this situation should not have a significant impact on the non-increase of sinks, even more so considering that the ENCCRV has restricted afforestation actions in the exclusive use of native species.
Management plans do not ensure sustainable use	Low	Low	It is assumed that the level of relevance of this driver remains low since the area managed under these plans is still small, and there has also been progress in the capacities to support and monitor the correct application of these plans. There are no systematized statistics, but it is a widely recognized reality.

2 SYSTEM FOR MEASUREMENT, MONITORING AND REPORTING EMISSIONS AND REMOVALS OCCURRING WITHIN THE MONITORING PERIOD

2.1 Forest Monitoring System

Organizational structure, responsibilities, and competencies, linking these to the diagram shown in the next section

The National Forest Monitoring System (NFMS) of Chile has been established for monitoring forests in the country and operates on existing systems supported by various institutions which underpin and maintain it, which produces a functional link among its multiple building elements.

The NFMS in Chile is coordinated by CONAF, institution serving as REDD+ Focal Point to the UNFCCC (CMNUCC in Spanish) in accordance with Decision 10/CP.19. CONAF operating under the MINAGRI who gives the REDD+ Focal Point to the Climate Change and Ecosystem Services Department (DCCSE) of the Forest and Xerophytic Ecosystems Conservation Management (GCEBX, acronym in Spanish). As the REDD+ focal point, DCCSE has the responsibility of being the organization in charge of coordinating the generation and reporting of elements linked to REDD+, which includes the responsibility of coordinating the NFMS, reporting and generation for FREL/FRL and REDD+ result reports.

Inside CONAF, there are other units with the main responsibility of generating activity data. Among them, the Climate Change and Ecosystem Monitoring Department (DMECC, acronym in Spanish) of the Environmental Evaluation and Oversight Management (GEF, acronym in Spanish), has a primary role for the generation of base information. DMECC is responsible for implementing the mandate established by Law No. 20,283 of 2008, which establishes that CONAF "Will maintain a Forest Cadastre, which is to identify and establish, at least cartographically, the forest types that exist in each region of Chile".

The Forest Cadastre, called "Cadastre of Native Forests and Vegetation Resources", is the main source of information for the development of Land – Use Change Maps, also developed by DMECC for the continuous monitoring of vegetation cover in Chile.

As the next figure shows, CONAF also includes the participation of the Forest Fire Protection Management (GEPRIF, acronym in Spanish) through the provision of information by means of the Operation Control Digital System (SIDCO, acronym in Spanish) and GEF using the Forestry Administration and Control System (SAFF, acronym in Spanish).

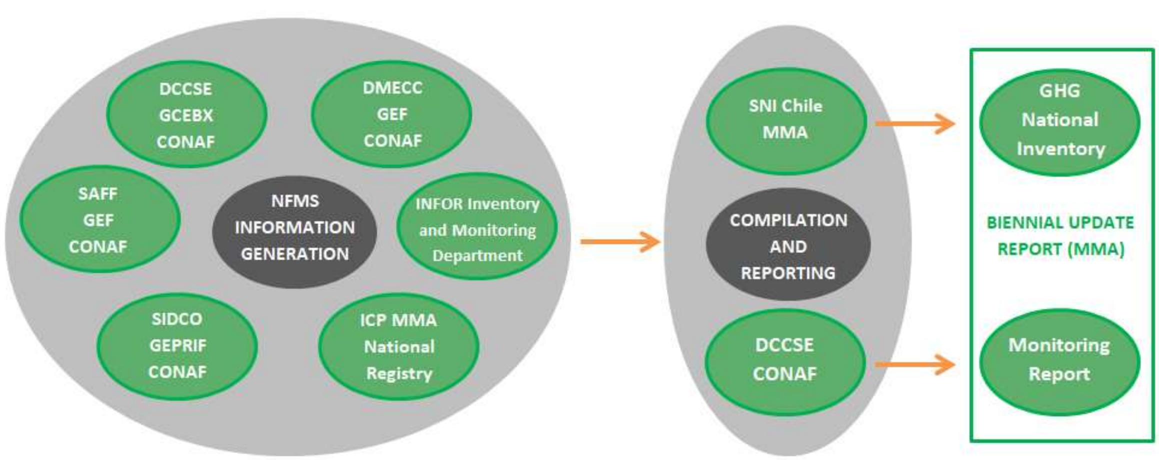

Figure 1. NFMS Organizational Structure of Chile.

Within GEPRIF, The Protection against Forest Fires Department and its Digital Information System for Operation Control (SIDCO), provides annualized statistical information on the occurrence of forest fires in the entire country. On the other hand, SAFF provides information about the implementation of forestry management plans. Finally, also within CONAF, The Protected Wilderness Areas Management (GASP, acronym in Spanish) is responsible for providing information on conservation areas in the National System of Wilderness Protection Areas or SNASPE.

Together with the CONAF units, activity data for the NFMS is provided by the Forestry Institute INFOR and the Ministry of the Environment (MMA, acronym in Spanish). INFOR is established as a private law corporation, part of MINAGRI, with such institution providing public funding for the design, technological development, implementation, and execution of the National Forestry Inventory.

Information about emission factors for forest monitoring comes from the National Forestry Inventory or INF, administered by INFOR which is also used by the Chilean National Greenhouse Gases Inventory System (SNIChile), administered by the Climate Change Office, which arises as a response to the need to inform the citizens about GHG emissions and removals in the country.

Emission factors are monitored by INFOR through inventory plots and reported annually through IFN national reports. Emission factors are applied to the NFMS by forest type and/or region, depending on the REDD+ activity evaluated.

The Ministry of the Environment is the State organ in charge of working with information provision on private conservation initiatives, for their incorporation to the accounting of areas subject to conservation. The National Registry of Protected Areas was established within the MMA, which operates as an information platform where the 9 categories are considered protected areas (Marine Park, Pristine Regions Reserve, National Park, Natural Monument, Forest Reserve, National Reserve, Marine Reserve and Multiple Use Coastal Marine Areas), aside from Private Protected Areas and Community / Private Conservation initiatives, encompassing the entire national territory.

The selection and management of GHG related data and information

The information and data selected to be incorporated to the NFMS, have been defined by Chile in the ERPD on which the subnational FREL/FRL was established. Selected information and data remain for this monitoring report, being managed by DCCSE for the monitoring and reporting.

Activity data: Land use and land use changes maps[3]

Land use data selected for the FREL/FRL were those coming from existing Native Forest Cadastres in regions of the Accounting Area. The information provided by the Cadastre is regularly updated by the Climate Change and Ecosystem Monitoring Department (DMECC) of CONAF, describing 9 Land uses and 20 Sub – uses, along with other breakdowns by altitude, cover and structure.

Nevertheless, as indicated in Annex 4 of the first Monitoring Report, the reference level was corrected by incorporating spatially explicit use change data estimated based on reference maps for evaluation instances 2001 and 2013. Such maps are developed through the implementation of a semi – automated methodology for change detection that operates on Landsat images analyzed in Google Earth Engine by applying the land use definitions defined by Chile in the Cadastre of Native Forests.

REDD+ activities and sub – activities that occur in forest remaining forests

The data selected for the estimation of emissions and captures from activities that occur in forest remaining forests are those indicated in the ERPD and refer to data coming from plots in the Continuous Inventory of Forest Ecosystems or National Forest Inventory (IFN) by INFOR, combined with spectral information from the Landsat series. This information integrates forest state variables on the number of trees per hectare and basal area registered in the IFN plot monitoring, with Landsat spectral data in order to estimate carbon stocks in a spatially explicit manner.

[3] Land Use Change Maps are available in https://plataforma.enccrv.cl/static/erpa/mr2/mapas/CUT-MR2.zip

Satellite Information

The generation of activity data in land use change activities and change detection is developed based on spectral information from the Landsat data. To obtain satellite images that are representative of the beginning and end of each period, NFMS has been corrected through work with multi – pixel mosaics that require a time range for the search for cloud free images and the selection of the pixels that comprise such images. The multi – pixel mosaic is an image comprised of pixels from various images, extracted from the definition of a time range or window. The selection of each pixel seeks to define the best available information for a given area, with the priority being pixels free of clouds and shadows of such clouds.

Given the large number of clouds in the south of Chile, this time window will correspond to a range of ± 3 months for the starting date of the period and the end date of the analysis period respectively, as it corresponds to the dry season period in Chile. As an example, for the 2018 – 2019 where the starting date is January 1, 2018, the time range or window will cover between October 1, 2017, to March 31, 2018. For the end of the period until December 31, 2019, the time range for multi – pixel mosaic estimation will address from October 1, 2019, until March 31, 2020.

For pixel selection, a code is applied in GEE where median NDVI values are selected for pixels corrected to land surface. NDVI medians are selected with the purpose of not incorporating phenological states of vegetation with high photosynthetic activity or vigor, but rather selecting values that do not alter the outcome of the method application.

Information administration and Management

The management of the information that comprises the NFMS is led by the Climate Change and Ecosystem Services Department (DCCSE) of CONAF, by means of a cloud-based infrastructure. For the development of FREL/FRL, the associated information was managed through spreadsheets stored in desktop computers, backed up in external storage devices.

Currently, data management is done through cloud storage using Gmail and OneDrive platforms. A series of folders have been organized in order to favor versioned and organized information storage, to which access is granted through various permissions to the people who participate in the estimation process. The folders are divided into base information, documents, tools, reports, and work for each of the NFMS reporting elements.

The base information provided by the DMECC and INFOR, along with the auxiliary information which feeds the monitoring, are stored in different folders that can be accessed by the working teams that generate such data. Each folder may contain different versions of the data, which is documented through files that account for the changes between versions. The versioning description is the joint responsibility of the DCCSE team and the information generating team.

The data that comprise the NFMS and allow for the generation of reports are public in nature and made available to the community through links to downloadable files in the reports published by Chile. CONAF is responsible for the information as the REDD+ focal point that generates estimates and develops the reports, therefore being the owner of their intellectual property.

Processes for collecting, processing, consolidating, and reporting GHG data and information

The main processes for collecting, processing, consolidating, and reporting GHG emissions in NFMS are described below.

- Activity data generation processes

Activity data generation is also divided into land use change activities, obtained from land use change maps, and activities on forest remaining forests, these being associated to the development of carbon flow and stock maps for forest degradation.

These two elements are generated through two base official inputs, respectively: Land use type surfaces and land use change surfaces from maps of changes in land use based on the Native Forest Cadastre and Carbon content and variation in forest carbon content from the Forest Inventory. Both processes begin with the development of satellite mosaics.

a) Land Use and Land use change map development

The development process for use and land use change maps has been a joint development by DCCSE and DMECC, with the purpose of defining forest related land use changes for determining REDD+ activities and sub activities.

For the 2020-2021 monitoring period, the process considers the development of one Land Use Change Map per region, based on satellite mosaics and the MIICA[4] change detection method. To achieve this objective, it was necessary to establish change thresholds that ensure the spectral values register empirical changes. Change categories to be used are those mentioned in the CONAF "Methodological protocol for the development of land use and land use change maps in Native Forests as of 2016".

Land Use Change Map Validation

The land use change map is implemented by comparing the results achieved in maps to reference observations obtained through open-source platforms available at Open Foris: SEPAL, Open Foris Collect and its Google Earth interface, Collect Earth.

The validation process starts with the implementation of a pre – sampling to estimate the accuracy of each IPCC land sub use.

The polygons from the land use change map which are overlapped are first selected from the previously obtained pre sampling points and then, entered in Google Earth in .kml format so reference data (ground truth) can be collected with support from Collect Earth surveys. Both data collection and user accuracy estimation are conducted in the same way as the sampling, through confusion matrixes.

Reference data are selected based on the information obtained in the pre sampling, through a random sampling design stratified for each IPCC land sub use in each region. This sampling type also allows to report the accuracy and surface evaluated for each category in the results, aside from adjusting a sample size for each that ensures global reliability in the evaluated areas (Olofsson et al., 2014).

Surface per IPCC land sub use information in vectorial format is necessary for the sampling design, reducing map input and processing times in the server. User accuracy parameters for each land sub use are obtained from the information obtained in the pre sampling stage, which are then entered into the platform as expected user accuracy values, considering a 0.01 standard accuracy error (Olofsson et al., 2014).

Activities and sub activities related to forest remaining forests[5]

The process is based on the methodology detailed in Bahamondez et al. (2009), which considers the number of trees per hectare and basal area monitored by the inventory as input variables. It refers to spatially explicit information which location is known, by applying an interpolation process for carbon flux and stock in the analyzed periods.

Forest Inventory plots, from the IFN, are placed in a density plot or stock chart, based on the number of trees and basal area per hectare. The density plot considers various lines or thresholds which determine, for various forest types, their status at the time of measuring. This information identifies the state of plots, distinguishing between degraded and non-degraded plots (Bahamóndez, 2009).

In the case of the methodology applied in the NFMS, the B line or threshold will allow the degradation in forest remaining forests and restoration in degraded forests to be identified. Line B represents the limit at which trees can develop large treetops and completely occupy the site capacity without excessive competition (Gingrinch, 1967). The limit for this threshold was established through field work by experts and is specific for each forest type (INFOR,

[4] The MIICA methodology is based on the combination of 2 spectral indices (dNBR, dNDVI) which, through integration rules, provide coverage of land use change, indicating the magnitude and directionality of the change.
[5] CO2 maps are available in https://plataforma.enccrv.cl/static/erpa/mr2/mapas/CO2-MR2.zip

2012). Line B is considered the natural resilience threshold of a forest. Plots located below the B line or threshold are not recommended for productive work.

Forest types with density diagrams available and incorporated to the degradation estimation methodology are the following: Roble – Raulí – Coihue (RoRaCo in Spanish), Siempreverde, Canelo, Lenga – Hualo (RoHua), Coihue – Raulí – Tepa (CoRaTe), Coihue de Magallanes, Spinal subtype Esclerófilo and Esclerófilo.

The IFN is designed under a two-stage statistical design concept, in clusters of three concentric circular plots of an area equivalent to $500m^2$, distributed in a 5x7 km systematic grid. The inventory is based on the generation of a first measurement cycle for permanent sampling plots covering 9.38 million hectares of native forest between the Coquimbo and Magallanes regions, completed in the 2001 – 2010 period, together with a second yearly basis measurement cycle under the partial replacement system with support from growth projections.

GHG data and information consolidation and integration

The previously described inputs are integrated into geospatial relational databases associated to spreadsheets, which pick up and systematize information about activity data and emission factors for the inputs generated following a structure in accordance with the necessities of REDD+ activities.

DCCSE is responsible for the consolidation of information, integration, emissions and captures estimation for REDD+ activities, with such consolidation being implemented by the MRV Monitoring, Reporting and Verification team. The use of semi-automated software tools has the main goal of minimizing human errors, increasing result consistency and transparency through the association between these spreadsheets and a PostgreSQL database. This process also adds improvements concerning result check and update times.

The protocol for estimate integration and execution, aside from the spreadsheets summarizing estimate results divided by REDD+ activities integrating results for the updated monitoring period and FREL/FRL can be found as an annex to this document.

The data integration process operates on the PostgreSQL database server, to which the main and auxiliary NFMS information, land use change maps, carbon content map and estimate parameters are loaded. Change map vectorial coverages are used in .gdb formats, while rasters are integrated from map associated .dbf files.

Information entry to the database for estimate execution is supported by a series of geographic and topologic validation rules, data attributes and content, to avoid subsequent errors during estimations or errors and inconsistencies in the results. Data is repaired, corrected, and prepared for integration during these validations. Among all the processes being run, one of the most important tones is the estimation of surfaces per REDD+ activities, equivalent to activity data.

Finally, the data uploaded to postgreSQL interacts with Excel [6]to run the estimation process. This connection takes place through the ODBC Open Database Connectivity connector. The data is then entered into the excel spreadsheets where result estimation is run.

Systems and processes that ensure the accuracy of the data and information

The NFMS has processes established to ensure the accuracy of information, which also contribute to improving the accuracy, transparency, integrity, consistency, and comparability of estimations conducted.

Land use change maps quality control

The quality control process for land use change maps has the main objective of identifying discrepancies and inconsistencies in the results obtained. Considering a semi-automated methodology where some stages are executed through programming code is applied, it is necessary to perform checks on the end product.

[6] Instruction are available in https://plataforma.enccrv.cl/static/erpa/mr2/db/ConectarExcelConPostgreSQL_v3.pdf

Quality control has been developed by DCCSE to be applied to the products delivered by the DMECC about change maps and is mainly focused on detailed map database and attribute reviews, along with layer geometry. Once discrepancies have been identified, they are submitted to the team responsible for their resolution, and then it must be verified if such discrepancies still remain. It is also necessary to document all methodological steps applied, in such a way that a record of continuous improvement is established.

<u>Methodological protocol for the development of land use maps and land use change maps in Native Forests</u>

The objective of this protocol is to describe all procedures, inputs, data sets and methodological steps needed to generate thematic cartography and statistical reports at the technical level on land use extension, distribution and coverage changes from the digital processing of satellite images, to allow for their replication and reconstruction. Some of its specific objectives are:

- Establish a methodology for the evaluation of land use and land use changes in Native Forests with biennial frequency.
- Generate use and change (directionality) coverages for Native Forest land use in the Maule, Ñuble, Biobío, Araucanía, Los Ríos and Los Lagos regions.

<u>Protocol for the development of carbon stock, flux and degradation maps in forest remaining forest</u>

The methodology for estimating forest degradation, applied by INFOR, is based on the integration of satellite information provided by CONAF and the use of information from national forest inventory plots. The use of satellite images must guarantee necessary adjustments for the application of the degradation algorithm. This process is semi-automated by using multi pixel mosaics downloaded from Google Earth Engine. The protocol establishes the requirements of spatial information, dasometric information and data processing needed for calculations.

The application of this process results in thematic maps that combine the information of parcels which information is known, then spatially intersected with state variable and spectral information data.

<u>Uncertainty Estimation System for Land Use Change Maps</u>

The main ways to estimate the accuracy of land use and land use change maps correspond to the comparison between the results of the sorting conducted on reference maps and observations corresponding to a sample. The factors that influence such estimation are sampling design and the size of the map accuracy and precision assessment sample. Errors related to changes in land uses and sub – uses according to Cadastre characterization are calculated by following the Guides on Good Practices for the estimation of use change accuracy described in Olofsson et al (2013).

Chile has a semi-automated software tool that allows to compare land use change map results to high resolution images through Collect Earth. Some of its functions and use steps are:

1. Generate a pre-sampling by change class.
2. From the results of the previously generated pre-sampling, the tool generates one sampling per class that meets the guidelines described in the Map Accuracy Reports (Maximum global error) and as in pre-sampling, this tool can be used in the Collect Earth tool where a group of expert interpreters who assess the initial and final uses of the period according to IPCC classes modified for Chile.
3. The software uses the sampling results to calculate uncertainty at the general and use change/region class level, along with details of emission and commission errors for each map.

<u>Geographic data validation for calculating results</u>

Results estimation is implemented from geographic data of carbon and land use change maps. In order to validate such data, a process with the aim of ensuring the data meets basic conditions for spatial analysis by means of topological conditions has been developed.

Data geometry is validated in others, as it is fundamental for spatial analysis since errors detected by validation codes must be fixed before integration and calculation.

Aside from this and to reduce processing time for millions of records, an index structure for improving database performance has been developed. These indexes are applied to non-spatial values from the land use change map.

Applying a checklist to activity data

NFMS has a base process for ensuring information quality and consistency, which consists in applying checklists to the results of activity data obtained from the final integration and calculation tools. The process is applied by DCCSE, with the aim of having informed surfaces be completely consistent according to each REDD+ activity and region informed.

The verification seeks to ensure consistency between the surface reported for each activity and the official surface of each region, through two revisions:

- Total sum of REDD+ activity surfaces per region.
- Consistency between the surfaces reported between two periods.
- The process is applied during the integration of final calculation results and in case of finding inconsistencies, integration must be stopped, and input data reviewed.

Design and maintenance of the Forest Monitoring System

The NFMS has been designed and structured on the institutions related to Chilean forestry resources and the processes conducted by each institution, responsible for use change maps, degradation maps and forest inventory plots, and the GHG National Inventory of Chile.

Its design has a gradual approach, starting with a reference level at subnational scale and therefore its construction has been on a step-by-step basis, with the goal of advancing towards the national scale monitoring of forestry regions.

Regarding NFMS maintenance, the main activities by each institution that allow continuing the development of necessary inputs and methodologies for guaranteeing reporting on forest status in a climate change context considering continuous improvement elements are described below:

- CONAF: as part of its mandate, CONAF is responsible for implementing native forest registries through the DMECC. Also, based on international commitments on climate change, it has assumed the responsibility to develop biennial land use change national maps that contribute to ensure reporting on climate change matters and results – based payment projects. On the other hand, CONAF has made progress in the development of software tools for the development of MRV estimates and reports.

- INFOR, due to being responsible for the National Forestry Inventory, is responsible for continuing the measurements supported by the Chilean GHG reports, both from REDD+ and the GHG National Inventory. On the other hand, as a member of the Agriculture, Forestry and Other Land Use (AFOLU) like CONAF, INFOR remains close to the ERPA associated INGEI and REDD+ climate change commitments of Chile and maintains the commitment of executing the necessary processes for estimating degradation of the two next monitoring milestones, in accordance with the agreement.

Systems and processes that support the Forest Monitoring System, including Standard Operating Procedures and QA/QC procedures

The processes that support the FNMS are described in the next SOPS:

- **SOP01 Satellite mosaic elaboration (includes satellite image selection)[7]**

This document is a guideline to select and download multi pixel satellite mosaics to monitoring land use and land use change and to evaluate forest degradation in NFMS. The document indicates the searching windows of images and pixels with the minimum required quality to be included in the mosaic elaboration.

- **SOP02 LULUCF Maps elaboration[8]**

The SOP 2 indicates the technical procedure to detect gain and losses in forest land, for the land use change monitoring, through the Multi Index Integrated Change Detection MIICA method application.

- **SOP03 Standardization and quality control protocol for land use change maps [9]**

Standards or guidelines are established and used as compliance rules to standardize formats regarding historical and use change map, which contain information and traceability by region of land use, sub – use, structure, forest type, forest subtype, change and type of change for each evaluated period.

Also, a series of methodological steps consisting in a quality control for identifying discrepancies between the various versions of the historical and use change maps is described.

- **SOP04 Uncertainty assessment on land use change maps[10]**

Correspond to standard operating procedures in writing containing detailed protocols to be followed in order to correctly attribute land uses, training procedures for interpreters/evaluators and develop a re-photointerpretation process for a series of sample units to guarantee that standard operating procedures are correctly implemented and identify areas of improvements through the use of a Platform of Uncertainty.

Visual Interpretation Classification Manual:

Written manual created as a practical, step by step tutorial meant for interpreters/evaluators that participate in uncertainty estimation processes.

- **SOP05 Forest carbon flux estimation assessment[11]**

Develops the methodological protocol for estimating carbon fluxes in forest lands that remain as such, by integrating satellite mosaics with data series from forest inventory plots. These data are combined to determine the degradation or increase of carbon stock in permanent forest.

- **SOP06 Field operation manual[12]**

This manual details the procedures and methods to be used in the field data collection for the inventory of the resources comprised in the native forest ecosystems of the country. It includes the chapters that deal with the data and information referring to the field brigades and the conglomerates, the plots and the trees, including the variables that characterize the development environment from an ecosystem perspective. As such, it aims to rescue data and information from the different components of forest ecosystems.

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[7] SOP_01 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_01_MR2.zip
[8] SOP_02 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_02_MR2.zip
[9] SOP_03 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_03_MR2.zip
[10] SOP_04 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_04_MR2.zip
[11] SOP_05 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_05_MR2.zip
[12] SOP_06 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_06_MR2.zip

- **SOP07 Forest fire polygons**[13]

This document establishes the procedure for the elaboration of forest fire polygons, operational, post and final fire, as an input for the evaluation of the damage caused by these at the level of plant formations, populated centers and strategic infrastructure.

Role of communities in the forest monitoring system

The role of communities in the NFMS is connected to activities previously presented during the 2016 report, which has extended until today in this regard. In such a context, communities actively participate in the system in terms of complaints, first of all, on fire related issues, where territorial committees led by GEPRIF, and its Forest Fire Prevention Department have been established. In this point, the previous report mentioned that the use of fire as a tool in agriculture and silviculture activities is regulated by Decree No. 276 of MINAGRI, enacted in 1980. This decree regulates and establishes norms on technical and administrative procedures for fire use, mainly for agriculture or silviculture harvest residues disposal. When this decree was issued, 45% of all forest fires in Chile were generated using fire for disposing of forestry and agriculture residues without adequate planning or control measures. Nevertheless, the current situation reveals that only 6% of fires are caused due to agricultural and/or forest burning.

CONAF´s online platform for the Burn Assistance System (SAQ, acronym in Spanish) facilitates procedures and processes when members of the community need to use fire, where the user conducting the controlled burning can obtain a voucher for his burn notification without having to visit a CONAF office in person. In this regard, CONAF has provided capacity building and trained communities so their users can use the system effectively and independently through the national territory.

On the other hand, and on this same point about controlled burning notifications, members of the community can also actively participate in complaint procedures that lead to fire use oversight, a situation made possible by the close cooperation between CONAF and the national police (Carabineros de Chile). In this context, initiatives such as these encourage the communities to actively participate in protecting their lands by establishing the already mentioned forest oversight committees, which for example have been developed in Maule, Biobío and Araucanía regions.

In parallel, illegal logging is another aspect related to the role of communities. For this purpose, CONAF also has a mechanism for receiving citizen complaints either via postal mail or e-mail when there is information of any acts where a violation of the Forest Law of Chile has taken place. For this, CONAF oversees verifying the truthfulness of the information being provided through the complaint, following a site inspection process as final verification, and also setting in motion the various legal actions that are required to be filed against the alleged offender. Afterwards, CONAF sends a document to the complainant´s address to notify him/her about the outcome of the complaint and the law enforcement conducted by CONAF, informing the complainant if there was a breach of the existing forest legislation and any legal measures adopted by CONAF if required.

Use of and consistency with standard technical procedures in the country and the National Forest Monitoring System.

The approach for the measuring, monitoring, and reporting established for emissions and captures accounting is completely consistent with the procedures established by Chile for the National Forest Monitoring System, which has been developed and implemented in accordance with the technical requirements established by the UNFCCC and the Carbon Fund. It has also been subject to a technical evaluation by the Green Climate Fund panel of experts during 2019, for the results – based payment phase. The NFMS is part of the ENCCRV Monitoring and Measurement System (SMM), which besides forest monitoring is also designed to monitor neutral land degradation elements, safeguards and co – benefits.

[13] SOP_07 Available in https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_07_MR2.zip

The SMM of the ENCCRV has the information collection processes and systems that act as a basis for the NFMS. These correspond to land use change maps based on a Native Forest Cadastre for land use change activity data, the National Forest Inventory for the estimation of forest degradation, the National Wood Fuel and Carbon Inventory and the Forestry Administration and Control System (SAFF) and the Territorial Information System (SIT). These systems allow the gathering, visualization, query, and maintenance of information related to land use in Chile.

2.2 Measurement, monitoring and reporting approach

The approach applied by the country is based on the preparation of land use / land use change maps, from which the stable and changing forest areas are defined for both the reference period and the period of follow-up. The first step in the process is the preparation of the land use change map and the second is the preparation of the carbon stock map, for monitoring degradation. These are the most important points in the process.

Then, for the land use change activities, the NFMS applies the gain losses estimation approach, and the stock change approach for forest remaining forest activities. For both, the emission factors come from the national forest inventory data.

2.2.1 Line Diagram

A line diagram outlining the important monitoring points, parameters monitored and the integration process according to the two areas of result estimation is shown below. In addition, specific diagrams according to REDD + activity are presented in the text. The next figure shows in a summarized way, the sources of information for the generation of emissions and absorption estimations.

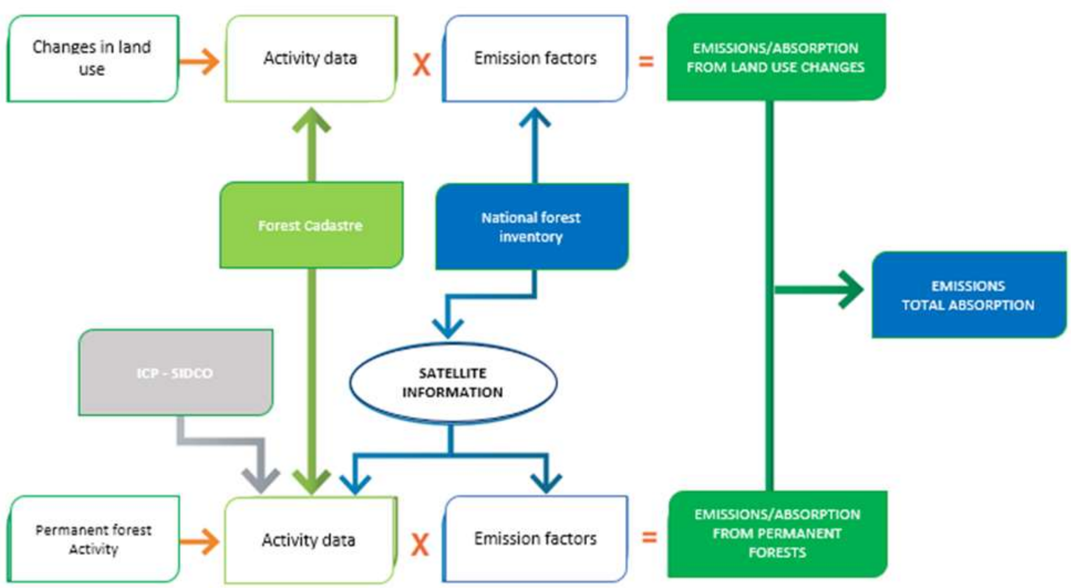


Figure 2. Sources of information for the generation of forest carbon emissions and absorption estimations.

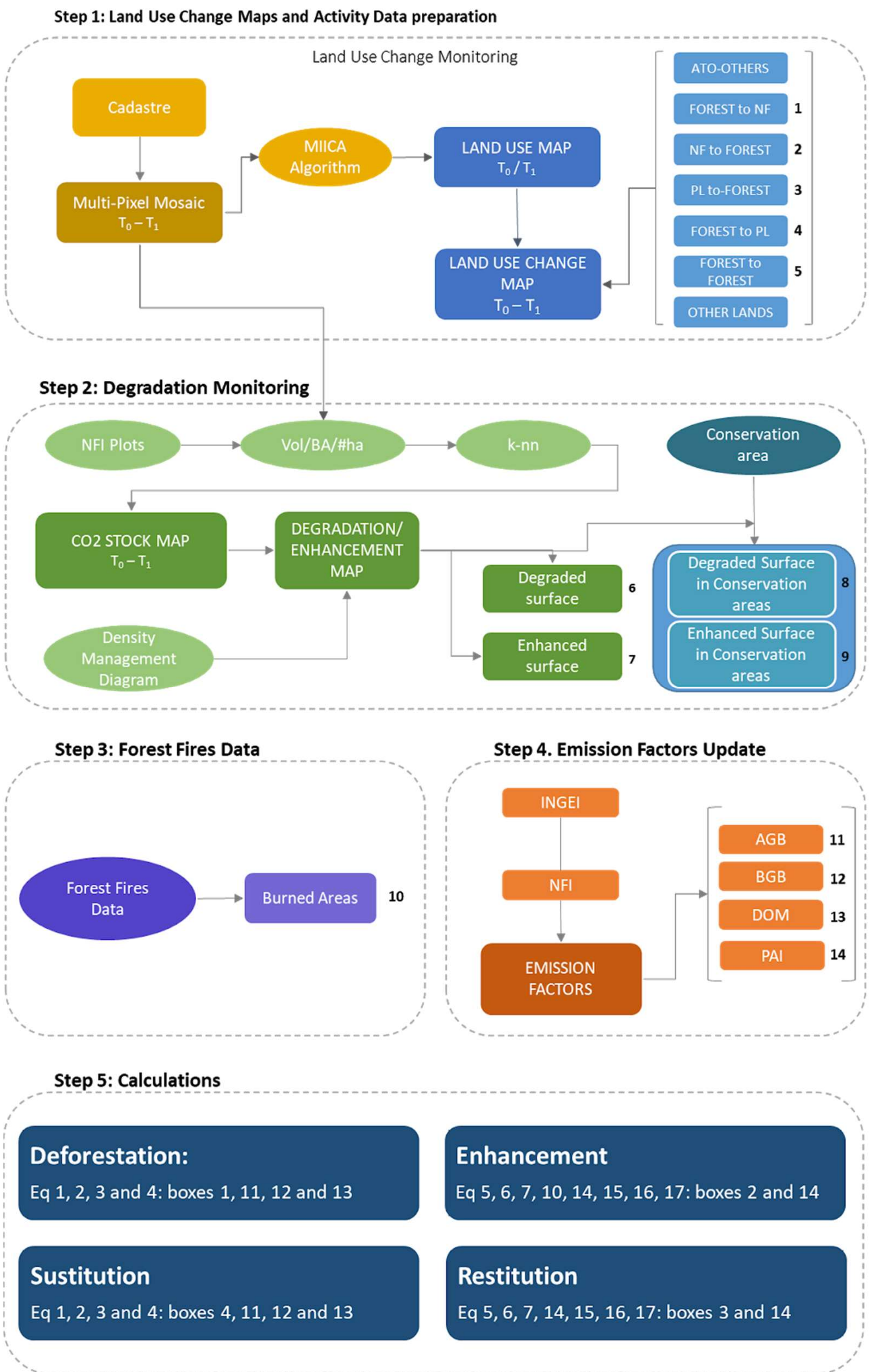


Figure 3. Methodological diagram of the Measurement and Monitoring process.

2.2.2 Calculation

Removals and emissions are estimated in the NFMS by applying the IPCC 2006 equations, in accordance with the methodology applied by INGEI. The equations applied are the same ones presented in the ERPD, both for the reference period and the result monitoring. They are detailed below, by REDD+ activity:

Deforestation

The methodology for calculating deforestation is based on the IPCC 2006 equations for forest lands converted into other lands, which are also used in the INGEI for calculating emissions from forests converted into other land uses. Above ground biomass, below ground biomass and DOM reservoirs are included.

Equation 1. Estimation of Deforestation

$$FREL_{Def} = \frac{\sum_t^n \quad \Delta C_{B_{t,Def}}}{p} * \frac{44}{12}$$

Where:

- Def = annual average carbon stock losses in forest lands converted into non – forest during the reference and monitoring period, in tonnes CO_2e year^{-1}.
- CBt, Def = carbon stock change in forest lands converted into non – forest in year *t* of the reference and monitoring period, in tonnes C.
- *p* = years of the reference and monitoring period.
- 44/12 = factor for converting carbon into equivalent carbon dioxide, tonnes CO_2e ton C^{-1}.

Tier 3 of the IPCC methodology is used in estimations of emissions from deforestation, as carbon stocks in land uses before and after conversion are specific to Chile, with conversion areas being broken down by original land cover type (Sidman et al., 2015).

As recommended in IPCC (2006), Equation 2.15 is used to calculate annual carbon stock changes in wooded lands converted into other land use categories (in the case of deforestation, any forest area converted into non – forest)

Equation 2 [Eq. 2.15 of IPCC (2006)]

$$\Delta C_{B_{t,Def}} = \Delta C_{G_t} + \Delta C_{CONVERSION_t} - \Delta C_{L_t}$$

Where:

- $\Delta C_{B_{t,Def}}$ = annual carbon stock change in forest lands converted into non – forest in year *t* under deforestation activity (Def), in tonnes C.
- ΔC_{G_t} = annual increase in carbon stocks due to growth in forest lands converted into non – forest in year t, tonnes C.
- $\Delta C_{CONVERSIO\ \ t}$ = initial change in biomass carbon stocks in forest lands converted into non – forest in year *t*, in tonnes C.
- ΔC_{L_t} = annual loss of biomass carbon stocks due to wood harvesting, firewood extraction and disturbances in forest lands converted into non – forest in year *t*, in tonnes C.

In this equation, changes in carbon stocks from gains and losses due to any activity other than conversion (ΔC_G and ΔC_L) to net gains and losses directly due to conversion ($\Delta C_{CONVERSION}$; in case of deforestation, as it generally results in a negative value due to the loss in forest carbon stocks) to calculate total changes in carbon stocks.

The NFMS of Chile includes ΔC_G, which represents carbon captures for non – forest uses after conversion (agricultural, urban, others). This variable will be given a value of zero, as it does not impact the deforestation loss analysis.

Equation 3 [Eq. 2.16 of IPCC (2006)]

$$\Delta C_{CONVERSION_t} = \sum_i \left\{ \left(B_{AFTER_i} - B_{BEFORE_i} \right) * \Delta A_{TO_{OTHERS_{i,t}}} \right\} * CF$$

Where:

- $\Delta C_{CONVERSION}$ = initial change in biomass carbon stocks in forest lands converted into non – forest, in tonnes C year^{-1}.
- B_{AFTER_i} = existence of biomass in non – forest land use type i after conversion, in dry biomass tonnes per hectare.
- B_{BEFORE_i} = existence of biomass in forest type before conversion, in dry biomass tonnes per hectare.
- $\Delta A_{TO_{OTHERS_{i,t}}}$ = forest type *i* area converted into non – forest in year t, in ha.
- CF = carbon fraction of dry biomass, in tonnes of carbon by tons of dry biomass. 0.47 is the default value as per IPCC AFOLU guidelines 2006, Table 4.3.

In the case of deforestation, these two equations can be represented with two essential inputs ($\Delta A_{TO\_OTHERS i}$), frequently called activity data (AD) and the amount of carbon stocks emitted due to conversion ($B_{AFTER i}$ - $B_{BEFORE i}$), frequently called emission factors (EF). Parameters $B_{AFTER i}$ and $B_{BEFORE i}$ only include above and below ground biomass, so DOM is included by adding parameter ΔC_{DOM} calculated according to the following equation:

Equation 4 [Eq. 2.23 of IPCC (2006)]

$$\Delta C_{DOM_t} = \frac{(C_n - C_o) * A_{on_t}}{T_{on}}$$

Where:

- ΔC_{DOM_t} = DOM carbon stock change in year t, tonnes C.
- C_n = dead wood and DOM carbon stocks in non – forest land use after conversion, ton C year^{-1}.
- C_o = dead wood and DOM carbon stocks in forest before conversion into non - forest, ton C year^{-1}.
- A_{on_t} = area converted from forest into non – forest in year t, hectares.
- T_{on} = time period for the forest into non – forest transition.

In this equation A_{on} corresponds to activity data, or $A_{TO_{OTHERS_i}}$, according to the parameter of previously described in Equation 3. In order to simplify accounting, DOM emissions will be counted in the year of conversion (meaning T_{on} is supposed to have a value of 1).

The process for calculating emissions from deforestation is summarized in the following diagram:

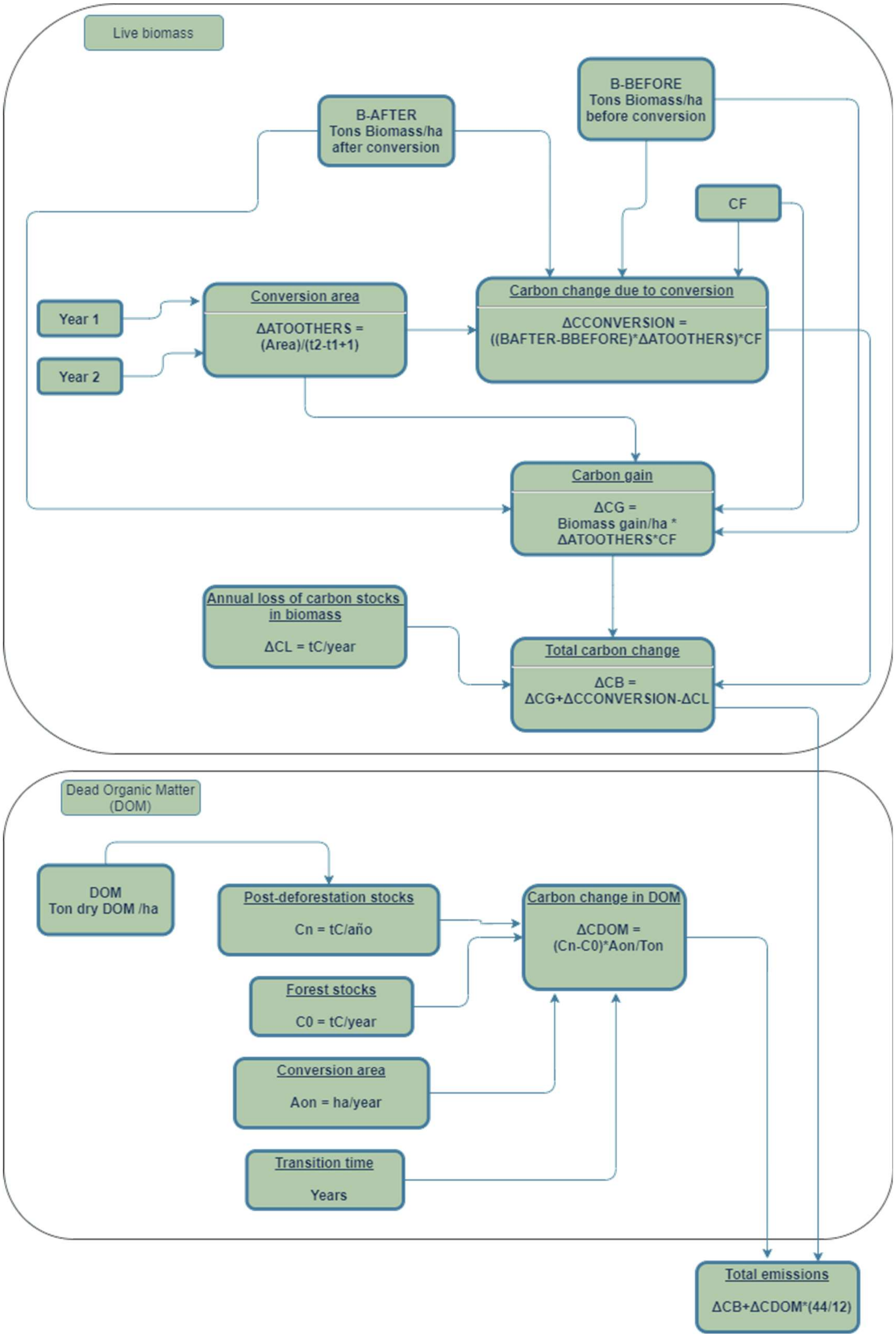


Figure 4. Step by step diagram for estimating emissions from deforestation.

Degradation from substitution

The equation used for estimating deforestation is applied to estimate degradation in native forests converted into plantations, as it is assumed that for a plantation to be established, all carbon content in the preceding native forest must be reduced to zero. Equation 1 is used to calculate the reference and monitoring period in CO_2e. Step-by-step diagram summarizing the process is presented below:

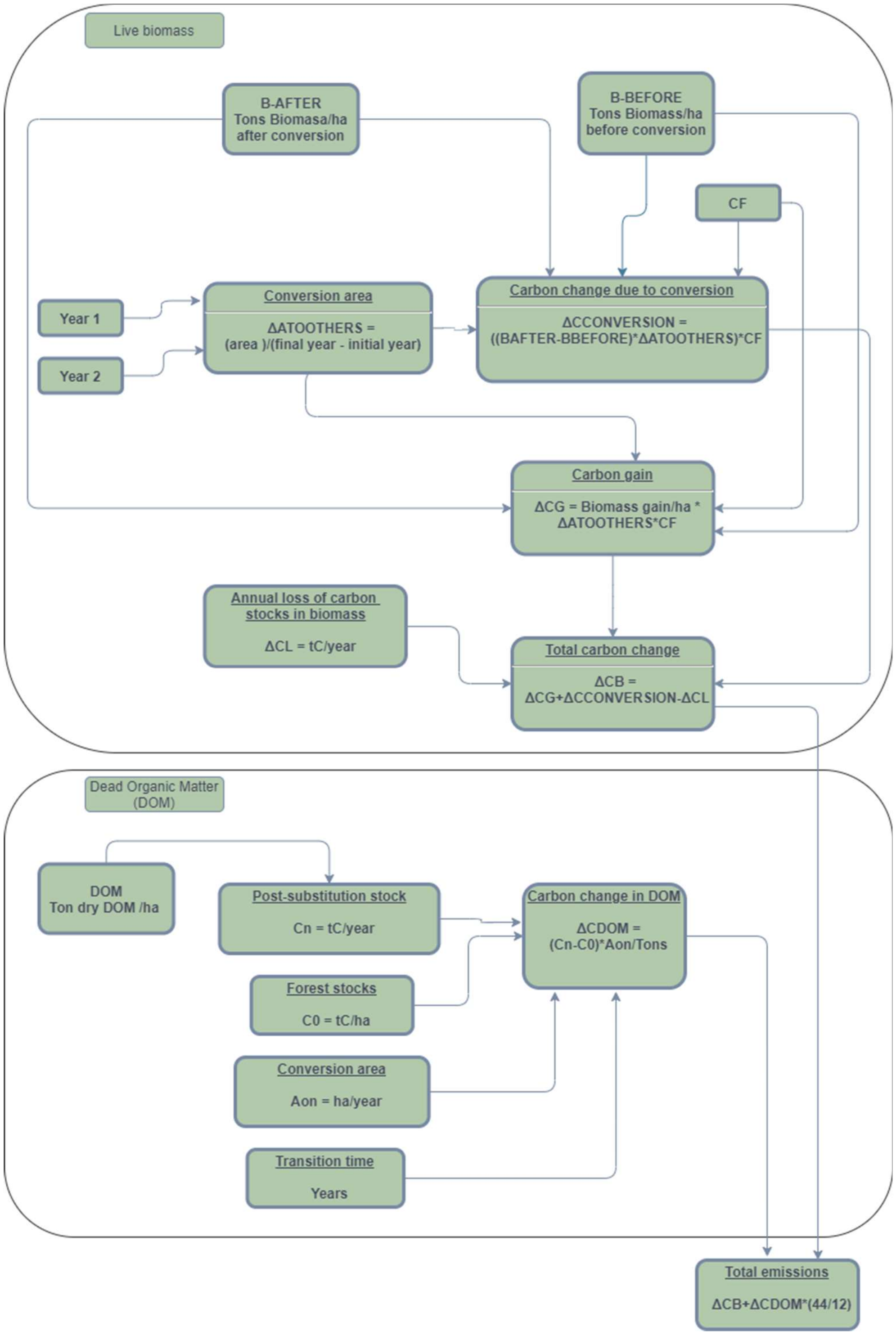


Figure 5. Step by step diagram for estimating emissions from Substitution.

Forest area Restitution and carbon stock Enhancement

As in the other calculated activities, the methodology for enhancements in other lands converted into forests is consistent with the methodology used in INGEI which is based on equations 2.9, 2.10 and 2.15 of IPCC (2006).

The general equation corresponding to Tiers 2 and 3 of IPCC (2006) is 2.15, used for calculating annual changes in carbon stocks in above and below ground biomass (the only reservoirs included in enhancement estimations) and lands converted into other land uses (In this case, non – forest into forest):

Equation 5 [Eq. 2.15 of IPCC (2006)]

$$\Delta C_{B_{t,ANFF}} = \Delta C_{G_t} + \Delta C_{CONVERSION_t} - \Delta C_{L_t}$$

Where:

- $\Delta C_{B_{t,\,ANFF}}$ = carbon stock enhancements in year *t*, from non – forest lands converted into forests during the reference period, under the stock enhancement activity (A), in tonnes C.
- ΔC_{G_t} = carbon stock enhancement due to growth in non – forest lands converted into forest year *t*, in tonnes C.
- $\Delta C_{CONVERSION_t}$= initial carbon stock change in non – forest lands converted into forests in year *t*, in ton C.
- ΔC_{L_t} = annual carbon stock decrease due to wood harvesting, firewood extraction and disturbances in non – forest lands converted into forest in year *t*, in ton C.

The estimations for enhancements assume ΔCL to be zero, due to the lack of sufficient data to quantify losses in non – forest areas converted into forest. Equation 2.16 of IPCC (2006) is used for the parameter$\Delta C_{CONVERSION_t}$:

Equation 6 [Eq. 2.16 of IPCC (2006)]

$$\Delta C_{CONVERSION_t} = \sum_i \left\{ \left(B_{AFTER_i} - B_{BEFORE_i} \right) * \Delta A_{TO_{OTHERS_{i,t}}} \right\} * CF$$

Where:

- $\Delta C_{CONVERSIO\ \ t}$ = initial carbon change in non – forest lands converted into forest in year *t*, ton C.
- B_{AFTER_i} = biomass stocks in forest type i immediately after conversion, ton m.s. ha^{-1}.
- B_{BEFORE_i}= biomass stocks in land type i before conversion, ton d.m. ha^{-1}.
- $\Delta A_{TO_{OTHERS_{i,t}}}$= non – forest land use surface converted into forest in year *t*, ha.
- CF = carbon fraction in dry matter, ton C $(\text{ton m.s.})^{-1}$ 0.47 is the default value as per IPCC AFOLU guidelines 2006, Table 4.3.

For parameter ΔCG (enhancement due to forest growth), INGEI uses IPCC 2006 Equation 2.9 for a Tier 2 – 3 calculation. Nevertheless, INGEI only uses it for lands converted into forest in the year of conversion.

Equation 2.9 of IPCC (2006) calculates annual carbon enhancements. But Equation 6 [(Eq. 2.16 of IPCC (2006)] does not consider captures converted in previous years that keep accumulating in strata "i". So it is necessary to modify equation 2.9 of IPCC (2006) as follows to achieve a correct accounting:

Equation 7 [adapted from Eq. 2.9 of IPCC (2006)]

$$\Delta C_{G_t} = \sum_i \sum_x \left(A_{i,x} * G_{TOTAL_i} * CF \right)$$

Where:

- ΔC_{G_t}= carbon stock enhancement in year *t*, due to growth in non – forest lands converted into forest type *i* during the reference period, in ton C.
- $A_{i,x}$= Area converted into forest *i* in year *x* of the reference period, in ha.
- G_{TOTAL_i}= annual average biomass growth in non – forest lands converted into forest type *i*, ton d. m. ha^{-1} $year^{-1}$.
- *CF* = dry matter carbon fraction, ton C (ton d.m.)$^{-1}$ · 0.47 is the default value as per IPCC AFOLU guidelines 2006, Table 4.3.

Equation 7 considers that for calculating ΔC_{G_t}in year t, it is necessary to add captures from areas converted in each year *x* before year t in the reference and monitoring period, to captures from areas converted in year t. In case a forest reaches adulthood and stops capturing CO_2 from the atmosphere, it should be removed from enhancement accounting. Nevertheless, this is not supposed to happen during the reference and monitoring period.

The following diagram represents step by step the calculation of removals due to increases from non-forest to forest and restitution (plantation to native forest). In the lower part, the number of years considered in the reference period is represented (13 in total), indicating that forests grow cumulatively from year 1 to year 13.

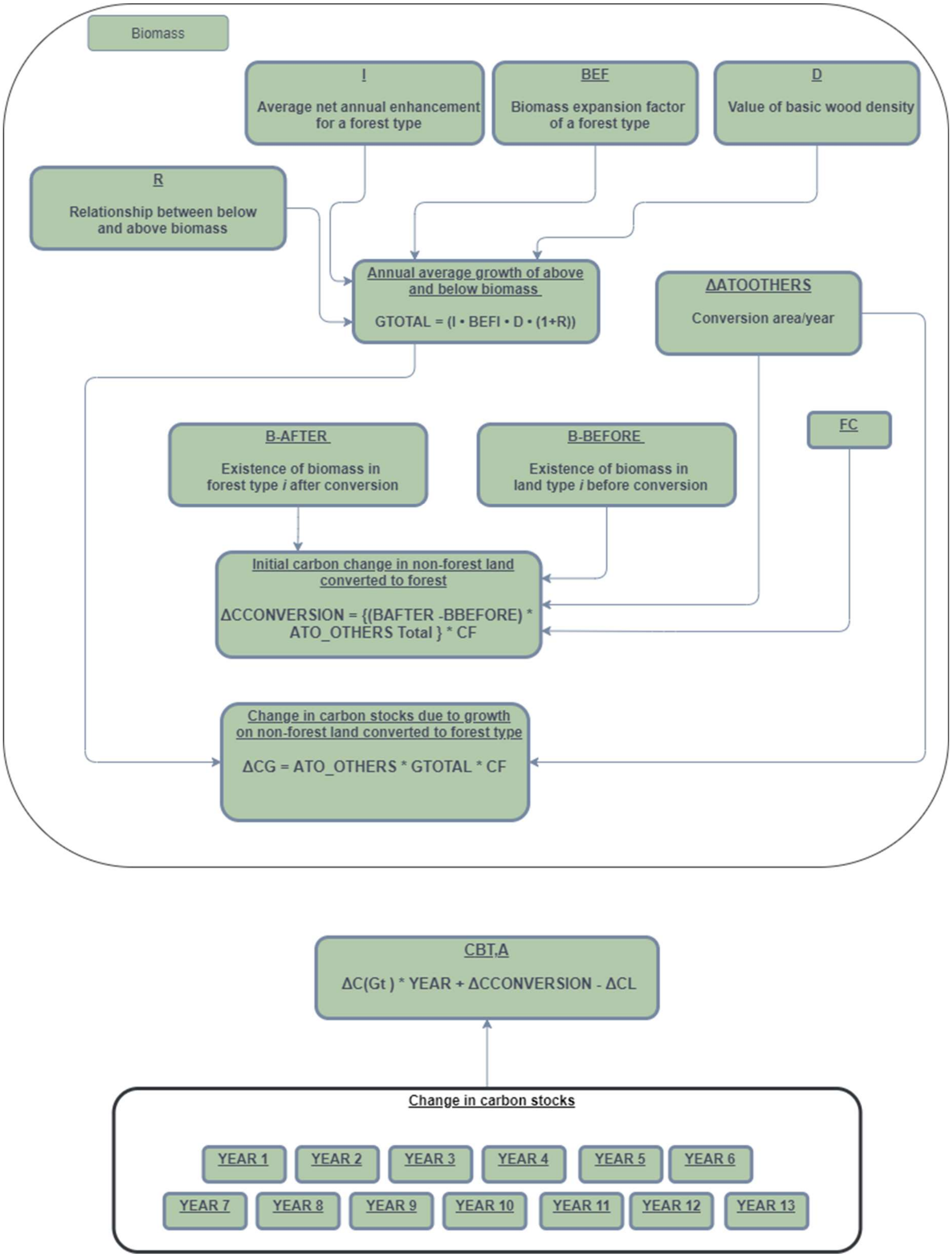


Figure 6. Step by step diagram for estimating removal from Enhancement.

Forest Remaining Forest

Degradation

Equation 2.8(a) of IPCC (2006) is used to estimate changes in carbon stocks in forest lands that remain as such due to degradation:

Equation 8 [Eq. 2.8 of IPCC (2006)]

$$\Delta C_{B_{t,DegFF}} = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)}$$

Where:

- $\Delta C_{B_{t,Deg}}$ = annual carbon stock change in forest lands that remain as such considering total area under degradation activity (*DegFF*), ton C.
- C_{t_2}= total forest carbon in year t_2, ton C.
- C_{t_1}= total forest carbon in year t_1, ton C.

The equation is applied for the reference level accounting described in Bahamondez *et al.* (2009)[14]. This methodology accounts for carbon stocks at different points in time, where the difference in carbon stocks in forest lands is considered degradation in case of losses. On the other hand, INGEI uses a loss – gain method, Equation 2.7 of IPCC (2006) instead of the stock difference method found in IPCC 2006 equation 2.8, where tabular data from INFOR is integrated to estimate volume extracted through selective logging, INFOR and MINENERGIA firewood statistics, and CONAF tabular data for the surface of fires in native forest and forest plantations. According to national experts, firewood extraction data are not very robust or representative of degradation in a comprehensive manner. The methodology used in NFMS allows to achieve Approach 3 results, spatially explicit data, and is based on robust and independent sources of information.

IPCC equation 2.8(b) is used to calculate carbon stocks in the initial and final moments of the reference period (C_1 and C_2 in Equation 8):

Equation 9 [Eq. 2.8 of IPCC (2006)]

$$C_t = A_{Deg} * EF * CF$$

Where:

- $C_{t,i}$= total forest carbon in year t, ton C.
- A_{Deg}= degradation area in forest that remains as such, ha.
- EF= carbon stocks in forest that remains as such, ton biomass ha^{-1}.
- CF= carbon fraction, t carbon t biomass^{-1}. 0.47 is the default value as per IPCC AFOLU guidelines 2006, Table 4.3.

[14] Bahamóndez, C., Martin, M., Muller-Using, S., Rojas, Y., Vergara, G., 2009. Case Studies in Measuring and Assessing Forest Degradation: An Operational Approach to Forest Degradation. (Forest Resources Assessment Working Paper). Forestry Department, Food and Agriculture Organization of the United Nations

Stock Enhancement in Forest remaining forest

IPCC (2006) equation 2.8 was used to calculate annual stock enhancements:

Equation 10 [Eq. 2.8 of IPCC (2006)]

$$\Delta C_{B_{t,AFF}} = \frac{(C_{t_2} - C_{t_1})}{(t_2 - t_1)}$$

Where:

- $\Delta C_{B_{t,AFF}}$ = annual carbon stock change in forest lands that remain as such, considering total area under stock enhancement activity (*DegFF*), ton C year^{-1}.
- C_{t_2}= total forest carbon in year t_2, ton C.
- C_{t_1}= total forest carbon in year t_1, ton C.

Carbon contents in year t_1 (2001) and t_2 (2010) were obtained from the results of applying the methodology that allows to identify areas that were below threshold or line B at the start of the reference and monitoring period.

Forest Conservation

As explained in previous sections, emissions and removals for Forest Conservation is estimated by adding emissions from forest degradation in forest remaining forest and absorptions from the restoration of degraded forests in forest areas under formal conservation processes.

Equation 11 [Eq. 2.8(a) of IPCC (2006)]

$$\Delta C_{B_{t,ConFF}} = \Delta C_{B_{t,AFF}} - \Delta C_{B_{t,DegFF}}$$

Where:

- $\Delta C_{B_{t,C}}$= carbon stock annual change in forest lands subject to formal conservation processes in year t, in ton C.
- $\Delta C_{B_{t,AFF}}$= annual changes in carbon stocks due to recovery of degraded forests in areas subject to formal conservation processes, in ton C year^{-1}.
- $\Delta C_{B_{t,DegFF}}$= annual changes in carbon stocks due to forest degradation in forest lands subject to formal conservation processes, in ton C year^{-1}.

In the following diagram the summary of steps for estimating emissions and captures in forest remaining forest is presented, both for increases, degradation and conservation. As can be seen, the conservation areas correspond to a part of the forest remaining forest that is under protection. It is defined by the geographic limit that delimits the area.

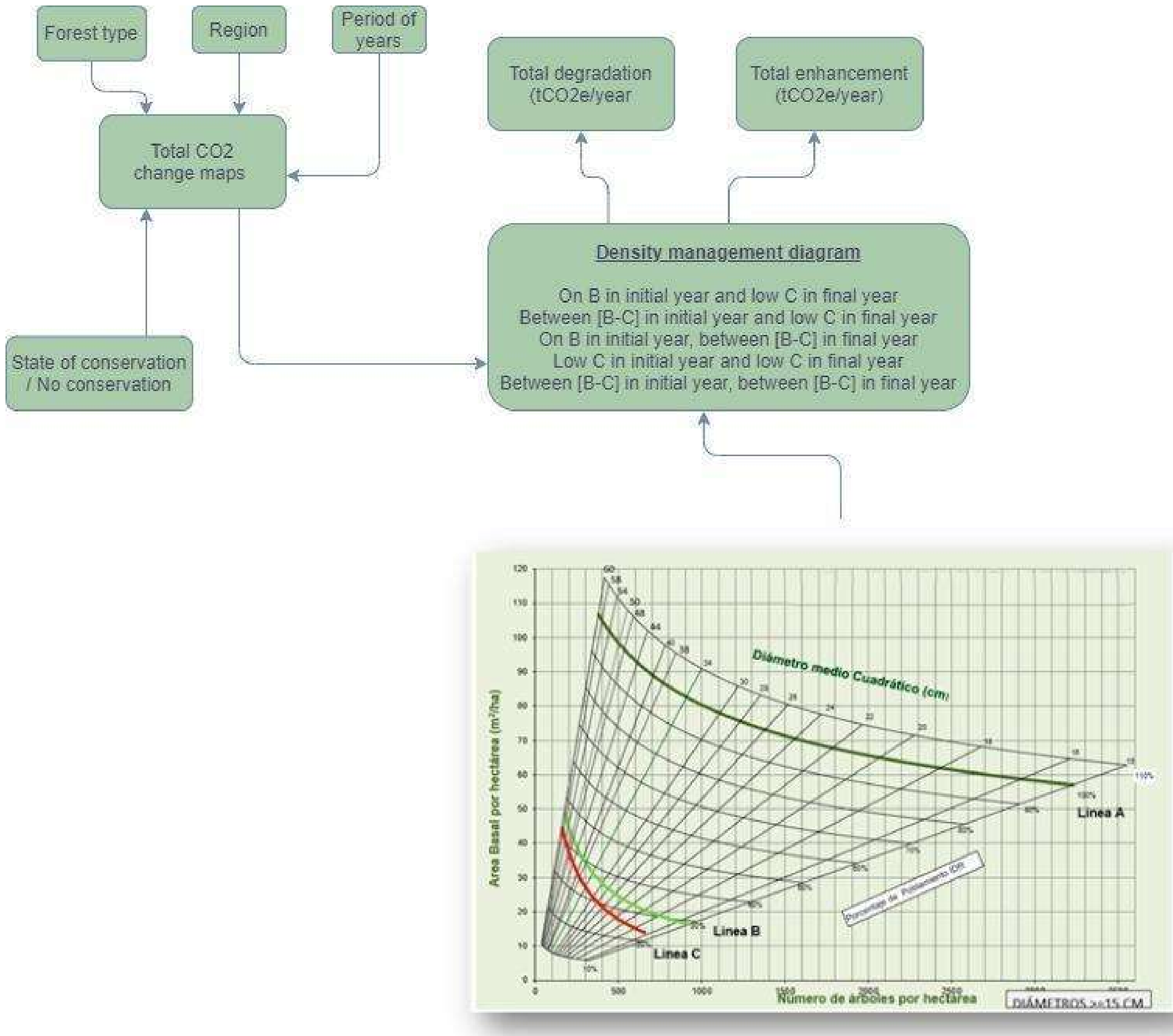


Figure 7. Step by step diagram for estimating emissions and removals from forest remaining forest.

Non -CO_2 emissions from Forest Fires

The methodology by Bahamondez et al. (2009) estimates CO_2 emissions in forest remaining forests. Therefore, Equation 2.27 of IPCC (2006) is used to calculate non – CO_2 emissions from forest fires:

Equation 12 [Eq. 2.27 of IPCC (2006)]

$$L_{fire} = A * M_B * C_f * G_{ef} * 10^{-3}$$

Where:

- L_{fire} = amount of greenhouse gas emissions caused by fire, ton of each GHG gas year^{-1}
- A = burned surface, ha year^{-1}
- M_B= fuel mass available for combustion, ton ha^{-1}.
- C_f= combustion factor, no dimension. The value applied is 0.45 according to IPCC 2006.
- G_{ef} = emission factor, g kg^{-1} of burned dry matter. Emission factors used for the equation are 4.7 for CH_4 and 0.26 for N_2O.

Equation 13 is used to convert L_{fire} into CO_2e, for Equation 12:

Equation 13

$$GEI_{fire} = L_{fire} * CF$$

Where:

- CF = conversion factor of non no-CO_2 gas into CO_2e, ton gas no-CO_2 ton CO_2e^{-1}. CF value is 25 for CH_4 and 298 for N_2O, according to IPCC 2006.

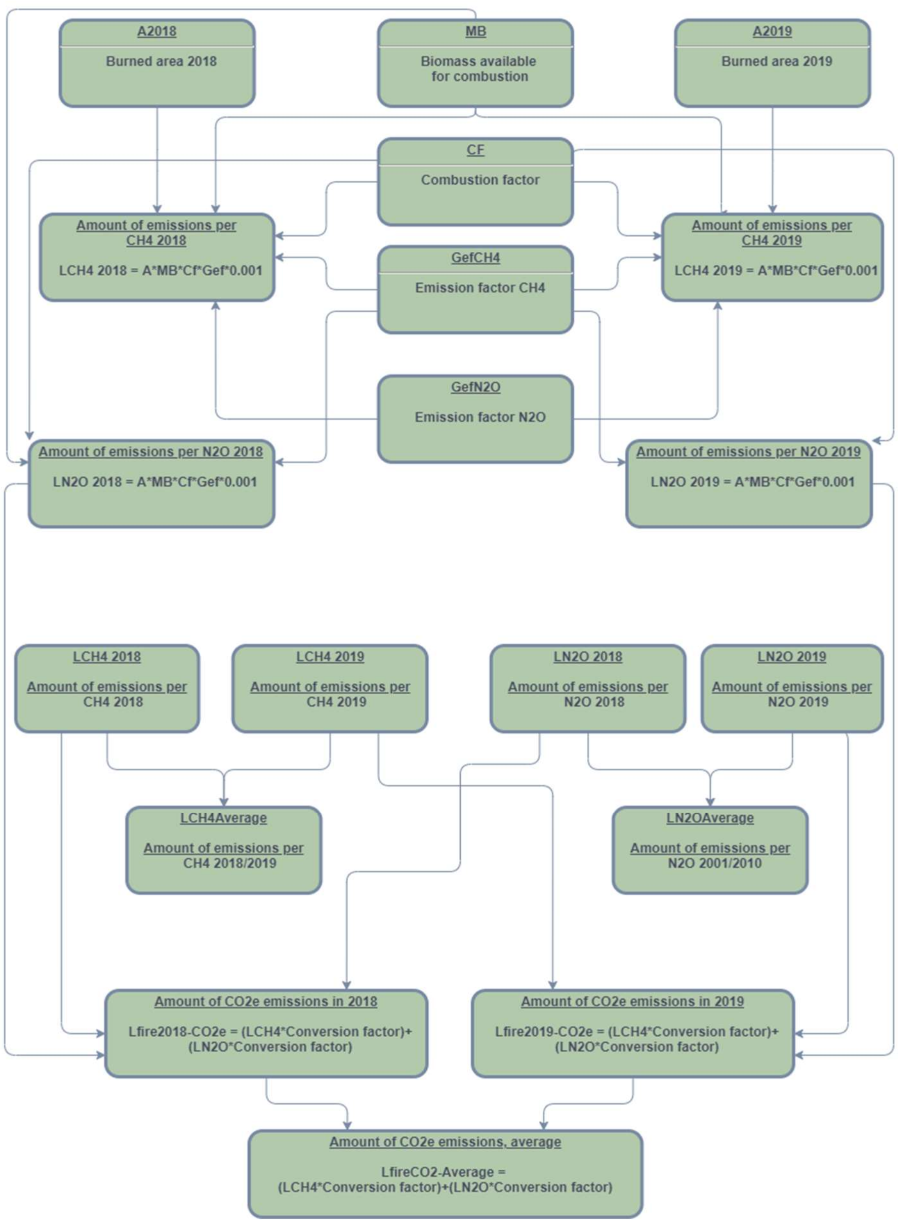


Figure 8. Step by step diagram for estimating emissions from forest fires.

Emission Factors

Deforestation

Carbon stocks before deforestation (B_{BEFORE})

Forest carbon stocks before deforestation were obtained from the information base of the INGEI of Chile. These numbers are derived from the national forest inventory in order to reach a Tier 2 living above ground biomass estimation. Estimations are stratified by forest type to obtain carbon contents before deforestation. Information of changes in land use was updated to include forest type data.

Above and below ground biomasses (B_{BEFORE} in Equation 3 and 6) along with DOM (Co in Equation 4) are obtained from the GHG national inventory. Under deforestation accounting, harvested wood products (HWP) carbon stocks are supposed to be zero, due to the lack of reliable sources of data for distinguishing between HWP due to deforestation and HWP due to degradation.

Carbon stocks after deforestation (B_{AFTERi})

INGEI uses IPCC (2006) default values for B_{AFTERi}, but these values are supposed to be the non – forest land use growth that really corresponds to ΔCG. For FREL estimations, carbon stocks directly after deforestation in deforested lands will be assumed to be zero.

Changes in carbon stocks other than deforestation events (ΔCG and ΔCL)

Post – deforestation carbon stocks (ΔCG) are determined in one of two ways:

- Values taken from a literature review of non – forest carbon stocks, ideally studies conducted in Chile (such as Gayoso 2006). If these studies are not available, data from other regional studies (Temperate South America under similar management regimes) can be used. This is the preferred method, representing a Tier 2 approach.
- When these values are not available, IPCC (2006) default values can be used. This is the method being currently used by the INGEI but represents a Tier 1 method.

Losses due to wood harvesting, firewood extraction and disturbances (ΔCL) are supposed to be zero in deforestation areas, using the same assumption as INGEI.

Degradation from Substitution

Carbon stock estimations derived from National Inventory plots and other carbon stock studies in other land uses are utilized for the emission factors in changes from native forest into plantation. Biomass stock estimations in plantations are assumed to be zero (0), as stocks in the native forest are supposed to have been reduced to zero before the establishment of the plantation.

Forest Surface Enhancement and Restitution

The value of B_{AFTER_i} in Equation 7 is supposed to be zero for agricultural lands and urban – industrial areas, as carbon stocks in non – forest land use converted into forest have been removed before forests are established. For natural land uses, mainly grasslands and scrubs, $B_{AFTER_i}$is supposed to be equal to B_{BEFORE_i}, as no clearing or cleaning processes are supposed to take place in those lands before the forest is established, but rather are naturally converted into forest without losing initial carbon stocks. Carbon stocks in $B_{BEFORE_i}$are equivalent to carbon stocks in non – forest land use. National or regional scientific reports such as Gayoso (2006) which have estimated carbon stocks in non – forest land uses are used for these stocks.

In Equation 7, G_{TOTAL_i}, average annual biomass growth per hectare for each forest type is calculated through Equation 14 (modified from Equation 2.10 in IPCC 2006).

Equation 14 [adapted from Eq. 2.10 of IPCC (2006)]

$$G_{TOTAL} = \Sigma_i(I_{Vi} \cdot BCEF_i \cdot (1+R_i))$$

Where:

- G_{TOTAL} = Average annual above and below ground biomass growth, ton d. m. ha^{-1} $year^{-1}$.
- I = Annual average net increase for one forest type, m^3 ha^{-1} $year^{-1}$.
- $BCEF_I$ = Biomass expansion and conversion factor for the conversion of annual net volume increase into Above ground biomass growth for one forest type, tons of aerial growth (m^3 of annual average increase)$^{-1}$.
- R = Relation between above and below ground biomass for one forest type in ton m.s of below ground biomass (ton m.s. of Above ground biomass)^{1}.

Annual average net increase values, I, are gathered in the INGEI data set, based on data from national forest inventory, which estimates values for the following forest types: Alerce, Ciprés de las Guaitecas, Araucaria, Ciprés de la Cordillera, Lenga, Coihue de Magallanes, Roble Hualo, Roble-Raulí-Coihue, Coihue-Raulí-Tepa, Esclerófilo and Siempreverde. Equation 15 is used for calculating $BCEF_i$:

Equation 15

$$BCEF_I = BEF_I \cdot D_i$$

Where:

- BEF_I= Biomass expansion factor for one forest type. This factor expands total above ground biomass value to offset the non – marketable components of the increase, no dimension.
- D = Basic wood density value, ton $m^{-3.}$ The value applied for D is 0.496166.

The biomass expansion factor, BEF_I, and wood basic density value, D, come from the INGEI data set, having a BEF_I value for native forests, not classified by forest type, by Gayoso et al (2002). Likewise, there is only one wood density value for native species, without INGEI defining the original source, which is used for ensuring consistency with the INGEI.

The relation between above and below ground biomass in native forests, R, was estimated by Gayoso et al (2002) and is found in the INGEI data set. The value applied for R is 0.2869.

Forest remaining forest

Emission factors for degradation in forests remaining forests, carbon content enhancement from restoration of degraded forests, and forest conservation all use the same methodology.

The emission factors come from the national forest inventory, which is the basis for the methodology. The methodology determines a basal area for each forest hectare in t_1 and t_2. The total volume of each hectare is calculated based on this data:

Equation 16

$$Vol = KAB^{\beta}$$

Where:

- Vol= Volume of trees in forest, cubic meters ha^{-1}.
- AB= Basal area square meters ha^{-1}.

- K= Constant, value of 2,9141.
- β = Constant, value of 1,2478.

To convert volume into CO_2 for its use in equation:

Equation 17

$$EF = Vol * D * BEF$$

Where:

- EF = carbon stocks in forests that remain as such, ton biomass ha^{-1}.
- Vol = Volume of trees in forest, cubic meters ha^{-1}.
- D = average forest density, tons $meters^{-3}$.
- *BEF* = biomass expansion and conversion factor for the conversion of annual net volume increase (bark included) into above ground biomass growth for one forest type, above ground biomass growth in tons (m^3 of average annual $increase)^{-10}$.

CALCULATION OF ANNUAL EMISSION HISTORICAL AVERAGE DURING THE REFERENCE PERIOD

Forest Degradation

There are two sub activities under the degradation activity, according to the definitions:

1. Degradation in forest remaining forest.
2. Degradation from Substitution.

Various methodologies are used for each sub – activity type as previously described and justified, to calculate FREL, adding different methodologies and reference periods in ton CO_{2e}, using the following equation:

Equation 18

$$FREL_{Deg} = \frac{(\sum_t^n \quad \Delta C_{B_{t,DegFF}} + \sum_t^n \quad \Delta C_{B_{t,DegFNF}}) * \frac{44}{12} + \sum_t^n \quad GEI_{fire}}{p}$$

Where:

- $FREL_{Deg}$ = carbon stock annual average losses due to forest degradation during the reference period, in ton C $year^{-1}$.
- $\Delta C_{B_{t,DegFF}}$ = carbon stock change in forest lands that remain as such in year *t* of the reference period, in ton C.
- $\Delta C_{B_{t,DegFNF}}$ = carbon stock change in forest lands converted into arborescent scrub or plantations in year *t* of the reference period, in ton C.
- GEI_{fire}= Amount of non-CO_2 gas emissions from forest fires, ton CO_2e.
- *p* = years of the reference period.
- $\frac{44}{12}$ = factor for converting carbon into equivalent carbon dioxide, ton CO_2e ton C^{-1}.

Forest Carbon Stock Enhancement

Captures associated to areas that change from non – forest into forest, along with captures from forest areas that remain as such are accounted under the stock enhancement category.

1. Forest surface restitution and enhancement.
2. Restoration of degraded forests

Likewise, FREL activity data regarding forest carbon stock enhancements is estimated using differentiated methodologies for forests that remain as such and the identification of non – forest areas converted into forests, just as in the degradation FREL.

Equation 19

$$FRL_A = \frac{(\sum_t^n \Delta C_{B_{t,ANFF}} + \sum_t^n \Delta C_{B_{t,AFF}}) * \frac{44}{12}}{p}$$

Where:

- FRL_A = annual average carbon stock increase during the reference period, in ton CO_2e $year^{-1}$.
- $\Delta C_{B_{t,ANFF}}$ = carbon stock change in year t, from non – forest lands converted into forest during the reference period, under the stock enhancement activity (A), in ton C.
- $\Delta C_{B_{t,AFF}}$ = annual carbon stock change in forest areas that remain as forest, considering total area, in ton C $year^{-1}$.
- p = years of the reference period.

3 DATA AND PARAMETERS

The parameters applied to the estimates of emissions and removals in the SNMF are summarized below:

Parameter	Acronym	Units	Value	Source	Sub activity
Biomass expansion factor	BEF	No units	1.75	INGEI, 2020	Deforestation Substitution Stock Enhancement
Wood base density value	D	t d.m. m^{-3}	0.496166	INGEI, 2020	Deforestation Substitution Stock Enhancement
Relationship between above and below ground biomass	R	No units	0.2869	INGEI, 2020	Deforestation Substitution Stock Enhancement
Yearly decrease in carbon contents due to wood harvesting, firewood extraction and disruption in non-forest lands converted into forest	ΔCL Aum	t C $year^{-1}$	0	Assumption	Deforestation Substitution Stock Enhancement
Post – conversion biomass	BAFTER	t biomass ha^{-1}	0	Assumption	Deforestation Substitution Stock Enhancement
Post – deforestation stocks	Cn	t C ha^{-1}	0	Assumption	Deforestation Substitution Stock Enhancement
Yearly loss of carbon stocks in biomass due to disruptions in forest lands converted to non-forests in year -t.	ΔCL	t C $year^{-1}$	0	Assumption	Deforestation Substitution Stock Enhancement

Table 1. Parameters applied to emissions and removals estimations in the NFMS.

The parameters used for the calculations of emissions and reversals, segregated by land use and sub-use, and according to REDD+ activity are summarized in the following table:

Land use	Sub-use	t dry AGB/ha	t dry BGB/ha	Source
		REDD Activities Deforestation, Enhancement Substitution		
Settlements	-	2	0	INGEI, 2020
Cropland	-	10	2	INGEI, 2020
Grassland and Shrubland	Grassland	4.73	8.13	Gayoso et al. (2006)
	Scrub - Grassland	9.04	14.99	Gayoso et al. (2006)
	Scrub	9.04	14.99	Gayoso et al. (2006)
	Arborescent Scrub	21.78	35.25	Gayoso et al. (2006)
	Scrub with Succulent plants	9.04	14.99	Gayoso et al. (2006)
	Succulent Plant Formation	4.73	8.13	Assumption, equal to grassland
	Shrubs Plantation	9.04	14.99	Gayoso et al. (2006)
Forest land	Plantation	0	0	National panel of experts
Wetlands	Managed bodies (reservoirs)	0	0	Assumption
	Unmanaged bodies (natural rivers, lakes)	0	0	Assumption
Other land	Areas without vegetation (bare soil, rock)	0	0	Assumption
	Perennial snow and glacier areas	0	0	Assumption
	Unrecognized Areas	N/U	N/U	-

Table 2. Parameters by REDD activity, land use, and land sub – use.

3.1 Fixed Data and Parameters

Parameter:	Biomass expansion factor (BEF) for the native forest
Description:	This factor expands the total volume of above ground biomass to compensate for non-marketable aspects of the enhancement.
Data unit:	Dimensionless parameter
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	The Biomass expansion factor comes from information collected in the country from the study of Gayoso et al. (2002) and used in INGEI (2020). This value is for native species and has a national spatial level.
Value applied:	1.75
QA/QC procedures applied	These are reference national values obtained from Gayoso et al. (2002) and INGEI (2020) as was mentioned before.
Uncertainty associated with this parameter:	Error calculation based on statistical data from the Biomass Inventory and Carbon Accounting of the Universidad Austral de Chile (UACh). Error: 18%
Any comment:	

Parameter:	Basic density value of the wood (D)
Description:	Calculated using basic density data collected from native species growing in Chile.
Data unit:	t d.m. m^{-3}
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	A bibliographic review of basic densities of the forest species in Chile was carried out and there were no modifications for the value exposed from Gayoso et al. (2002) and INGEI (2020).
Value applied:	0.496166
QA/QC procedures applied	These are reference national values obtained from Gayoso et al. (2002) and INGEI (2020) as was mentioned before.
Uncertainty associated with this parameter:	Calculation was performed using basic density data collected from native species growing in Chile. Error: 5.6%
Any comment:	

Parameter:	Root-to-shoot ratios of native forest (R factor)
Description:	Relationship between below ground and above ground biomass
Data unit:	t d.m. m^{-3}
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	R factor comes from information collected in the country (Gayoso et al., 2002; INGEI, 2020). This value is within the range of values indicated in the 2006 IPCC Guidelines for temperate forests (between 0.20 and 0.46, according to Table 4.4; Chapter 4; Volume 4) and within the values available worldwide, which provide R factors that range between 0.09 and 0.33. This value is for native species and has a national spatial level.
Value applied:	0.2869
QA/QC procedures applied	These are reference national values obtained from Gayoso et al. (2002) and INGEI (2020) as was mentioned before. QA / QC applied in documentation process "Estimación de valores de fracción de carbono, relación tallo raíz" ("Estimation of carbon fraction values, stem-root relation").
Uncertainty associated with this parameter:	Error calculation based on statistical data from the Biomass Inventory and Carbon Accountancy of the Universidad Austral de Chile (UACh). Error: 9.4%
Any comment:	

Parameter:	Above and below ground biomass of other uses
Description:	Above and below ground biomass of Urban and Industrial Areas, agricultural land, grassland, scrub, arborescent scrub, shrub planting, succulent scrub, succulent formations, plantations, wetlands, areas deprived of vegetation, eternal snows and glaciers, waterbodies and unrecognized areas
Data unit:	Tons of dry biomass ha^{-1} (t d.m. ha^{-1})
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	● Urban and Industrial Areas (INGEI, 2020) ● Agricultural land (INGEI, 2020) ● Grassland (Gayoso et al., 2006) ● Grassland - Scrub (Gayoso et al., 2006) ● Scrub (Gayoso et al., 2006) ● Arborescent scrub (Gayoso et al., 2006) ● Scrub with succulent (Gayoso et al., 2006) ● Succulent formations (assumption of grassland values (Gayoso et al., 2006)) ● Shrub planting (Gayoso et al., 2006) ● Plantation (Expert national panel) ● Wetlands (assumption) ● Areas deprived of vegetation (assumption) ● Eternal snows and glaciers (assumption) ● Waterbodies (assumption) ● Unrecognized areas (assumption) These are reference national values obtained from Gayoso et al. (2006), INGEI (2020), an expert national panel and assumption as mentioned before.

Value applied:	See table below

Use / sub use	t dry above ground biomass ha^{-1}	t dry below ground biomass ha^{-1}
Urban and Industrial Areas	2	0
Agricultural land	10	2
Grassland	4.73	8.13
Grassland - Scrub	9.04	14.99
Scrub	9.04	14.99
Arborescent scrub	21.78	35.25
Scrub with succulent	9.04	14.99
Succulent formations	4.73	8.13
Shrub planting	9.04	14.99
Plantation	0	0
Wetlands	0	0
Areas deprived of vegetation	0	0
Eternal snows and glaciers	0	0
Waterbodies	0	0
Unrecognized areas	0	0

QA/QC procedures applied	These are reference national values obtained from Gayoso et al. (2006), INGEI (2020), an expert national panel and assumption as mentioned before.
Uncertainty associated with this parameter:	Data from INGEI (2020) and Gayoso et al., (2006).

Use / sub use	Error % in above ground biomass
Urban and Industrial Areas	95%
Agricultural land	75%
Grassland	27.7%
Grassland – Scrub	34.6%
Scrub	34.6%
Arborescent scrub	22.4%
Scrub with succulent	34.6%
Succulent formations	27.7%
Shrub planting	34.6%

Uncertainty for below ground biomass (BGB) of Non-Forest lands is based on propagation error estimate following IPCC approach 1 of Matorral-Arborescente AGB error (22.42%) and Root shoot ratio -R Factor error (48.27%) estimated by Gayoso et al. (2002), resulting in total uncertainty of 53.2%.

Any comment:	

Parameter:	Above and below ground biomass of native forest.
Description:	Above and below ground biomass of native forest. The native forest is classified by different forest type and structure. Each forest type has its own biomass value in some cases, depending on data availability.
Data unit:	Tons of dry biomass ha^{-1} (t d.m. ha^{-1}).
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Native forest data are national data and published in INGEI (2020). The mixed forest is calculated as a weighted average value of the forest types present in the region and according to the forest type surface present for the activity of deforestation of the period. For missing biomass values of the forest types and some of the structures a weighted average value was calculated in the region and according to the forest type surface present at the final year in the reference level (2013). The AGB and BGB parameters are estimated from the IFN plots. The estimate of the variation in carbon content on forests that remain as such for FREL/FRL and monitoring report for Degradation, Restoration of Forest remaining forests and Forestry Conservation activities is estimated based on information coming from the Continuous Inventory of Forest Ecosystems and the application of remote sensing techniques on LANDSAT satellite images.
Value applied:	

Forest type	Structure	AGB (t d.m. ha^{-1})	BGB (t d.m. ha^{-1})
Alerce	Adult	339.1	97.3
Alerce	Young	203.6	58.4
Alerce	Adult/Young	203.6	58.4
Alerce	Stunted	339.1	97.3
Cipres de las Guaitecas	Adult	198.0	56.8
Cipres de las Guaitecas	Young	198.0	56.8
Cipres de las Guaitecas	Adult/Young	198.0	56.8
Cipres de las Guaitecas	Stunted	198.0	56.8
Araucaria	Adult	421.4	120.9
Araucaria	Young	219.1	62.9
Araucaria	Adult/Young	219.1	62.9
Araucaria	Stunted	421.4	120.9
Cipres de la Cordillera	Adult	124.0	35.6
Cipres de la Cordillera	Young	124.0	35.6
Cipres de la Cordillera	Adult/Young	124.0	35.6
Cipres de la Cordillera	Stunted	124.0	35.6
Lenga	Adult	198.5	56.9
Lenga	Young	237.2	68.1
Lenga	Adult/Young	237.2	68.1
Lenga	Stunted	198.5	56.9
Coihue de Magallanes	Adult	129.1	37.1
Coihue de Magallanes	Young	129.1	37.1
Coihue de Magallanes	Adult/Young	129.1	37.1
Coihue de Magallanes	Stunted	129.1	37.1
Roble - Hualo	Adult	114.9	33.0
Roble - Hualo	Young	114.9	33.0
Roble - Hualo	Adult/Young	114.9	33.0

	Roble - Hualo	Stunted	114.9	33.0
	Roble - Rauli - Coihue	Adult	178.6	51.2
	Roble - Rauli - Coihue	Young	152.8	43.8
	Roble - Rauli - Coihue	Adult/Young	152.8	43.8
	Roble - Rauli - Coihue	Stunted	178.6	51.2
	Coihue - Rauli - Tepa	Adult	377.0	108.2
	Coihue - Rauli - Tepa	Young	377.0	108.2
	Coihue - Rauli - Tepa	Adult/Young	377.0	108.2
	Coihue - Rauli - Tepa	Stunted	377.0	108.2
	Esclerófilo	Adult	18.6	5.3
	Esclerófilo	Young	18.6	5.3
	Esclerófilo	Adult/Young	18.6	5.3
	Esclerófilo	Stunted	18.6	5.3
	Siempreverde	Adult	361.6	103.8
	Siempreverde	Young	127.3	36.5
	Siempreverde	Adult/Young	127.3	36.5
	Siempreverde	Stunted	361.6	103.8
QA/QC procedures applied	SOP_06_Field Operation Manual			
Uncertainty associated with this parameter:	Uncertainty for Below Ground Biomass BGB is based on propagation error estimate following IPCC approach 1 of Above Ground Biomass-AGB error (18.85%) and Root shoot ratio -R Factor error (9.4%) estimated by Gayoso et al. (2002), resulting in total uncertainty of 44.2%. For the forest types with a limited number of sampling plots, AGB uncertainty propagation with Monte Carlo analysis uses the following information: i. DBH measurement error (0.2%), calculation based on Continuous Forest Inventory data of INFOR; ii. Volume estimation error (0.07%), calculation based on Continuous Forest Inventory data of INFOR, iii. Biomass Expansion Factor (BEF) error (18.0%), BEF comes from information collected in the country from the study of Gayoso et al. (2002) and used in INGEI (2020). This value is for native species and has a national spatial level. Error calculation is based on statistical data from the Biomass Inventory and Carbon Accountancy of the Universidad Austral de Chile (UACh); and iv. Wood Density (5.6%) calculated using basic density data collected from native species growing in Chile. Finally, these uncertainties are combined following IPCC approach 1 (error propagation), resulting in total uncertainty of 18.85%			
Any comment:				

Parameter:	Dead organic matter of native forest (DOM).
Description:	The native forest is classified by different forest types and structures. Each forest type has its own dead organic matter value in some cases, depending on data availability. The mixed forest is calculated as a weighted average value of the forest types present in the region and according to the forest surface present for the activity of deforestation of the period. For the missing DOM value of the forest types and some of the structures, a weighted average value was calculated in the region and according to the forest type surface present at the final year in the reference level (2013).
Data unit:	Tons of carbon in dead organic matter ha^{-1} ($tC\ ha^{-1}$).
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Forest native data are national data and published in INGEI (2020).
Value applied:	(see table below)

Forest type	Structure	AGB ($tC\ ha^{-1}$)
Alerce	Adult	121.4
Alerce	Young	121.4
Alerce	Adult/Young	121.4
Alerce	Stunted	121.4
Cipres de las Guaitecas	Adult	62.11
Cipres de las Guaitecas	Young	62.11
Cipres de las Guaitecas	Adult/Young	62.11
Cipres de las Guaitecas	Stunted	62.11
Araucaria	Adult	133.4
Araucaria	Young	133.4
Araucaria	Adult/Young	133.4
Araucaria	Stunted	133.4
Cipres de la Cordillera	Adult	62.11
Cipres de la Cordillera	Young	62.11
Cipres de la Cordillera	Adult/Young	62.11
Cipres de la Cordillera	Stunted	62.11
Lenga	Adult	43.4
Lenga	Young	43.4
Lenga	Adult/Young	43.4
Lenga	Stunted	43.4
Coihue de Magallanes	Adult	140.1
Coihue de Magallanes	Young	140.1
Coihue de Magallanes	Adult/Young	140.1
Coihue de Magallanes	Stunted	140.1
Roble - Hualo	Adult	62.11
Roble - Hualo	Young	62.11
Roble - Hualo	Adult/Young	62.11
Roble - Hualo	Stunted	62.11
Roble - Rauli - Coihue	Adult	52.9
Roble - Rauli - Coihue	Young	52.9
Roble - Rauli - Coihue	Adult/Young	52.9
Roble - Rauli - Coihue	Stunted	52.9

	Coihue - Rauli - Tepa	Adult	74.4
	Coihue - Rauli - Tepa	Young	74.4
	Coihue - Rauli - Tepa	Adult/Young	74.4
	Coihue - Rauli - Tepa	Stunted	74.4
	Esclerófilo	Adult	16.7
	Esclerófilo	Young	16.7
	Esclerófilo	Adult/Young	16.7
	Esclerófilo	Stunted	16.7
	Siempreverde	Adult	64.8
	Siempreverde	Young	64.8
	Siempreverde	Adult/Young	64.8
	Siempreverde	Stunted	64.8
QA/QC procedures applied	SOP_06_Field Operation Manual		
Uncertainty associated with this parameter:	Error estimated from permanent plots of the INFOR Continuous Forest Inventory Error: 28.4%		
Any comment:			

Parameter:	Periodic annual increment (PAI) according to forest type
Description:	Periodic annual increment (PAI) according to forest type and structure. Each forest type has its own biomass value in some cases, depend on data availability. For missing PAI value of the forest types and some of the structures a weighted average value was calculated in the region and according to the forest type surface present at the final year in the reference level (2013).
Data unit:	Cubic meter per hectare and year (m^3 ha^{-1} $year^{-1}$)
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Forest native data are national data and published in INGEI (2020)
Value applied:	

Forest type	Structure	PAI (m^3 ha^{-1} $year^{-1}$)
Alerce	Mature	0.5
Alerce	Young	0.5
Alerce	Mature/Young	0.5
Alerce	Stunted	0.5
Ciprés de las Guaitecas	Mature	3.9
Ciprés de las Guaitecas	Young	3.9
Ciprés de las Guaitecas	Mature/Young	3.9
Ciprés de las Guaitecas	Stunted	3.9
Araucaria	Mature	4.6
Araucaria	Young	4.6

	Araucaria	Mature/Young	4.6
	Araucaria	Stunted	4.6
	Ciprés de la Cordillera	Mature	5
	Ciprés de la Cordillera	Young	2.7
	Ciprés de la Cordillera	Mature/Young	2.7
	Ciprés de la Cordillera	Stunted	5
	Lenga	Mature	5.8
	Lenga	Young	3.9
	Lenga	Mature/Young	3.9
	Lenga	Stunted	5.8
	Coihue de Magallanes	Mature	2.6
	Coihue de Magallanes	Young	3.7
	Coihue de Magallanes	Mature/Young	3.7
	Coihue de Magallanes	Stunted	2.6
	Roble - Hualo	Mature	5.1
	Roble - Hualo	Young	3.5
	Roble - Hualo	Mature/Young	3.5
	Roble - Hualo	Stunted	5.1
	Roble - Raulí - Coihue	Mature	6.6
	Roble - Raulí - Coihue	Young	4.1
	Roble - Raulí - Coihue	Mature/Young	4.1
	Roble - Raulí - Coihue	Stunted	6.6
	Coihue - Raulí - Tepa	Mature	5.8
	Coihue - Raulí - Tepa	Young	4.9
	Coihue - Raulí - Tepa	Mature/Young	4.9
	Coihue - Raulí - Tepa	Stunted	5.8
	Esclerófilo	Mature	1.5
	Esclerófilo	Young	1.6
	Esclerófilo	Mature/Young	1.6
	Esclerófilo	Stunted	1.5
	Siempreverde	Mature	6
	Siempreverde	Young	4.1
	Siempreverde	Mature/Young	4.1
	Siempreverde	Stunted	6
QA/QC procedures applied	SOP_06_Field Operation Manual		
Uncertainty associated with this parameter:	SOP_06 Field Operations Manual was implemented during fieldwork to estimate PAI in the National Forest Inventory, for some forest types were possible to adjust a Probability Distribution Function (PDF). For the forest types with a limited number of sampling plots, uncertainty propagation with Monte Carlo analysis uses the calculation of the measurement uncertainty for PAI based on the 95% CI of the removal rate by forest type, calculated with Continuous Forest Inventory data of INFOR. ● PAI Araucaria Adulto, PAI Lenga Adulto, PAI Lenga Renoval, PAI Roble - Hualo Adulto, PAI Roble - Raulí - Coihue Adulto, PAI Roble - Raulí - Coihue Renoval, PAI Coihue - Raulí - Tepa Adulto, PAI Coihue - Raulí - Tepa		

	Renoval, PAI Esclerófilo Adulto, PAI Siempreverde Adulto, PAI Siempreverde Renoval= adjust a Probability Distribution Function (PDF) ● PAI Alerce Adulto = 58.47% (The higher uncertainty of the errors estimated for PAI is assumed due to a lack of data.) ● PAI Ciprés de las Guaitecas Adulto = 58.47% (The higher uncertainty of the errors estimated for IPA is assumed due to a lack of data.) ● PAI Ciprés de la Cordillera Adulto =15.83% (Error estimated from permanent plots of the INFOR Continuous Forest Inventory) ● PAI Ciprés de la Cordillera Renoval = 9.97% (Error estimated from permanent plots of the INFOR Continuous Forest Inventory) ● PAI Coihue de Magallanes Adulto = 13.42% (Error estimated from permanent plots of the INFOR Continuous Forest Inventory) ● PAI Coihue de Magallanes Renoval = 7.68% (Error estimated from permanent plots of the INFOR Continuous Forest Inventory) ● PAI Roble - Hualo Renoval = 54.47% (The higher uncertainty of the errors estimated for PAI is assumed due to a lack of data) ● PAI Esclerófilo Renoval = 21.31% (Error estimated from permanent plots of the INFOR Continuous Forest Inventory)
Any comment:	

Parameter:	Combustion factor
Description:	Emission factor for degradation due to forest fires
Data unit:	Non-dimensional
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Intergovernmental Panel on Climate Change (IPCC). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4, Chapter 2, Table 2.6 International - Extra tropical forest
Value applied:	0.45
QA/QC procedures applied	
Uncertainty associated with this parameter:	Error estimated using the standard deviation and median default emission factor of the IPCC 2006. Error: 36%
Any comment:	

Parameter:	CH_4 emission factor
Description:	Emission factor for degradation due to forest fires
Data unit:	g kg^{-1} of burned dry material
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Intergovernmental Panel on Climate Change (IPCC). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4, Chapter 2, Table 2.5 International - Extra tropical forest
Value applied:	4.7
QA/QC procedures applied	
Uncertainty associated with this parameter:	Error estimated using the standard deviation and median default emission factor of the IPCC 2006. Error: 29.0%
Any comment:	

Parameter:	N_2O emission factor
Description:	Emission factor for degradation due to forest fires
Data unit:	g kg^{-1} of burned dry material
Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):	Intergovernmental Panel on Climate Change (IPCC). 2006. 2006 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 4, Chapter 2, Table 2.5 International - Extra tropical forest
Value applied:	0.26
QA/QC procedures applied	
Uncertainty associated with this parameter:	Error estimated using the standard deviation and median default emission factor of the IPCC 2006. Error: 43.8%
Any comment:	

3.2 Monitored Data and Parameters

a) Deforestation FREL/FRL

Parameter:	$\Delta A_{TO\_OTHERSi,t}$ = Areas of different Forest Types(i) converted to another category of land use during the 2001 – 2013 period.
Description:	Chile has eleven different Native Forest Types in the PRE area.
Data unit:	Total hectares (ha/year) of the 2001-2013 period.
Value monitored during this Monitoring / Reporting Period:	see table below
Source of data and description of measurement/calculation methods and procedures applied:	Matrices of change in land use taken from Land Use Change Maps. Multipixel mosaics are used for the detection of changes in land use, focused in polygons of native forest. From the mosaic, the MIICA method is applied for the identification of spectral gains and losses, which through different techniques of post-processing allow identifying areas of forest losses and gains. The application of method establishes a series of requirements for the tiles, related to the removal of clouds, cloud shadows and artifacts. In addition, the map of use and change of use is linked to the information that comes from the Native Forest Cadastres of CONAF, therefore, the map of Land Use Change is the result of the application of the MIICA method, and the Cadastre of Native Forest. The Land Use Change Map is presented as a product through a coverage geographical area called "Traceability", which has as a characteristic the monitoring periods available for a certain region, which allows giving monitoring of historical land uses for each polygon. The final product is regional, characterized by stunted, mature, young mature, mixed and young forests converted into areas with no vegetation, urban and industrial areas, waterbodies, areas where succulents, wetlands, scrubland, perennial snow and glaciers, grasslands and farmland have formed.
QA/QC procedures applied:	For the generation of deforestation activity data and as part of the QA / QC process, the different procedures implemented are documented in SOPs that allow the estimates to be standardized over time. SOP_01: Selection of REDD+ satellite mosaics SOP_02: Elaboration of LULUCF maps
Uncertainty for this parameter:	The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice

Value monitored during this Monitoring / Reporting Period:

Forest Type	Area
Alerce	119.3
Araucaria	337.3
Ciprés de la Cordillera	35.4
Ciprés de las Guaitecas	9.2
Coihue - Raulí - Tepa	653.3
Coihue de Magallanes	143.9
Esclerófilo	407.2
Lenga	2,519.3
Roble - Hualo	104.4
Roble - Raulí - Coihue	1,714.6
Siempreverde	1,873.9
Without Forest Type	144.6
Total (ha)	8,062.4

	Guidelines for estimating the precision of change of use described in Olofsson et al. (2013). Error = Maule 111.3%, Ñuble 72.3%, Biobío 109.6%, Araucanía 191.6%, Los Ríos 96.6%, Los Lagos 89.1%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/deforestacion/Herramienta_Deforestacion_NR2_MR2_v018.xlsx

b) Degradation – forest remaining forest FREL/FRL

Parameter:	A_{DegFF} = Area of degradation of forests remaining forests monitored during 2001 - 2010 period, in areas not affected by browning (NBA).
Description:	We have 6 regions for the PRE area, Maule, Ñuble, Biobio, La Araucanía, Los Ríos and Los Lagos. The Biobio Region was divided in two Region. The province of Ñuble, which was part of Biobio Region, is a new Region. The surface of the total area remains equal. The surface area was described by degradation of native forest that remains as such.
Data unit:	Total hectares (ha/year) of the 2001-2010 period.
Value monitored during this Monitoring / Reporting Period:	**Region** / **Area** Maule: 73,201 Ñuble: 29,480 Biobío: 50,825 La Araucanía: 57,880 Los Ríos: 29,709 Los Lagos: 116,395 **Total**: 357,490
Source of data and description of measurement/calculation methods and procedures applied:	The data comes from INFOR's National Forest Inventory (IFN) plots, combined with spectral information from the Landsat series. This information integrates the variables of the state of the forests on the number of trees per hectare, basal area and volumes recorded by the monitoring of IFN plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way.
QA/QC procedures applied:	Since one input for AD on degradation are the Land Use Change Maps in order to define areas of forest remaining forest, same QA/QC procedures and SOP are used during the process. Additional procedures are applied, and proper SOP were developed. SOP_05_ Method for estimating in forest remaining forests the carbon variation. SOP_06: Field Operations Manual
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_No_Conservacion_NR2_MR2_v12.xlsx

c) Degradation - Substitution activity FREL/FRL

<table>
<tr><td>Parameter:</td><td>A_{DegNFF} = Surface of degradation areas resulting from the conversion of forests into plantations during the 2001-2013 period.</td></tr>
<tr><td>Description:</td><td>The total of areas by forest type that was degradation to plantation were registered</td></tr>
<tr><td>Data unit:</td><td>Total hectares (ha/year) of the period 2001-2013</td></tr>
<tr><td>Value monitored during this Monitoring / Reporting Period:</td><td>
<table>
<tr><th>Forest Type</th><th>Area</th></tr>
<tr><td>Alerce</td><td>0.6</td></tr>
<tr><td>Araucaria</td><td>8.1</td></tr>
<tr><td>Ciprés de la Cordillera</td><td>15.2</td></tr>
<tr><td>Ciprés de las Guaitecas</td><td>0.8</td></tr>
<tr><td>Coihue - Raulí - Tepa</td><td>335.3</td></tr>
<tr><td>Coihue de Magallanes</td><td>2.5</td></tr>
<tr><td>Esclerófilo</td><td>1,423.8</td></tr>
<tr><td>Lenga</td><td>186</td></tr>
<tr><td>Roble - Hualo</td><td>523.1</td></tr>
<tr><td>Roble - Raulí - Coihue</td><td>2,881.3</td></tr>
<tr><td>Siempreverde</td><td>1,376.2</td></tr>
<tr><td>Without Forest Type</td><td>1,577.6</td></tr>
<tr><td>Total (ha)</td><td>8,330.4</td></tr>
</table>
</td></tr>
<tr><td>Source of data and description of measurement/calculation methods and procedures applied:</td><td>To estimate degradation of native forests converted to plantations, the equation used to estimate deforestation is applied, since it is assumed that, to establish a plantation, all the carbon content present in the preceding native forest must be reduced to zero.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>For the generation of degradation by substitution activity data and as part of the QA / QC process, the different procedures implemented are documented through a series of protocols or SOPs that allow the estimates to be standardized over time.
SOP_01: Selection of REDD+ satellite mosaics
SOP_02: Elaboration of LULUCF maps</td></tr>
<tr><td>Uncertainty for this parameter:</td><td>The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013).
Error = Maule 191.8%, Ñuble 139.9%, Biobío 134.9%, Araucanía 113.4%, Los Ríos 138.6%, Los Lagos 100.0%</td></tr>
<tr><td>Any comment:</td><td>Link:
https://plataforma.enccrv.cl/static/erpa/mr2/sustitucion/Herramienta_Sustitucion_NR2_MR2_v008.xlsx</td></tr>
</table>

d) **Degradation – Forest fire activity FREL/FRL**

Parameter:	A = Area burned between 2001-2010 in the ERP Regions.
Description:	The surface of burned areas was recorded to estimate the degradation of the native forest.
Data unit:	Total hectares (ha) of the 2001-2010 period.
Value monitored during this Monitoring / Reporting Period:	*(see table below)*

Region/Year	Maule	Biobío	La Araucanía	Los Lagos	Los Ríos	Ñuble
2001	25	69	64	9	1	20
2002	147	7,443	18,765	2,552	904	117
2003	504	30	226	27	3	129
2004	171	197	268	91	175	15
2005	140	118	72	47	19	278
2006	62	57	73	207	7	90
2007	9	747	39	52	5	199
2008	344	144	307	4,234	119	87
2009	3,999	898	726	598	271	59
2010	432	581	42	1	1	399
Total period	5,834	10,285	20,581	7,819	1,504	1,392

Source of data and description of measurement/calculation methods and procedures applied:	The Forest Fire Protection Department and its Digital Information System for Operations Control provides annualized statistical information on the occurrence of forest fires for the entire country, which in recent years it has been improved by adding the spatial location of fires.
QA/QC procedures applied:	SOP_05_ Method for estimating in forest remaining forests the carbon variation.
Uncertainty for this parameter:	Area burned uncertainty estimated by INGEI (2020) Error: 15%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/incendios/Herramienta_Incendios_NR2_MR2_v016.xlsx

e) **Enhancement activity – No forest to native forest FREL/FRL**

Parameter:	$\Delta A_{TOOTHERS i,t}$ = Area of used non-forest land converted into forest during the reference level
Description:	The areas that correspond to non-forest lands were quantified in hectares to later estimate the carbon capture balances of these changes in land use. In this data forest plantations with exotic species are included as non-forest land.
Data unit:	Total hectares (ha/year) of the period 2001-2013
Value monitored during thisMonitoring / Reporting Period:	*(see table below)*

Forest Type	Area
Alerce	23
Araucaria	103
Ciprés de la Cordillera	125
Ciprés de las Guaitecas	21
Coihue - Raulí - Tepa	202
Coihue de Magallanes	13
Esclerófilo	4,863
Lenga	320
Roble - Hualo	490
Roble - Raulí - Coihue	3,585
Siempreverde	1,417

	Without Forest Type: 2,360 **Total (ha)**: **13,522**
Source of data and description of measurement/calculation methods and procedures applied:	A semi-automated technique is applied to detect changes using satellite images. The Multi-index method or MIICA (Jin et al., 2013) detects changes in land use for the period under study. The MIICA methodology is based on the combination of 2 spectral indices (dNBR, dNDVI) which, through integration rules, provide coverage of land use change, indicating the magnitude and directionality of the change. (Profit and loss). The MIICA methodology used images from the Landsat 8 sensor and was applied through a series of codes in programming language (Javascript, R) complemented with Google Earth Engine cloud processing, in GIS programs and R software, with the objective of obtaining an efficient land use change map.
QA/QC procedures applied:	For the generation of enhancement (non-forest to forest) activity data and as part of the QA / QC process, the different procedures implemented are documented through a series of protocols or SOPs that allow the estimates to be standardized over time. SOP_01: Selection of REDD+ satellite mosaics SOP_02: Elaboration of LULUCF maps,
Uncertainty for this parameter:	The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013). Error = Maule 80%, Ñuble 50.5%, Biobío 136.5%, Araucanía 192.2%, Los Ríos 65.1%, Los Lagos 138.5%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/aumento/Herramienta_Aumentos_NR2_MR2_v029.xlsx

f) Enhancement activity – forest remains forest in non-conservation areas FREL/FRL

Parameter:	A_{EnhFF} = Areas of non-conservation native forest that remains forest during the 2001– 2010 period for the Sixth Region of the ERP, in areas not affected by browning (NBA).
Description:	The areas that in 2001-2010 are forest in non-conservation area and remain as such, the hectares were estimated.
Data unit:	Total hectares (ha/year) of the 2001-2010 period.
Value monitored during this Monitoring / Reporting Period:	**Region** / **Area** Maule: 88,778 Ñuble: 33,323 Biobío: 65,805 La Araucanía: 87,901 Los Ríos: 47,402 Los Lagos: 139,986 **Total (ha)**: **463,195**
Source of data and description of measurement/calculation	The data comes from INFOR's National Forest Inventory IFN plots, combined with spectral information from the Landsat series. This information integrates

methods and procedures applied:	the variables of the state of the forests on the number of trees per hectare and basal area recorded by the monitoring of IFN plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way.
QA/QC procedures applied:	Since one input for AD on enhancement in areas of forest that remain as forest are the Land Use Change Maps in order to define areas of forest remaining forest, same QA/QC procedures and SOP are used during the process. Additional procedures are applied, and proper SOP were developed. SOP_05: Method for estimating in forest remaining forests the carbon variation. SOP_06: Field Operations Manual Inventory
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_No_Conservacion_NR2_MR2_v12.xlsx

g) Conservation activity FREL/FRL

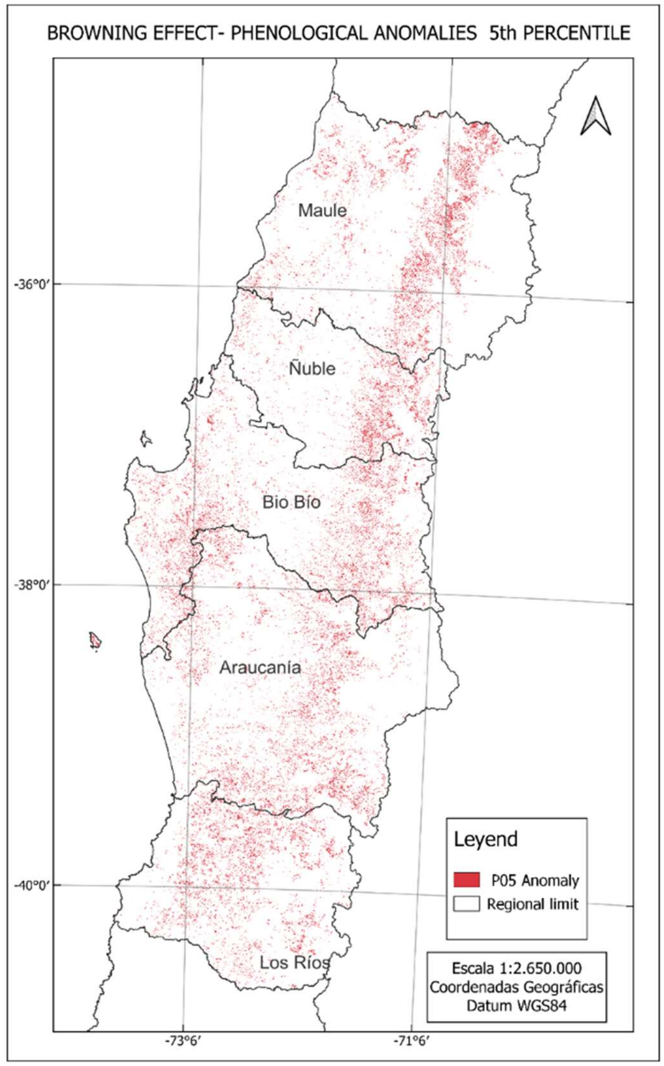
Parameter:	$\Delta A_{TO\_OTHERSi,t}$ = Areas of conservation native forest that remains as such during the 2001-2010 period in the Six Region of the ERP, in areas not affected by browning (NBA).
Description:	The areas that in 2001 to 2010 are forest in conservation area and remain as such
Data unit:	Total hectares (ha) of the period 2001-2010
Value monitored during this Monitoring / Reporting Period:	(see table below)
Source of data and description of measurement/calculation methods and procedures applied:	The data comes from INFOR's National Forest Inventory (IFN) plots, combined with spectral information from the Landsat series. This information integrates the variables of the state of the forests on the number of trees per hectare and basal area recorded by the monitoring of IFN plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way.
QA/QC procedures applied:	Since one input for AD on enhancement in areas of forest that remain as forest are the Land Use Change Maps in order to define areas of forest remaining forest, same QA/QC procedures and SOP are used during the process. Additional procedures are applied, and proper SOP were developed. SOP_05: Method for estimating in forest remaining forests the carbon variation. SOP_06: Field Operations Manual
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_Conservacion_NR2_MR2_v12.xlsx

Value monitored during this Monitoring / Reporting Period:

Region	Area
Maule	3,315
Ñuble	8,882
Biobío	15,509
La Araucanía	27,794
Los Ríos	26,371
Los Lagos	88,396
Total (ha)	**170,267**

h) Emissions and removals from browning affected forest area FREL/FRL

<table>
<tr><td>Parameter:</td><td>Browning = Areas of native forest that remains as such affected by browning during the 2001– 2010 period in the six Region of the ERP.</td></tr>
<tr><td>Description:</td><td>The areas that in 2001 to 2010 are forests affected by browning in forest areas that remain as such.</td></tr>
<tr><td>Data unit:</td><td>Total hectares (ha) of the 2001-2010 period.</td></tr>
<tr><td>Value monitored during this Monitoring / Reporting Period:</td><td>
<table>
<tr><th>Region</th><th>Degradation (Ha)</th><th>Enhancement (Ha)</th><th>Conservation (Ha)</th></tr>
<tr><td>Maule</td><td>24,394</td><td>31,978</td><td>976</td></tr>
<tr><td>Ñuble</td><td>7,157</td><td>8,850</td><td>1,342</td></tr>
<tr><td>Biobío</td><td>10,009</td><td>14,065</td><td>2,666</td></tr>
<tr><td>La Araucanía</td><td>7,725</td><td>11,916</td><td>776</td></tr>
<tr><td>Los Ríos</td><td>3,323</td><td>6,640</td><td>299</td></tr>
<tr><td>Los Lagos</td><td>1</td><td>0</td><td>0</td></tr>
<tr><td>Total (ha)</td><td>52,609</td><td>73,449</td><td>6,059</td></tr>
</table>
</td></tr>
<tr><td>Source of data and description of measurement/calculation methods and procedures applied:</td><td>As could be seen in certain tables by activity data described above, emissions accounting in forest remaining forest was carried out in areas not affected by browning (NBA) excluding the areas affected by browning (BA). This occurs due to areas affected by browning are considered as a non-anthropogenic emission source because the carbon fluxes that occurs on these areas are not related to human activities as the deforestation activity. It is a non-anthropogenic source because it is generated by the decreases in precipitation falls, and water availability. The areas affected by browning correspond to those areas of forest that remain as forests that present phenological anomalies because of the impact of the megadrought. These anomalies were detected in the integral productivity of native forest in the ERP implementation area and are under the 5th percentile data productivity anomaly (GAC,2023). The phenological anomaly results in the desiccation of the crowns, loss of foliage and even the mortality of individuals.
Down below is a map with the areas of the 5th percentile anomalies distribution. These areas were used in each monitoring report to exclude the emission related to the non-anthropogenic emissions in each period. They correspond to areas of native forest between the regions of Maule and La Araucanía, together with the area of the RORACO forest type extended</td></tr>
</table>

	to the region of Los Ríos.  It is worth clarifying that the browning effect emission are excluded in both the degradation, increase and conservation activities in forest remaining forest. However, the forest stratum affected by browning is not excluded from the ERP implementation and monitoring area, and its treatment is maintained continuously at the same level of scope as those areas outside this stratum. The raster layer of phenological anomalies could be found in the following link: https://plataforma.enccrv.cl/static/erpa/mr2/mapas/BROWNING-MR2.zip
QA/QC procedures applied:	
Uncertainty for this parameter:	
Any comment:	The same anomalies raster layer was used to segregate the browning areas in the NREF and Reporting Periods this allows that non-anthropogenic and anthropogenic emissions and removals are kept separate. The segregation considers report all the carbon fluxes which occur in those areas (gain, loss and neutral) from each period and excluding them from the account.

i) Periodic Annual Increment for mixed forest

<table>
<tr><td>Parameter:</td><td>Periodic annual increment (PAI) for mixed forest</td></tr>
<tr><td>Description:</td><td>The mixed forest is calculated as a weighted average value of the forest types present in the region and according to the forest surface present for the activity of enhancement of the period (from no forest to native forest).</td></tr>
<tr><td>Data unit:</td><td>Cubic meter per hectare and year (m^3 ha^{-1} $year^{-1}$)</td></tr>
<tr><td>Source of data or description of the method for developing the data including the spatial level of the data (local, regional, national, international):</td><td>Forest native data are national data and published in INGEI (2020)</td></tr>
<tr><td>Value applied:</td><td>
<table>
<tr><th>Region</th><th>PAI NREF
(m^3 ha^{-1} $year^{-1}$)</th></tr>
<tr><td>Maule</td><td>2.1</td></tr>
<tr><td>Ñuble</td><td>2.8</td></tr>
<tr><td>Biobío</td><td>3.7</td></tr>
<tr><td>Araucanía</td><td>4.2</td></tr>
<tr><td>Los Ríos</td><td>4.1</td></tr>
<tr><td>Los Lagos</td><td>4.2</td></tr>
</table>
</td></tr>
<tr><td>QA/QC procedures applied</td><td>SOP_06_Field Operation Manual</td></tr>
<tr><td>Uncertainty associated with this parameter:</td><td>SOP_06 Field Operations Manual was implemented during fieldwork to estimate PAI in the National Forest Inventory, for some forest types were possible to adjust a Probability Distribution Function (PDF). For the forest types with a limited number of sampling plots, uncertainty propagation with Monte Carlo analysis uses the calculation of the measurement uncertainty for PAI based on the 95% CI of the removal rate by forest type, calculated with Continuous Forest Inventory data of INFOR.
● PAI Mixed Forest = 28.7% (Average of PAI error for all forest types given lack of data.)</td></tr>
<tr><td>Any comment:</td><td></td></tr>
</table>

j) Deforestation activity MR2

Parameter:	$\Delta A_{TO\_OTHERSi,t}$ = Areas of different Forest Types (i) converted to another category of land use during the 2020-2021 period.
Description:	Chile has 11 different Native Forest Type in the PRE area.
Data unit:	Total hectares (ha) of the 2020-2021 period.

Value monitored during this Monitoring / Reporting Period:	<table><tr><th>Forest Type</th><th>Area</th></tr><tr><td>Alerce</td><td>10</td></tr><tr><td>Araucaria</td><td>1</td></tr><tr><td>Cipres de la Cordillera</td><td>14</td></tr><tr><td>Cipres de las Guaitecas</td><td>17</td></tr><tr><td>Coihue - Rauli - Tepa</td><td>438</td></tr><tr><td>Coihue de Magallanes</td><td>2</td></tr><tr><td>Esclerófilo</td><td>2,101</td></tr><tr><td>Lenga</td><td>67</td></tr><tr><td>Roble - Hualo</td><td>24</td></tr><tr><td>Roble - Rauli - Coihue</td><td>1,291</td></tr><tr><td>Siempreverde</td><td>2,032</td></tr><tr><td>Without Forest Type</td><td>736</td></tr><tr><td>Total</td><td>6,733</td></tr></table>
Source of data and description of measurement/calculation methods and procedures applied:	Matrixes of change in land use taken from land-use change maps. Regional, characterized by stunted, adult, young adult, mixed and young forests converted into areas with no vegetation, urban and industrial areas, waterbodies, areas where succulents, wetlands, scrubland, perennial snow and glaciers, grasslands and farmland have formed.
QA/QC procedures applied:	SOP_02_LULUCF Maps Elaboration_ERPA2 SOP_03_ Standardization and quality control protocol for land use change maps QAQC_03_ Standardization and Quality control for land use change maps_ERPA2
Uncertainty for this parameter:	The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013) and the estimator of the total area using the separate ratio estimator (formulas from sec. 6.10 of W.G. Cochran, Sampling Techniques, 3rd Edition, 1977) Error = Maule 40%, Ñuble 34%, Biobío 39%, Araucanía 7%, Los Ríos 87%, Los Lagos 56%.
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/deforestacion/Herramienta_Deforestacion_NR2_MR2_v018.xlsx

k) Degradation – forest remaining forest MR2

Parameter:	A_{DegFF} = area of degradation of forests that remain as forests monitored during the 2020-2021 period.
Description:	The area was described by degradation of native forest that remains as such, in areas not affected by browning (NBA).
Data unit:	Total hectares (ha) of the 2020-2021 period.
Value monitored during this Monitoring / Reporting Period:	<table><tr><th>Region</th><th>Area</th></tr><tr><td>Maule</td><td>51,300</td></tr><tr><td>Ñuble</td><td>19,161</td></tr><tr><td>Biobío</td><td>34,994</td></tr><tr><td>La Araucanía</td><td>49,899</td></tr><tr><td>Los Ríos</td><td>29,995</td></tr><tr><td>Los Lagos</td><td>77,032</td></tr><tr><td>Total</td><td>262,381</td></tr></table>
Source of data and description of measurement/calculation methods and procedures applied:	The data comes from INFOR's National Forest Inventory (IFN) plots, combined with spectral information from the Landsat series. This information integrates the variables of the state of the forests on the number of trees per hectare, basal area and volumes recorded by the monitoring of IFN plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way. The estimation of the variation in carbon content on forests that remain as such for FREL/FRL and monitoring report for Degradation, Restoration of Forest remaining forests and Forestry Conservation activities is estimated based on information coming from the Continuous Inventory of Forest Ecosystems and the application of remote sensing techniques on LANDSAT satellite images.
QA/QC procedures applied:	SOP_05.0_Forest Carbon Flux estimation assessment_ERPA2 SOP_06_Field Operation Manual
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_No_Conservacion_NR2_MR2_v12.xlsx

l) Degradation - Substitution activity MR2

<table>
<tr><td>Parameter:</td><td>A_{DegNFF} = Surface of degradation areas resulting from the conversion of forests into plantations during the 2020-2021 period.</td></tr>
<tr><td>Description:</td><td>The total of areas by forest type that was degraded to plantation were registered.</td></tr>
<tr><td>Data unit:</td><td>Total hectares (ha) of the 2020-2021 period.</td></tr>
<tr><td>Value monitored during this Monitoring / Reporting Period:</td><td>
<table>
<tr><th>Forest Type</th><th>Area</th></tr>
<tr><td>Alerce</td><td>0</td></tr>
<tr><td>Araucaria</td><td>0</td></tr>
<tr><td>Ciprés de la Cordillera</td><td>13</td></tr>
<tr><td>Ciprés de las Guaitecas</td><td>0</td></tr>
<tr><td>Coihue - Raulí - Tepa</td><td>0</td></tr>
<tr><td>Coihue de Magallanes</td><td>0</td></tr>
<tr><td>Esclerófilo</td><td>30</td></tr>
<tr><td>Lenga</td><td>0</td></tr>
<tr><td>Roble - Hualo</td><td>13</td></tr>
<tr><td>Roble - Raulí - Coihue</td><td>237</td></tr>
<tr><td>Siempreverde</td><td>32</td></tr>
<tr><td>Without Forest Type</td><td>414</td></tr>
<tr><td>Total</td><td>739</td></tr>
</table>
</td></tr>
<tr><td>Source of data and description of measurement/calculation methods and procedures applied:</td><td>To estimate degradation of native forests converted to plantations, the equation used to estimate deforestation is applied, since it is assumed that, to establish a plantation, all the carbon content present in the preceding native forest must be reduced to zero.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>SOP_02_LULUCF Maps Elaboration_ERPA2
SOP_03 Standardization and quality control protocol for land use change maps
QAQC_03_ Standardization and Quality control for land use change maps_ERPA2</td></tr>
<tr><td>Uncertainty for this parameter:</td><td>The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013) and the estimator of the total area using the separate ratio estimator (formulas from sec. 6.10 of W.G. Cochran, Sampling Techniques, 3rd Edition, 1977).
Error = Maule 518%, Ñuble 214%, Biobío 138%, Araucanía 126%, Los Ríos 196%, Los Lagos 77%</td></tr>
<tr><td>Any comment:</td><td>Link:
https://plataforma.enccrv.cl/static/erpa/mr2/sustitucion/Herramienta_Sustitucion_NR2_MR2_v008.xlsx</td></tr>
</table>

m) Degradation – Forest fire activity MR2

<table>
<tr><td>Parameter:</td><td>A = Area burned between 2020-2021 in the ERP Regions.</td></tr>
<tr><td>Description:</td><td>The surface of burned areas was recorded to estimate the degradation of the native forest.</td></tr>
<tr><td>Data unit:</td><td>Total hectares (ha) of the 2020-2021 period.</td></tr>
<tr><td>Value monitored during this Monitoring / Reporting Period:</td><td>
<table>
<tr><th>Region</th><th>2020’s area</th><th>2021’s area</th></tr>
<tr><td>Maule</td><td>9,571</td><td>2,840</td></tr>
<tr><td>Ñuble</td><td>209</td><td>255</td></tr>
<tr><td>Biobío</td><td>2,587</td><td>186</td></tr>
<tr><td>La Araucanía</td><td>3,314</td><td>511</td></tr>
<tr><td>Los Ríos</td><td>193</td><td>20</td></tr>
<tr><td>Los Lagos</td><td>16</td><td>215</td></tr>
<tr><td>Total (ha)</td><td>15,890</td><td>4,028</td></tr>
</table>
</td></tr>
<tr><td>Source of data and description of measurement/calculation methods and procedures applied:</td><td>The Forest Fire Protection Department and its Digital Information System for Operations Control (SIDCO), provides annualized statistical information on the occurrence of forest fires for the entire country, which in recent years has been improved by adding the spatial location of fires.</td></tr>
<tr><td>QA/QC procedures applied:</td><td>SOP_07_ForestFire_Polygons</td></tr>
<tr><td>Uncertainty for this parameter:</td><td>Area burned uncertainty estimated by INGEI (2020)
Error: 15%</td></tr>
<tr><td>Any comment:</td><td>Link:
https://plataforma.enccrv.cl/static/erpa/mr2/incendios/Herramienta_Incendios_NR2_MR2_v016.xlsx</td></tr>
</table>

n) Enhancement activity – No forest to native forest MR2

Parameter:	$\Delta A_{TOOTHERS i,\ t}$ = Non-forest land use area converted to forest during the crediting period.
Description:	The areas that correspond to non-forest lands were quantified in hectares to later estimate the carbon capture balances of these land changes use. In this data forest plantations with exotic species are included as non-forest land.
Data unit:	Total hectares (ha) of the 2020-2021 period.
Value monitored during this Monitoring / Reporting Period:	(see table below)
Source of data and description of measurement/calculation methods and procedures applied:	A semi-automated technique is applied to detect changes using satellite images. The Multi-index method or MIICA (Jin et al., 2013) detects land use changes for the period under study. The MIICA methodology is based on the combination of 2 spectral indexes (dNBR, dNDVI) which, through integration rules, provide coverage of land use change, indicating the magnitude and directionality of the change. (Gain and loss). The MIICA methodology used images from the Landsat 8 sensor and was applied through a series of codes in programming language (JavaScript, R) complemented with Google Earth Engine cloud processing, in GIS programs and R software, with the objective of obtaining an efficient land use change map.
QA/QC procedures applied:	SOP_02_LULUCF Maps Elaboration_ERPA2 SOP_03 Standardization and quality control protocol for land use change maps QAQC_03_ Standardization and Quality control for land use change maps_ERPA2

Forest Type	Area
Alerce	0
Araucaria	0
Cipres de la Cordillera	0
Cipres de las Guaitecas	0
Coihue - Rauli - Tepa	0
Coihue de Magallanes	0
Esclerófilo	0
Lenga	0
Roble - Hualo	0
Roble - Rauli - Coihue	0
Siempreverde	0
Without Forest Type (mixed forest)	0
Total (ha)	**0**

Uncertainty for this parameter:	The uncertainty of land-use change maps is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013) and the estimator of the total area using the separate ratio estimator (formulas from sec. 6.10 of W.G. Cochran, Sampling Techniques, 3rd Edition, 1977) Error = Maule NA, Ñuble NA, Biobío NA, Araucanía NA, Los Ríos NA, Los Lagos NA. The error does not apply because no enhancement activity was mapped.
Any comment:	The error does not apply because no enhancement activity was mapped. Link: https://plataforma.enccrv.cl/static/erpa/mr2/aumento/Herramienta_Aumentos_NR2_MR2_v029.xlsx

o) Enhancement activity – forest remains forest in non-conservation areas

Parameter:	A_{EnhFF} = Areas of non-conservation native forest that remains forest during the 2020-2021 period for the six Region of the ERP.
Description:	The number of hectares of forest that remains as forest during the period 2020 - 2021 was estimated, in non-conservation areas considering that they are not within an area affected by browning (NBA).
Data unit:	Total hectares (ha) of the 2020-2021 period.
Value monitored during this Monitoring / Reporting Period:	(see table below)
Source of data and description of measurement/calculation methods and procedures applied:	The data comes from INFOR's IFN plots, combined with spectral information from Landsat series. This information integrates the variables of the state of the forests on the number of trees per hectare and basal area recorded by the monitoring plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way.
QA/QC procedures applied:	SOP_05_Forest Carbon Flux estimation assessment_ERPA2 SOP_06_Field Operation Manual
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_No_Conservacion_NR2_MR2_v12.xlsx

Value monitored during this Monitoring / Reporting Period:

Region	Area
Maule	62,001
Ñuble	20,744
Biobío	33,108
La Araucanía	44,453
Los Ríos	28,777
Los Lagos	72,113
Total (ha)	**261,196**

p) **Conservation activity**

Parameter:	$\Delta A_{TO\_OTHERSi,t}$ = areas of conservation of native forest that remains as such during the 2020-2021 period in the six Region of the ERP.
Description:	The areas that in 2020-2021 are forest in conservation area and remain as such.
Data unit:	Total hectares (ha) of the 2020-2021 period.
Value monitored during this Monitoring / Reporting Period:	see table below
Source of data and description of measurement/calculation methods and procedures applied:	The data comes from IFN plots, combined with spectral information from the Landsat series. This information integrates the variables of the state of the forests on the number of trees per hectare and basal area recorded by the monitoring of IFN plots, with the spectral data from Landsat to estimate carbon stocks in a spatially explicit way.
QA/QC procedures applied:	SOP_05_Forest Carbon Flux estimation assessment_ERPA2 SOP_06_Field Operation Manual
Uncertainty for this parameter:	Degradation mapping accuracy estimated by INFOR. Error: 32.8%
Any comment:	Link: https://plataforma.enccrv.cl/static/erpa/mr2/bosque-permanente/Herramienta_BP_Conservacion_NR2_MR2_v12.xlsx

Region	Area
Maule	3,041
Ñuble	6,330
Biobío	10,215
La Araucanía	20,372
Los Ríos	25,406
Los Lagos	106,482
Total (ha)	**171,846**

q) Emissions and removals from browning affected forest area

Parameter:	Browning = Areas of native forest that remains as such affected by browning during the 2020 – 2021 period in the six Region of the ERP.
Description:	The areas that in 2020 to 2021 are forests affected by browning in forest areas that remain as such.
Data unit:	Total hectares (ha) of the 2020-2021 period.
Value monitored during this Monitoring / Reporting Period:	see table below

Region	Degradation (Ha)	Enhancement (Ha)	Conservation (Ha)
Maule	18,827	23,058	971
Ñuble	5,138	5,372	1,066
Biobío	8,313	7,662	1,839
La Araucanía	6,337	5,964	430
Los Ríos	3,003	2,743	191
Los Lagos	0	0	0
Total (ha)	**41,618**	**44,799**	**4,497**

Source of data and description of measurement/calculation methods and procedures applied:	For the second monitoring period, the same methodology applied in both the NREF and RP1 was carried out regarding the segregation of non-anthropogenic emission through the exclusion of the areas affected by browning (BA) in forest remaining forest. These areas are considered as a non-anthropogenic emission source because the carbon fluxes that occurs on these areas are not related to human activities as the deforestation activity and t is generated by the decreases in precipitation falls, and water availability. The areas affected by browning correspond to those areas of forest that remain as forests that present phenological anomalies because of the impact of the megadrought. These anomalies were detected in the integral productivity of native forest in the ERP implementation area and are under the 5th percentile data productivity anomaly (GAC,2023). The phenological anomaly results in the desiccation of the crowns, loss of foliage and even the mortality of individuals. The same anomalies raster layer was used to segregate the browning areas in the NREF and Reporting Periods and considers all the carbon fluxes which occur in those areas (gain, loss and neutral) from each period. This allows that non-anthropogenic and anthropogenic emissions and removals are kept separate.
QA/QC procedures applied:	
Uncertainty for this parameter:	
Any comment:	Regarding to the provisions will be established towards monitoring browning area recovery, the areas will continue to be monitored as part of the PRE's accounting area in accordance with the established methodology and monitoring plan. These areas are not being excluded and it is expected that, if they remain as forest, the recovery or loss of the stock can be detected, or that emissions can be detected in the event that they are deforested, which will be reported in the third monitoring event to guarantee the account of emissions resulting from any land use changes and any other anthropogenic activities in the areas affected by browning. Notwithstanding the above, it is not feasible to propose that these areas can recover their initial condition prior to the disturbance, since even if restoration or recovery actions are carried out, there is no certainty of the result they may have in reversing the effect of water deficit and stress. The raster layer of phenological anomalies could be found in the following link: https://plataforma.enccrv.cl/static/erpa/mr2/mapas/BROWNING-MR2.zip

4 QUANTIFICATION OF EMISSION REDUCTIONS

4.1 ER Program Reference level for the Monitoring / Reporting Period covered in this report

Year of Monitoring/ Reporting period *t*	Average annual historical emissions from deforestation over the Reference Period (tCO_{2-e}/yr)	If applicable, average annual historical emissions from forest degradation over the Reference Period (tCO_{2-e}/yr)	If applicable, average annual historical removals by sinks over the Reference Period (tCO_{2-e}/yr)	Adjustment, if applicable (tCO_{2-e}/yr)	Reference level (tCO_{2-e}/yr)
2001	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2002	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2003	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2004	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2005	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2006	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2007	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2008	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2009	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2010	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2011	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2012	5,140,727	11,914,436	-10,740,394	NA	6,314,770
2013	5,140,727	11,914,436	-10,740,394	NA	6,314,770
Total	**66,829,454**	**-154,887,668**	**-139,625,118**	**0**	**82,092,006**

4.2 Estimation of emissions by sources and removals by sinks included in the ER Program's scope

Year of Monitoring/ Reporting Period	Emissions from deforestation (tCO_{2-e}/yr)	If applicable, emissions from forest degradation (tCO_{2-e}/yr)*	If applicable, removals by sinks (tCO_{2-e}/yr)	Net emissions and removals (tCO_{2-e}/yr)
2020	1,390,352	27,826,068	-26,452,737	2,763,529
2021	1,390,352	27,826,068	-26,452,737	2,763,529
Total	**2,780,704**	**55,652,136**	**-52,905,474**	**5,527,366**

4.3 Calculation of emission reductions

Total Reference Level emissions during the Monitoring Period (tCO_2-e)	12,629,539
Net emissions and removals under the ER Program during the Monitoring Period (tCO_2-e)	5,527,366
Emission Reductions during the Monitoring Period (tCO_2-e)	7,102,173
Length of the Reporting period / Length of the Monitoring Period (# days/# days)	757/730
Emission Reductions during the Reporting Period (tCO_2-e)[15]	7,364,856
Cumulative quantity of Total ERs estimated for prior reporting periods (tCO_2-e, only use if negative)	-5,353,046
Cumulative Emission Reductions during the Reporting Period (tCO_2-e)	2,011,810

[15] Spreadsheet available in https://plataforma.enccrv.cl/static/erpa/mr2/resultados/0.-Resultados_MRV_ERPA_RP2_v10.xlsx

5 UNCERTAINTY OF THE ESTIMATE OF EMISSION REDUCTIONS

The country allocated Emission Reductions attributed to the reporting pro-rata period to the number of days of the Reporting Period. Chile applied a pro-rata factor of 1.03699. The ER global uncertainty was estimated with and without the pro-rata factor. The quantification of the uncertainty estimates of Emission Reductions and the sensitivity analysis included in this section have been calculated applying the pro-rata values.

5.1 Identification, assessment and addressing sources of uncertainty

In the table below, the country identified and discussed a list of the main sources of uncertainty and if its contribution to the total uncertainty of Emission Reductions is high or low, and whether they are systematic or random. In addition, the table includes the measures implemented to address these sources of uncertainty as part of the Monitoring Cycle.

Since a sampling approach is not used for Activity Data and emission factors are estimated from a model-based estimator, the uncertainty estimate of reduced emissions has deviated from the Guidelines on uncertainty ERs.

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
Activity Data					
Measurement	Systematic and random	Land-use and land-use change areas: The Activity Data for deforestation, substitution, restitution, area increase of native forest, and permanent forest lands come from Land-use changes maps. A Protocol have been prepared to facilitate the replication of the mapping steps from the digital processing of satellite images. All procedures required to prepare land-use and land-use change maps are described in the Methodological Protocol for the land-use and land-use change mapping in Native Forest (SOP 02). This protocol includes inputs, data sets, and the methodological steps necessary to generate thematic cartography and statistical reports at the national level on the extension, distribution, and land-use change. The land-use change detection maps are prepared with the Multi-Index Integrated Change Analysis methodology (MIICA - Jin et al., 2013), both for the reference and reporting periods. The application of the MIICA methodology uses the Landsat 7 multipixel mosaics for the reference period and Landsat 8 for the monitoring period. Land-use change control polygons (ground truth) are taken proportionally to each of the regions' surface to establish the spectral thresholds of the zones of change and the evaluated index for each IPCC land-use category. Next, the polygons are verified visually on the time series of high-resolution images provided by the Google Earth software. Finally, land-use allocation of the loss vector layer is done applying a supervised classification method to the multi-pixel mosaic. Additionally, temporal tracking of land-use	Low	Yes: SOP_01_Satellite mosaic elaboration_ERPA2 and QAQC_01_Mosaics elaboration metadata_ERPA2 https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_01_MR2.zip SOP_02_LULUCF Maps Elaboration_ERPA2 https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_02_MR2.zip QAQC_03_ Standardization and Quality control for land use change maps_ERPA2 https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_03_MR2.zip	NO

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
		changes is done by integrating the polygons of areas of change resulting from each monitoring period into the existing layers of change maps. The topological conditions, data geometry, databases, and map attributes are reviewed in detail. Then, any discrepancies or inconsistencies are sent to the responsible team for resolution (SOP 03). After the solution, the inconsistency is double checked.			
		The result of the activity data measurement is reviewed to ensure consistency, according to the sum of REDD+ activities areas and the surface region. This process is applied during the integration of final calculation results, and in case of finding inconsistencies, the integration must stop, and the input data must be verified. Finally, Uncertainties associated with AD are due to the production process of land use maps. The uncertainties of the AD for deforestation, substitution, restitution, area increase of native forest, and permanent forest activities are associated with the errors of the satellite image processing during the preparation of land-use change maps. The uncertainty of land-use change maps[16] is estimated by comparing the results of the land-use change category on the map and the reference observations corresponding to a sample of visually interpreted points. Factors influencing the estimation of uncertainty are the sampling design and the sample size used to assess the precision and accuracy of the maps. The errors related to land-use change are calculated following the Good Practice Guidelines for estimating the precision of change of use described in Olofsson et al. (2013). This approach is applied with the FAO Collect Earth tool.The sample size of the accuracy assessment of the land-use change maps is calculated considering the user's precision parameters for each land use or category of change. These parameters are obtained from a pre-sampling. The sample size is calculated assuming a standard error of the precision of 0.01 using the equation of Cochran (1977). The evaluation points are selected with a stratified random sampling design for each IPCC sub-use in each region.			
Measurement	Systematic and random	Permanent forest degradation and carbon enhancement: The Activity Data for degradation and carbon enhancement in permanent forest lands comes from satellite imaging and IFN biomass information integration.	High	Yes, for a and b sources: SOP_05: Forest Carbon Flux estimation assessment_ERPA2	NO

[16] Available in https://plataforma.enccrv.cl/static/erpa/mr2/analisis-incertidumbre/Incertidumbre-Mapas-MR2.zip

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
		A Protocol has been prepared to facilitate replicating the mapping process from the digital processing of satellite images and IFN biomass information (SOP 05). All procedures are described in the Protocol to prepare carbon flux, stock, and degradation mapping in the permanent forest. This protocol includes methods description, spatial and dasometric information, and satellite data processing required to estimate activity data for degradation and carbon enhancement. The sources of error for estimating carbon degradation and enhancement activity data on permanent forest lands are: Uncertainty associated with the forest density charts used to determine the direction of carbon flux (neutral, loss or gain) for each pixel. This uncertainty has been estimated in 32.8%. Uncertainty associated with integrating the multi-pixel mosaic satellite data with the dasometric variables. This uncertainty has been estimated by calculating the Standard Error of Estimation of the volume function k-nn. This uncertainty has been estimated in 57%.		https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_05_MR2.zip SOP_06: SOP06 Field Operations Manual https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_06_MR2.zip	
Representativeness	Systematic	Land-use and land-use change areas: Multi-pixel mosaics are prepared with a temporal range with cloud-free pixels to obtain representative satellite images of the beginning and end of each period. The multi-pixel mosaic is an image composed of pixels of different images extracted from the definition of a range or time window. The selection of each pixel seeks to define the best information available in a specific area, prioritizing above all that they are pixels free of cloud and cloud shadows. Given the high cloud cover present in southern Chile, a ± 3 months window is used for the start and end date of the analyzed period. For example, considering the period 2020 - 2021, the start date is January 1, 2020, the range or time window will correspond from October 1, 2019, to March 31, 2020; the multipixel mosaic time window for the end of period (December 31, 2021) is from October 1, 2021, to March 31, 2022.	Low	Yes: SOP_01_Satellite mosaic elaboration_ERPA2 and QAQC_01_Mosaics elaboration metadata_ERPA2 https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_01_MR2.zip	NO
Sampling	NA	Land-use and land-use change areas: This source of uncertainty is not applicable. It is not required to use a sampling technique to estimate ADs for carbon deforestation, substitution, restitution, area increase of native forest, and permanent forest lands. The AD estimation is made with a total pixel count of the carbon content map for each land-use change category.	NA	NA	NA
	NA	Permanent forest degradation and carbon enhancement: This source of uncertainty is not applicable. It is not required to use a sampling technique to estimate ADs for carbon degradation	NA	NA	NA

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
		and enhancement. The AD estimation is made with a total pixel count of the carbon content map for each flow category (biomass gain or loss).			
Extrapolation	NA	This source of uncertainty is not applicable. Extrapolation is not applied to estimate REDD+ activities, the sample-based estimation area method is not used. All REDD+ activities are calculated from spatially explicit information.	NA	NA	NA
Approach 3	NA	This source of uncertainty is not applicable. Activity data were estimated conducting tracking of lands or IPCC Approach 3 for reference and monitoring periods.	NA	NA	NA
Emission Factor					
BH measurement H measurement Plot delineation Wood density estimation Biomass allometric model	Systematic and Random	Aerial Biomass The measurement uncertainty for aerial biomass estimate depends on the land-use carbon density data source: Aerial biomass of native and mixed forest: SOP_06 Field Operations Manual was implemented during fieldwork for the estimation of AGB in the National Forest Inventory. For some forest types were possible to adjust a Probability Distribution Function (PDF). For the forest types with a limited number of sampling plots, uncertainty propagation with Monte Carlo analysis uses the following information: DBH measurement error (0.2%). Calculation based on Continuous Forest Inventory data of INFOR. Volume estimation error (0.07%). Calculation based on Continuous Forest Inventory data of INFOR. Biomass Expansion Factor (BEF) error (18.0%). BEF comes from information collected in the country from the study of Gayoso et al. (2002) and used in INGEI (2020). This value is for native species and has a national spatial level. Error calculation is based on statistical data from the Biomass Inventory and Carbon Accountancy of the Universidad Austral de Chile (UACh). Wood Density (5.6%). Calculated using basic density data collected from native species growing in Chile. A bibliographic review of basic densities of the forest species in Chile was carried out and there were no modifications for the value exposed form Gayoso et al. (2002) and INGEI (2020). Finally, these uncertainties are combined following IPCC approach 1 (propagation of error), resulting in total uncertainty of 18.85%. Aerial biomass of non-forest uses: Monte Carlo analysis uses error estimation published in INGEI (2020) and Gayoso (2006) and Expert judgment estimates (IPCC, 2006). The error of carbon density for wetlands, water bodies, and other non-	Low	Yes, for a: SOP_06: Field Operation Manual https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_06_MR2.zip	Yes

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
		vegetations uses was assumed cero due to a lack of data. Annual Periodic Increment (IPA Spanish acronym): SOP_06 Field Operations Manual was implemented during fieldwork to estimate IPA in the National Forest Inventory, for some forest types were possible to adjust a Probability Distribution Function (PDF). For the forest types with a limited number of sampling plots, uncertainty propagation with Monte Carlo analysis uses the calculation of the measurement uncertainty for IPA based on the 95% CI of the removal rate by forest type, calculated with Continuous Forest Inventory data of INFOR.			
Sampling	Random	The Continuous Inventory of Forestry Ecosystems, henceforth referred to as the Continuous Inventory, managed by INFOR, and has been operational since 2000. The Continuous Inventory was designed under a statistical bi-stage design in three circular sample plot clusters in an area equivalent to 500m2 distributed in a systematic area of 5x7km. The sampling units have been systematically distributed over the national territory from the Maule to the Magallanes region.	Low	Yes: QA / QC applied in SOP06 https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_06_MR2.zip	Yes
Other parameters (e.g. Carbon Fraction, root-to-shoot ratios)	Systematic and Random	Root-to-shoot ratio (R factor-40% error): R factor comes from information collected in the country (Gayoso et al., 2002; INGEI, 2020). This value is within the range indicated in the 2006 IPCC Guidelines for temperate forests (between 0.20 and 0.46, according to Table 4.4; Chapter 4; Volume 4) and within of the values available worldwide, which provide R factors that range between 0.09 and 0.33. This value is for native species and has a national spatial level. Error	Low	NA	Yes

Sources of uncertainty	Systematic and/or random	Analysis of contribution to overall uncertainty	Contribution to overall uncertainty (High / Low)	Addressed through QA/QC?	Residual uncertainty estimated?
		calculation based on statistical data from the Biomass Inventory and Carbon Accountancy of the Universidad Austral de Chile (UACh). Finally, aerial biomass and R factor uncertainties are combined following IPCC approach 1 (propagation of error), resulting in total uncertainty of 44.2%.			
Representativeness	NA	This source of uncertainty is not applicable. Chile generates estimates of carbon densities per forest type, and non-forest land uses. Different forest types and structures classify the native forest. Each forest type has its biomass value depending on data availability. Also, non-forest lands include the following uses: Urban and Industrial Areas, agricultural land, grassland, scrub, arborescent scrub, shrub planting, succulent scrub, succulent formations, plantations, wetlands, areas deprived of vegetation, eternal snows and glaciers, waterbodies and unrecognized areas.	NA	NA	NA
Integration					
Model	Systematic	Calculation tools have been prepared to estimate Emission Reductions, including the FREL and Monitoring Period for REDD activity. In these tools, you can review the formulas used to estimate ERs. The country prepared these tools to ensure the same calculation methods are applied for all monitoring events and avoid errors during the processing and data preparation.	Low	NA	No
Integration	Systematic	The Emission factors were calculated for each region and forest type according to AGB sampling plots' location to assure the comparability between transition classes of the Activity Data and those of the Emission Factors. This source of uncertainty is considered in the sampling error of the AGB inventory.	Low	Yes: SOP_06_Field Operation Manual https://plataforma.enccrv.cl/static/erpa/mr2/sop/SOP_06_MR2.zip	No

5.2 Uncertainty of the estimate of Emission Reductions

Parameters and assumptions used in the Monte Carlo method

The following table shows the parameters and assumptions used in the Monte Carlo Analysis [17]to estimate the uncertainty of the Emission Reduction for the Monitoring Period. The parameter where the type of Probability Distribution Function (PDF) is fitted indicates the p-value of the adjustment obtained for the distribution function and its parameters

[17] Available in https://plataforma.enccrv.cl/static/erpa/mr2/analisis-incertidumbre/Incertidumbre-Global-MR2.zip

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
Activity Data				
Non-Forest land - Forest Maule Reference Period (ha/yr)	6,239	10.9%	Normal	Activity Data uncertainty used in Monte Carlo Analysis was calculated using the confidence limits of the sampling-based land-use change estimation areas for the reference and monitoring periods.
Non-Forest land - Forest Ñuble Reference Period (ha/yr)	546	10.9%	Normal	
Non-Forest land - Forest Biobio Reference Period (ha/yr)	1,795	8.84%	Normal	
Non-Forest land - Forest Araucanía Reference Period(ha/yr))	2,545	7.9%	Normal	
Non-Forest land - Forest Los Ríos Reference Period (ha/yr)	1,468	9.4%	Normal	
Non-Forest land - Forest Los Lagos Reference Period (ha/yr)	929	11.0%	Normal	
Non-Forest land - Forest Maule Monitoring Period (ha/yr)	80,038	10.9%	Normal	
Non-Forest land - Forest Ñuble Monitoring Period (ha/yr)	6,722	10.9%	Normal	
Non-Forest land - Forest Biobio Monitoring Period (ha/yr)	22,438	10.9%	Normal	
Non-Forest land - Forest Araucanía Monitoring Period (ha/yr))	32,961	7.9%	Normal	
Non-Forest land - Forest Los Ríos Monitoring Period (ha/yr)	19,004	9.4%	Normal	
Non-Forest land - Forest Los Lagos Monitoring Period (ha/yr)	11,994	11.0%	Normal	
Forest land – Non-Forest Maule Reference Period (ha/yr)	634	11.1%	Normal	
Forest land – Non-Forest Ñuble Reference Period (ha/yr)	424	11.1%	Normal	
Forest land – Non-Forest Biobio Reference Period (ha/yr)	1,147	3.4%	Normal	
Forest land – Non-Forest Araucanía Reference Period(ha/yr))	1,319	9.9%	Normal	
Forest land – Non-Forest Los Ríos Reference Period (ha/yr)	1,281	8.0%	Normal	
Forest land – Non-Forest Los Lagos Reference Period (ha/yr)	3,256	23.4%	Normal	
Forest land – Non-Forest Maule Monitoring Period (ha/yr)	1,022	11.1%	Normal	
Forest land – Non-Forest Ñuble Monitoring Period (ha/yr)	172	11.1%	Normal	
Forest land – Non-Forest Biobio Monitoring Period (ha/yr)	310	3.4%	Normal	
Forest land – Non-Forest Araucanía Monitoring Period (ha/yr))	266	9.9%	Normal	
Forest land – Non-Forest Los Ríos Monitoring Period (ha/yr)	308	8.0%	Normal	
Forest land – Non-Forest Los Lagos Monitoring Period (ha/yr)	1,288	23.4%	Normal	
Aum No Conserv Bajo C en 2001, entre [B-C] en 2010 RP (ha/yr)	47,034	32.8%	Normal	Degradation mapping accuracy estimated by INFOR.
Aum No Conserv Entre [B-C] en 2001 y sobre B en 2010 RP (ha/yr)	165,411	32.8%	Normal	
Aum No Conserv Bajo C en 2001 y sobre B en 2010 RP (ha/yr)	162,204	32.8%	Normal	
Aum No Conserv Bajo C en 2001 y bajo C en 2010 RP (ha/yr)	66,668	32.8%	Normal	
Aum No Conserv Entre [B-C] en 2001, entre [B-C] en 2010 RP (ha/yr)	21,878	32.8%	Normal	
Aum No Conserv Bajo C en 2020, entre [B-C] en 2021 MP (ha/yr)	25,521	32.8%	Normal	
Aum No Conserv Entre [B-C] en 2020 y sobre B en 2021 MP (ha/yr)	99,879	32.8%	Normal	
Aum No Conserv Bajo C en 2020 y sobre B en 2021 MP (ha/yr)	77,087	32.8%	Normal	
Aum No Conserv Bajo C en 2020 y bajo C en 2021 MP (ha/yr)	43,548	32.8%	Normal	
Aum No Conserv Entre [B-C] en 2020, entre [B-C] en 2021 MP (ha/yr)	15,161	32.8%	Normal	
Deg No Conserv Sobre B en 2001 y bajo C en 2010 RP (ha/yr)	105,699	32.8%	Normal	
Deg No Conserv Entre [B-C] en 2001 y bajo C en 2010 RP (ha/yr)	38,888	32.8%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
Deg No Conserv Sobre B en 2001, Entre [B-C] en 2010 RP (ha/yr)	129,910	32.8%	Normal	
Deg No Conserv Bajo C en 2001 y bajo C en 2010 RP (ha/yr)	62,074	32.8%	Normal	
Deg No Conserv Entre [B-C] en 2001, entre [B-C] en 2010 RP (ha/yr)	20,919	32.8%	Normal	
Deg No Conserv Sobre B en 2020 y bajo C en 2021 MP (ha/yr)	73,878	32.8%	Normal	
Deg No Conserv Entre [B-C] en 2020 y bajo C en 2021 MP (ha/yr)	24,963	32.8%	Normal	
Deg No Conserv Sobre B en 2020, Entre [B-C] en 2021 MP (ha/yr)	105,388	32.8%	Normal	
Deg No Conserv Bajo C en 2020 y bajo C en 2021 MP (ha/yr)	42,897	32.8%	Normal	
Deg No Conserv Entre [B-C] en 2020, entre [B-C] en 2021 MP (ha/yr)	15,255	32.8%	Normal	
Aum Conserv Bajo C en 2001, entre [B-C] en 2010 RP (ha/yr)	8,479	32.8%	Normal	
Aum Conserv Entre [B-C] en 2001 y sobre B en 2010 RP (ha/yr)	35,783	32.8%	Normal	
Aum Conserv Bajo C en 2001 y sobre B en 2010 RP (ha/yr)	24,973	32.8%	Normal	
Aum Conserv Bajo C en 2001 y bajo C en 2010 RP (ha/yr)	10,996	32.8%	Normal	
Aum Conserv Entre [B-C] en 2001, entre [B-C] en 2010 RP (ha/yr)	5,204	32.8%	Normal	
Aum Conserv Bajo C en 2020, entre [B-C] en 2021 MP (ha/yr)	7,556	32.8%	Normal	
Aum Conserv Entre [B-C] en 2020 y sobre B en 2021 MP (ha/yr)	34,595	32.8%	Normal	
Aum Conserv Bajo C en 2020 y sobre B en 2021 MP (ha/yr)	25,153	32.8%	Normal	
Aum Conserv Bajo C en 2020 y bajo C en 2021 MP (ha/yr)	10,225	32.8%	Normal	
Aum Conserv Entre [B-C] en 2020, entre [B-C] en 2021 MP (ha/yr)	4,788	32.8%	Normal	
Deg Conserv Sobre B en 2001 y bajo C en 2010 MP (ha/yr)	25,257	32.8%	Normal	
Deg Conserv Entre [B-C] en 2001 y bajo C en 2010 MP (ha/yr)	7,991	32.8%	Normal	
Deg Conserv Sobre B en 2001, Entre [B-C] en 2010 MP (ha/yr)	36,182	32.8%	Normal	
Deg Conserv Bajo C en 2001 y bajo C en 2010 MP (ha/yr)	10,415	32.8%	Normal	
Deg Conserv Entre [B-C] en 2001, entre [B-C] en 2010 MP (ha/yr)	4,987	32.8%	Normal	
Deg Conserv Sobre B en 2020 y bajo C en 2021 RP (ha/yr)	27,252	32.8%	Normal	
Deg Conserv Entre [B-C] en 2020 y bajo C en 2021 RP (ha/yr)	7,338	32.8%	Normal	
Deg Conserv Sobre B en 2020, Entre [B-C] en 2021 RP (ha/yr)	39,745	32.8%	Normal	
Deg Conserv Bajo C en 2020 y bajo C en 2021 RP (ha/yr)	10,398	32.8%	Normal	
Deg Conserv Entre [B-C] en 2020, entre [B-C] en 2021 RP (ha/yr)	4,796	32.8%	Normal	
Forest land - Forest Plantation Maule RP (ha/yr)	1,846	11.1%	Normal	Activity Data uncertainty used in Monte Carlo Analysis was calculated using the confidence limits of the sampling-based land-use change estimation areas for the reference and monitoring periods.
Forest land - Forest Plantation Ñuble RP (ha/yr)	771	11.1%	Normal	
Forest land - Forest Plantation Bío-Bío RP (ha/yr)	1,478	3.4%	Normal	
Forest land - Forest Plantation La Araucanía RP (ha/yr)	2,732	9.9%	Normal	
Forest land - Forest Plantation Los Ríos RP (ha/yr)	894	8.0%	Normal	
Forest land - Forest Plantation Los Lagos RP (ha/yr)	609	23.4%	Normal	
Forest land - Forest Plantation Maule MP (ha/yr)	91	11.1%	Normal	
Forest land - Forest Plantation Ñuble MP (ha/yr)	9	11.1%	Normal	
Forest land - Forest Plantation Bío-Bío MP (ha/yr)	141	3.4%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
Forest land - Forest Plantation La Araucanía MP (ha/yr)	80	9.9%	Normal	
Forest land - Forest Plantation Los Ríos MP (ha/yr)	32	8.0%	Normal	
Forest land - Forest Plantation Los Lagos MP (ha/yr)	16	23.4%	Normal	
Forest fires area Maule RP (ha/yr)	583.4	15%	Normal	INGEI, 2020
Forest fires area Ñuble RP (ha/yr)	139.2	15%	Normal	
Forest fires area Biobio RP (ha/yr)	1,028.5	15%	Normal	
Forest fires area Araucanía RP (ha/yr)	2,058.1	15%	Normal	
Forest fires area Los Ríos RP (ha/yr)	150.4	15%	Normal	
Forest fires area Los Lagos RP (ha/yr)	781.9	15%	Normal	
Forest fires area Maule MP (ha/yr)	6,205	15%	Normal	
Forest fires area Ñuble MP (ha/yr)	232	15%	Normal	
Forest fires area Biobio MP (ha/yr)	1,387	15%	Normal	
Forest fires area Araucanía MP (ha/yr)	1,913	15%	Normal	
Forest fires area Los Ríos MP (ha/yr)	107	15%	Normal	
Forest fires area Los Lagos MP (ha/yr)	115	15%	Normal	
Carbon content of Non-Forest Lands				
AGB Áreas Urbanas e Industriales	2.00	95%	Normal	(INGEI, 2020)
AGB Terrenos Agrícolas	10.00	75%	Normal	(INGEI, 2020)
AGB Praderas y Matorrales Praderas	4.73	27.7%	Normal	(Gayoso, 2006)
AGB Praderas y Matorrales Matorral-Pradera	9.04	34.6%	Normal	
AGB Praderas y Matorrales Matorral Arborescente	21.78	22.4%	Normal	
Carbon content of Native Forest				
BGB Terrenos Agrícolas	2.00	53.2%	Normal	Uncertainty for BGB of Non-Forest lands is based on propagation error estimate following IPCC approach 1 of Matorrals-Arborescente AGB error (22.42%) and Root shoot ratio -R Factor error (48.27%) estimated by Goyoso et al. (2002), resulting in total uncertainty of 53.2%.
BGB Praderas y Matorrales Praderas	8.13	53.2%	Normal	
BGB Praderas y Matorrales Matorral-Pradera	14.99	53.2%	Normal	
BGB Praderas y Matorrales Matorral Arborescente	35.25	53.2%	Normal	
AGB Alerce Adulto (t dry biomass/ha)	339.109	18.85%	Normal	For the forest types with a limited number of sampling plots, uncertainty propagation with Monte Carlo analysis uses the following information: i. DBH
AGB Alerce Renoval (t dry biomass/ha)	203.590	18.85%	Normal	
AGB Ciprés de las Guaitecas Adulto (t dry biomass/ha)	221.848	18.85%	Normal	
AGB Araucaria Adulto (t dry biomass/ha)	β: 222.628; k: 1.886	PDF	Gama 2; P:0.998; n: 16	
AGB Araucaria Renoval (t dry biomass/ha)	219.131	18.85%	Normal	
AGB Ciprés de la Cordillera Adulto (t dry biomass/ha)	97.116	18.85%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
AGB Ciprés de la Cordillera Renoval (t dry biomass/ha)	124.019	18.85%	Normal	measurement error (0.2%), calculation based on Continuous Forest Inventory data of INFOR; ii. Volume estimation error (0.07%), calculation based on Continuous Forest Inventory data of INFOR, iii. Biomass Expansion Factor (BEF) error (18.0%), BEF comes from information collected in the country from the study of Gayoso et al. (2002) and used in INGEI (2018). This value is for native species and has a national spatial level. Error calculation is based on statistical data from the Biomass Inventory and Carbon Accountancy of the Universidad Austral de Chile (UACh); and iv. Wood Density (5.6%) calculated using basic density data collected from native species growing in Chile. Finally, these uncertainties are combined following IPCC approach 1 (propagation of error), resulting in total uncertainty of 18.85%
AGB Lenga Adulto (t dry biomass/ha)	μ: 207.038; s: 84.017	PDF	Logistic; P:0.958; n:10	
AGB Lenga Renoval (t dry biomass/ha)	α: 0.431; β:0.439	PDF	Beta4; P:0.776; n:8	
AGB Coihue de Magallanes Adulto (t dry biomass/ha)	129.148	18.85%	Normal	
AGB Roble - Hualo Adulto (t dry biomass/ha)	β: 17.695; k: 5.884	PDF	Gamma (2); P:0.808; n: 17	
AGB Roble - Raulí - Coihue Adulto (t dry biomass/ha)	λ: 0.006	PDF	Exponential; P:0.850; n: 65;	
AGB Roble - Raulí - Coihue Renoval (t dry biomass/ha)	λ: 0.006	PDF	Exponential; P:0.709; n: 71	
AGB Coihue - Raulí - Tepa Adulto (t dry biomass/ha)	β: 1.162; γ:414.153	PDF	Weibull (2); P: 0.831; n: 57	
AGB Coihue - Raulí - Tepa Renoval (t dry biomass/ha)	β: 117.880; k: 1.720	PDF	Gamma (2); P:0.989; n: 12	
AGB Esclerófilo Adulto (t dry biomass/ha)	β: 0.721; γ:12.840	PDF	Weibull (2); P: 0.858; n: 33	
AGB Siempreverde Adulto (t dry biomass/ha)	μ: 5.765; σ: 0.646	PDF	Log-normal; P: 0.194; n: 49	
AGB Siempreverde Renoval (t dry biomass/ha)	β: 1.584; γ:139.543	PDF	Weibull (2); P: 0.673; n: 25	
AGB Araucanía Mixed Forest Monitoring Period (t dry biomass/ha)	161.13	18.85%	Normal	
AGB Los Ríos Mixed Forest Monitoring Period (t dry biomass/ha)	165.98	18.85%	Normal	
AGB Los Lagos Mixed Forest Monitoring Period (t dry biomass/ha)	207.13	18.85%	Normal	
AGB Ñuble Mixed Forest Monitoring Period (t dry biomass/ha)	57.48	18.85%	Normal	
AGB Maule Mixed Forest Monitoring Period (t dry biomass/ha)	43.46	18.85%	Normal	
AGB Biobio Mixed Forest Monitoring Period (t dry biomass/ha)	131.77	18.85%	Normal	
AGB Maule Mixed Forest Reference Period (t dry biomass/ha)	58.85	18.85%	Normal	
AGB Biobio Mixed Forest Reference Period (t dry biomass/ha)	210.75	18.85%	Normal	
AGB Araucanía Mixed Forest Reference Period (t dry biomass/ha)	246.71	18.85%	Normal	
AGB Los Ríos Mixed Forest Reference Period (t dry biomass/ha)	194.05	18.85%	Normal	
AGB Los Lagos Mixed Forest Reference Period (t dry biomass/ha)	221.64	18.85%	Normal	
AGB Ñuble Mixed Forest Reference Period (t dry biomass/ha)	58.85	18.85%	Normal	
BGB Araucanía Mixed Forest Monitoring Period (t dry biomass/ha)	46.23	44.2%	Normal	Uncertainty for Below Ground Biomass BGB is based on propagation error estimate following IPCC approach 1 of Above Ground Biomass-AGB error (18.85%) and Root shoot ratio -R Factor error (40.0%)
BGB Los Ríos Mixed Forest Monitoring Period (t dry biomass/ha)	47.62	44.2%	Normal	
BGB Los Lagos Mixed Forest Monitoring Period (t dry biomass/ha)	59.42	44.2%	Normal	
BGB Ñuble Mixed Forest Monitoring Period (t dry biomass/ha)	16.49	44.2%	Normal	
BGB Maule Mixed Forest Monitoring Period (t dry biomass/ha)	16.89	44.2%	Normal	
BGB Biobio Mixed Forest Monitoring Period (t dry biomass/ha)	60.46	44.2%	Normal	
BGB Maule Mixed Forest Reference Period (t dry biomass/ha)	70.78	44.2%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
BGB Biobio Mixed Forest Reference Period (t dry biomass/ha)	55.67	44.2%	Normal	estimated by Goyoso et al. (2002), resulting in total uncertainty of 44.2%.
BGB Araucanía Mixed Forest Reference Period (t dry biomass/ha)	63.59	44.2%	Normal	
BGB Los Ríos Mixed Forest Reference Period (t dry biomass/ha)	47.21	44.2%	Normal	
BGB Los Lagos Mixed Forest Reference Period (t dry biomass/ha)	12.47	44.2%	Normal	
BGB Ñuble Mixed Forest Reference Period (t dry biomass/ha)	37.80	44.2%	Normal	
Dead matter Araucanía Mixed Forest MP (t dry biomass/ha)	57.42	28.4%	Normal	Error estimated from permanent plots of the INFOR Continuous Forest Inventory
Dead matter Los Ríos Mixed Forest MP (t dry biomass/ha)	57.52	28.4%	Normal	
Dead matter Los Lagos Mixed Forest MP (t dry biomass/ha)	62.39	28.4%	Normal	
Dead matter Ñuble Mixed Forest MP (t dry biomass/ha)	27.19	28.4%	Normal	
Dead matter Maule Mixed Forest MP (t dry biomass/ha)	19.90	28.4%	Normal	
Dead matter Biobio Mixed Forest MP (t dry biomass/ha)	54.10	28.4%	Normal	
Dead matter Maule Mixed Forest RP (t dry biomass/ha)	72.30	28.4%	Normal	
Dead matter Biobio Mixed Forest RP (t dry biomass/ha)	52.91	28.4%	Normal	
Dead matter Araucanía Mixed Forest RP (t dry biomass/ha)	61.16	28.4%	Normal	
Dead matter Los Ríos Mixed Forest RP (t dry biomass/ha)	47.61	28.4%	Normal	
Dead matter Los Lagos Mixed Forest RP (t dry biomass/ha)	18.92	28.4%	Normal	
Dead matter Ñuble Mixed Forest RP (t dry biomass/ha)	45.49	28.4%	Normal	
Annual Periodic Increase of Native Forest				
IPA Araucanía Mixed Forest Monitoring Period (t dry biomass/ha)	4.13	28.7%	Normal	Average of IPA error for all forest types given lack of data.
IPA Los Ríos Mixed Forest Monitoring Period (t dry biomass/ha)	4.18	28.7%	Normal	
IPA Los Lagos Mixed Forest Monitoring Period (t dry biomass/ha)	4.81	28.7%	Normal	
IPA Ñuble Mixed Forest Monitoring Period (t dry biomass/ha)	2.82	28.7%	Normal	
IPA Maule Mixed Forest Monitoring Period (t dry biomass/ha)	2.02	28.7%	Normal	
IPA Biobio Mixed Forest Monitoring Period (t dry biomass/ha)	3.55	28.7%	Normal	
IPA Maule Mixed Forest Reference Period (t dry biomass/ha)	4.20	28.7%	Normal	
IPA Biobio Mixed Forest Reference Period (t dry biomass/ha)	4.14	28.7%	Normal	
IPA Araucanía Mixed Forest Reference Period (t dry biomass/ha)	4.06	28.7%	Normal	
IPA Los Ríos Mixed Forest Reference Period (t dry biomass/ha)	2.21	28.7%	Normal	
IPA Los Lagos Mixed Forest Reference Period (t dry biomass/ha)	3.70	28.7%	Normal	
IPA Ñuble Mixed Forest Reference Period (t dry biomass/ha)	4.03	28.7%	Normal	
IPA Alerce Adulto (m3/ha/yr)	0.5	58.47%	Normal	The higher uncertainty of the errors estimated for IPA is assumed due to a lack of data.
IPA Ciprés de las Guaitecas Adulto (m3/ha/yr)	3.9	58.47%	Normal	
IPA Araucaria Adulto (m3/ha/yr)	µ: 4.882; σ: 2.516	PDF	Normal; P:0.923; n: 16	
IPA Ciprés de la Cordillera Adulto (m3/ha/yr)	5.0	15.83%	Normal	Error estimated from permanent plots of the INFOR Continuous Forest Inventory
IPA Ciprés de la Cordillera Renoval (m3/ha/yr)	2.7	9.97%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
IPA Lenga Adulto (m3/ha/yr)	k: 5; γ:0.921	PDF	Erlang; P:0.986; n:10	
IPA Lenga Renoval (m3/ha/yr)	µ: 2.995; β:2.054	PDF	Fisher-Tippett (2); P:0.907; n:8	
IPA Coihue de Magallanes Adulto (m3/ha/yr)	2.6	13.42%	Normal	Error estimated from permanent plots of the INFOR Continuous Forest Inventory
IPA Coihue de Magallanes Renoval (m3/ha/yr)	3.7	7.68%	Normal	
IPA Roble - Hualo Adulto (m3/ha/yr)	µ: 1.534; σ: 0.507	PDF	Log Normal; P:0.873; n: 17	
IPA Roble - Hualo Renoval (m3/ha/yr)	3.5	54.47%	Normal	The higher uncertainty of the errors estimated for IPA is assumed due to a lack of data.
IPA Roble - Raulí - Coihue Adulto (m3/ha/yr)	µ: 1.335; σ: 1.106	PDF	Log Normal; P:0.257; n: 65;	
IPA Roble - Raulí - Coihue Renoval (m3/ha/yr)	β: 1.777; γ:4.664	PDF	Weibull (2); P:0.760; n: 71	
IPA Coihue - Raulí - Tepa Adulto (m3/ha/yr)	β: 1.403; γ:6.264	PDF	Weibull (2); P: 0.789; n: 57	
IPA Coihue - Raulí - Tepa Renoval (m3/ha/yr)	µ: 4.364; s: 1.558	PDF	Logistic; P:0.825; n: 12	
IPA Esclerófilo Adulto (m3/ha/yr)	β: 0.667; γ:0/875	PDF	Weibull (2); P: 0.512; n: 33	
IPA Esclerófilo Renoval (m3/ha/yr)	1.6	21.31%	Normal	Error estimated from permanent plots of the INFOR Continuous Forest Inventory
IPA Siempreverde Adulto (m3/ha/yr)	α: 13.411; β:29.589	PDF	Beta4; P: 0.940; n: 49	
IPA Siempreverde Renoval (m3/ha/yr)	µ: 4.664; s:0/893	PDF	Logistic; P: 0.994; n: 25	
Degradation and Enhancement in permanent forest				
Carbon stock change in permanent forest	Values depending on density diagram change and forest type	57%	Normal	Error estimation based on the standard error of the k-nn algorithm volume estimation.
Carbon content of forest lands (forest fires)				
AGB Maule (t dry biomass/ha/yr)	80.35	18.85%	Normal	This uncertainty is estimated following IPCC approach 1 (propagation of error), resulting in total uncertainty of 18.85%.
AGB Biobio (t dry biomass/ha/yr)	149.88	18.85%	Normal	
AGB Araucanía (t dry biomass/ha/yr)	252.33	18.85%	Normal	
AGB Los Ríos (t dry biomass/ha/yr)	310.35	18.85%	Normal	
AGB Los Lagos (t dry biomass/ha/yr)	230.41	18.85%	Normal	
AGB Ñuble (t dry biomass/ha/yr)	149.88	18.85%	Normal	
BGB Maule (t dry biomass/ha/yr)	23.05	44.2%	Normal	Uncertainty for Below Ground Biomass BGB is based on propagation error estimate following IPCC approach 1 of Above Ground Biomass-AGB error (18.85%) and Root shoot ratio -R Factor error (40.0%) estimated by Goyoso et al.
BGB Biobio (t dry biomass/ha/yr)	43.00	44.2%	Normal	
BGB Araucanía (t dry biomass/ha/yr)	72.39	44.2%	Normal	
BGB Los Ríos (t dry biomass/ha/yr)	89.04	44.2%	Normal	
BGB Los Lagos (t dry biomass/ha/yr)	66.10	44.2%	Normal	
BGB Ñuble (t dry biomass/ha/yr)	43.00	44.2%	Normal	

Parameter included in the model	Parameter values	Error sources quantified in the model	Probability distribution function	Assumptions
				(2002), resulting in total uncertainty of 44.2%.
Dead matter Maule (t dry biomass/ha)	52.60	28.4%	Normal	Error estimated from permanent plots of the INFOR Continuous Forest Inventory
Dead matter Biobio (t dry biomass/ha)	122.10	28.4%	Normal	
Dead matter Araucanía (t dry biomass/ha)	165.50	28.4%	Normal	
Dead matter Los Ríos (t dry biomass/ha)	146.90	28.4%	Normal	
Dead matter Los Lagos (t dry biomass/ha)	157.00	28.4%	Normal	
Dead matter Ñuble (t dry biomass/ha)	122.10	28.4%	Normal	
Other Factors				
Combustion factor	0.45	36.0%	Normal	IPCC, 2006
Emission Factor CH4	4.7	29.0%	Normal	
Emission Factor N2O	0.26	43.8%	Normal	

Quantification of the uncertainty of the estimate of Emission Reductions

		Reporting Period	Crediting Period
		Total Emission Reductions*	Total Emission Reductions*
A	**Median**	3,746,069	-534,641
B	**Upper bound 90% CI** (Percentile 0.95)	17,458,585	28,102,910
C	**Lower bound 90% CI** (Percentile 0.05)	-9,942,734	-29,582,065
D	**Half Width Confidence Interval at 90% (B – C)/ 2**	13,700,659	28,842,487
E	**Relative margin (D / A)**	365.7%	254.38%
F	**Uncertainty discount**	15%	15%

To combine the global uncertainty of reporting periods 1 and 2, the propagation method indicated by IPCC 2006 was applied, through the application of equation 3.2 "Combining uncertatinties – Approach 1 – Addition and subtraction". As a result, a combined uncertainty of 2,549% is achieved, which is based on the result of positive and negative reduced emissions in the two reporting periods that are being combined, which does not offer further interpretation.

5.3 Sensitivity analysis and identification of areas of improvement of MRV system

The following table and figure show the results for the sensitivity analysis of Emission Reductions (ERs) uncertainty. ERs estimate in forest remaining forest (conserved and non-conserved) contributes the 67.2% of total ERs uncertainty. The main contribution is coming from ERs' uncertainty in the non-conserved permanent forest (42.5%).

The sources of error for estimating forest degradation and carbon enhancement on permanent forest lands are:

i. Uncertainty associated with the forest density charts used to determine the direction of carbon flux (neutral, loss or gain) for each pixel (32.8%)
ii. Uncertainty associated with integrating the multi-pixel mosaic satellite data with the dasometric variables. This uncertainty has been estimated by calculating the Standard Error of Estimation of the volume function k-nn (57%).

Table 7 shows the results of sensitivity analysis for Emission Reductions uncertainty in non-conserved permanent forest. Both activity data and emission factors contributed equally to the uncertainty (50/50). The same uncertainty for AD and EF was used for all regions, therefore the difference in the uncertainty contribution between regions responds to the magnitude of ERs.

Further analysis of the Methodology used to estimate emissions and removals in permanent forest are required to determine the improvement actions on the MRV system to reduce Emission Reduction uncertainty.

REDD Activity	Component	Uncertainty Contribution
Carbon enhancement	Removals in forest remaining as forest	**19.7%**
	Removals in lands converted to forest	**0.7%**
	Total removals	**20.4%**
Conservation	Removals in forest remaining as forest	4.6%
	Emissions in forest remaining as forest	73.1%
	Conservation Total	**77.6%**
	Deforestation Total	**0%**
Degradation	Emissions in forest remaining as forest	20.1%
	Emissions from forests converted to plantations.	0.4%
	Forest fires	2.2%
	Degradation Total	**22.7%**
	Grand Total	**120.7%**

Table 3 Results for the sensitivity analysis of ERs' global uncertainty.

6 TRANSFER OF TITLE TO ERS

6.1 Ability to transfer title

The 2016 ERPD document defined that the Chilean ER Program will define a Benefit Sharing Plan, which is based on the basic principle that the distribution of benefits associated to result – based payment is conditional on a previous transfer of carbon rights (Annex 2). Nevertheless, no Contract ERs have been generated during this monitoring period so that no Contract ERs will be transferred to the FC.

Under this principle, CONAF, as the REDD+ focal point in Chile, carried out a legal study* with external specialists. These analyzes have made it possible to demonstrate Chilean capabilities for the transfer of titles on emission reductions (ER) caused by the implementation of ENCCRV actions, considering criterion 36 of the Methodological Framework of the Forest Carbon Partnership Facility (FCPF) Carbon Fund.

In the first place, this study determined that in the case of Chile, the ENCCRV contains a series of diverse actions affecting public, private or both public/private lands, without being possible to specifically determine the ER sources. This is explained by the fact that the FREL/FRL of Chile and its monitoring milestones estimate the volumes of carbon emission and removal due to deforestation, forest degradation, stock enhancements and forest conservation on a regional scale. This makes it impossible to identify whether specific smaller scale actions could be considered incremental. Because of this, ERs cannot be attributed to a spatially explicit area or individual owners.

In the case of activities associated with sequestration, although it is possible to identify with greater spatial accuracy the areas where such activities are being carried out, it is not technically feasible to isolate those that allow reaching the FREL estimated volume from which they should be considered. In accordance with these technical aspects of carbon accounting, the current methodology does not allow an individual owner to claim or demonstrate that they have rights to capture or reduction of emissions on a regional scale that implies additionality, therefore, the same applies to possible properties. Following this understanding, the fact that the reductions occur as a result of a better performance of forests located in public lands, areas protected by the State or private lands is not relevant for the transfer of ERs.

From a regulatory point of view, Chile does not have a specific framework to determine the transfer or ownership of ERs. However, of transferring ERs is based on different legal norms and other mechanisms that give effect to criterion 36 of the FPCF Carbon Fund Methodological Framework. In that case, the ability of the ER Program of Chile to transfer ER titles to the Carbon Fund is demonstrated through the following three mechanisms:

1) Regulatory Framework
The government of Chile ratified the CMNUCC and the Paris Agreement, converting its Nationally Determined Contribution (NDC) commitments into obligations and on the other hand, the appointment of CONAF as REDD+ focal point was made official[18]. Both decisions lead to the validation of a special title for transferring ERs to the World Bank within the FCPF framework, which is aligned with the system the UNFCCC and the Paris Agreement have developed to obtain emission reduction-based payments for REDD+.

The foregoing is consistent with the internal legal system, since according to CONAF Statutes Article 3, this organization has the exclusive purpose of "Contributing to the conservation, improvement, management and use of the protected forest resources and areas of wildlife of the country", also including among its functions the possibility of creating agreements and contracts with different organizations to achieve this purpose.

2) Additional agreements with possible title holders on use and land ownership rights
The previously mentioned, the legal study determined that ownership of lands where GHG capture capacity enhancements are produced is not relevant for determining a possible ER title transfer, as there is no ownership on

[18] Letter No. 99, of February 19, 2014, Issued by the Ministers of Agriculture and Foreign Affairs

said reduction but rather an obligation being complied with. In fact, individuals can own a specific land, but not the emission reductions produced by said land (or vegetation resources inside it) because this ER is a national asset for public use. Nevertheless, owners are able to transfer the right to transact that emission reduction in other instances such as the voluntary carbon market, or a local offset market, representing a real risk of double counting in the AA of the ER Program.

To avoid this risk, there are mechanisms for promoting compliance with emission reduction obligations that owners can choose to obtain benefits associated to land ownership. One of such agreements is the signing of Additional Agreements between land/resource ownership title holders and CONAF, which make express provisions for prohibiting those who adhere to such agreement of signing other similar instruments with public or private entities; and explicitly authorize CONAF to transfer ERs generated in such lands as a consequence of projects implemented there. Currently, no additional agreements have been signed in the ER program area.

CONAF is empowered to formalize such agreements, which is mentioned in the previously mentioned Article 3 of its statutes, more specifically in its literal which states: "Implement all kinds of actions and enter into all kinds of conventions or contracts aimed at the obtention or related to such purposes, with individuals or legal entities, national or foreign, under public or private law, even with its own partners". In line with this, there is no doubt the emission reduction objective is aligned with the objectives of CONAF, which is therefore empowered to enter into agreements and contracts with individuals for such purposes.

3) Benefit – Sharing Plan (BSP)

Besides the regulatory framework and agreements, the third FCPF mechanism for justifying ER transfers is referring to the BSP. This is even more important than the two previous mechanisms, as it recognized that public policy outcomes are not necessarily prone to private appropriation.

CONAF has developed a BSP for the ENCCRV and ER Program under transparency, participation, and fairness standards according to criteria 29, 30, 31, 32 and 33 of the FCPF Methodological Framework, a process described in Annex 2 of this report.

This BSP has a harmonious relationship with the previously mentioned regulatory framework and additional agreements; it also ensures and promotes an adequate benefit sharing which meets the principles of environmental law and UNFCCC agreements, particularly in terms of poverty eradication and respect for the human rights of vulnerable groups, article 3 and the preamble of the Paris Agreement.

To ensure this outcome and reduce possible conflicts, CONAF designed the BSP through a series of participative processes with gender and interculturality approaches, in accordance with the vision of communities within the territory. The foregoing to assure a fair, equitable and transparent distribution of resources considering the distribution of non-monetary benefits, which will be mainly focused on small and medium forest owners. In that same line, any measures taken such as collaboration agreements with large private conservation areas, will be important. Such agreements must include, on one hand, the transfer of rights to transact past and future ERs, committing result – based payment benefits, and on the other, collaboration agreements so that these private actors continue the emission reducing activities. At the present, no one of these agreements have been signed.

In conclusion, the BSP meets the requirements of the methodological framework and serves as a basis to validate that CONAF can transfer ERs according to the requirements.

Therefore, considering the three described mechanisms, the legal analysis determined that according to the FCPF Carbon Fund Methodological Framework, the document "Note on the Ability of Program Entity to Transfer Title to Emission Reductions (ERs) Forest Carbon Partnership Facility, Carbon Fund" and the existing legal framework, CONAF is empowered to transfer ERs, as stated in Official Letter No. 74/2019, March 1st, 2019, submitted to the FCPF by CONAF. However, for this reporting period, the Program Entity has not been aware of any title contest in which interested parties in the RE Program area have challenged the capacity of the Program Entity.

6.2 Implementation and operation of Program and Projects Data Management System

The design of the data management system for the ER Program and its respective projects was presented in the 2016 ERPD document, according to the requirements of the FCPF Methodological Framework. This is a fundamental part of the Monitoring Plan and suggests as objectives: provide transparent data and information, which are consistent over time and suitable for measuring, reporting and allowing the verification of emissions by the considered sources, absorptions and sinks.

Then, the document "Additional Information for the ER Program Update, per recommendations issued in the Chair´s Summary in the 15th Meeting of the Carbon Fund" from 2018 updates the Monitoring Plan and describes the progress made in its implementation, including time planning for monitoring milestone implementation, systems and methodologies to be used and institutional arrangements involved. The objectives of the NFMS Monitoring and Measurement System (SMM, acronym in Spanish) were also updated, defining the following:

- Optimize generation processes and ensure the implementation of monitoring events for primary elements (Land use and Land use change maps) for the estimation of emissions and absorptions linked to REDD+.
- Generate interoperability protocols for the integration of information at various spatial scales, time scales, differentiated file formats and purposes, including information of Co-benefits and Safeguard Follow-up.
- Automate report generation processes and increase report transparency.
- Have a visualization and consultation platform, in order to facilitate the dissemination of results, that responds both to the verification criteria in international instances as well as to institutional necessities and citizen demands for information.

The Data Management System, the development of the ENCCRV information platform was updated including semi-automated information integration tools. Also contain a geospatial content manager with a web mapper viewer and a forest carbon calculator for the executed land/property projects in regions of Chile. From here, two key tools are developed to monitor ENCCRV projects, the property monitoring system and the safeguards information system.

This computer applications were based on open programming languages to ensure and guarantee the durability of these components, with an interoperability that applies to other systems developed under CONAF and associated with the ENCCRV at the institutional level, such as the Uncertainty Evaluation System (Sistema de Evaluación de Incertidumbre, in Spanish), the Land Prioritization System (Sistema de Priorización de Territorios, in Spanish) and the Co-Benefits System (Sistema de Co-Beneficios, in Spanish). These systems are integrated into a unique digital platform, available in plataforma.enccrv.cl.

The Chilean ER Program Monitoring Plan is part of the ENCCRV Measuring and Monitoring System (SMM, acronym in Spanish), which began its implementation and operation during 2019, developing the Information Platform based on alphanumeric and spatial databases.

The development of this platform considered the following specific activities:

- Protocol elaboration for the standardization of spatial information and alphanumeric information generated in the ENCCRV framework.
- Standardization of the existing information and quality control of the information under development.
- Development of database architecture and model.
- Development of report generation tools.
- Development of web mapping viewer and geospatial content manager.
- Definition of the official registration system of the ER Program.
- Maintenance, adjustments, improvements, and new functionalities of the platform.
- Performance evaluation (tests) during the trial period.
- Technology transfer and training of pertinent/applicable CONAF personnel to carry out an internal execution of the platform.

This robust platform has made possible an adequate storage and visualization of the generated information. The platform has been able to improve reconstruction tasks and data integration, elaborating reports, indicators and perform calculations at different scales for multiple needs. This is in accordance with and responds to compliance with international requirements and responses, and also to specific requests from institutional executives instances or public consultation.

The ENCCRV Platform constitutes a centralized system of REDD+ projects executed within the framework of the ENCCRV, which is fed by the territorial implementation teams of REDD+ projects of CONAF. The system currently supports REDD+ projects executed by CONAF and does not yet consider the use of private projects, because CONAF does not have the power to mandate the use of the system by other developers.

As long as this data management system remains limited to CONAF projects, to registry REDD project executed by another entities a procedure is carried out that considers a review of the international registration systems for reduced emissions transactions or carbon credits, with the aim of keeping this information controlled and so that it can be excluded, in the event that a payment is generated. This information is made available to the general public through the ENCCRV site, in the Redd+ information tracking system, accessible in 2.4 of https://www.enccrv.cl/medicion-y-monitoreo. The details of this information are presented in 6.4.

6.3 Implementation and operation of ER transaction registry

As previously mentioned (6.2), the ENCCRV SMM defined the basic development of a Reduced Emission Transaction Registration System as one of its objectives. This tool responds to the FCPF Methodological Framework for those countries that aim to reach a result – based payment agreement with the Carbon Fund. It also responds to Articles 5 and 6 of the Paris Agreement on REDD+ through market-based approaches and other agreements, which makes it possible for different countries to exchange reduced emissions caused by the implementation of REDD+, in order to achieve the goals established in their NDCs and avoid double counting.

The ERPD considered developing a ENCCRV Reduced Emission Transaction Registration System, which should be a national and centralized system which guaranteed that the reduced emissions generated within the ENCCRV framework could be adequately emitted, serialized, transferred, removed, or canceled. In addition, it should also offer clear connections to different sources of information contained in the platforms used within the SMM framework. Its main function would be to avoid the duplicate transaction of reduced emissions, and act as the main tool for the control of REDD+ emission reduction transaction reporting and accounting in Chile.

The design of this registration system began in 2018, is already created and described in more detail in the ENCCRV SMM. It was developed under a system with IHS Markit adapted to the REDD+ activities quantified by CONAF.

Nevertheless, the World Bank designed the Carbon Assets Tracking System (CATS), a central platform to support operations under the FCPF CF and BioCF ISFL which is free and has flexible enough operating rules to be easily adapted to other World Bank platforms and future scenarios. Given this, Chile issued a formal letter to define the CATS platform as the official reduced emission transaction registration system of the ER Program and ENCCRV.

The use of CATS to register ER transactions generated in the accounting area of the PRE, has not yet begun its practical operation, therefore the country has not implemented a transaction registration system. However, in order to avoid double counting, Chile executes a verification procedure for International ER Registrations to identify REDD+ projects that are executed in the country. International registrations are reviewed every two months, and the information that is collected gives rise to a data sheet where the information of the projects is entered, including the owner, the volume of transfer of ER, the year of generation, along with other background. This information is publicly available on the ENCCRV website, SMM section https://www.enccrv.cl/medicion-y-monitoreo.

In addition to the above, it must be taken into consideration that recently in 2023 [19], the compensation regulation was approved and published in Chile, which regulates the operation of the Emissions Compensation System, which

[19] Available in https://www.bcn.cl/leychile/navegar/imprimir?idNorma=1196414&idVersion=2023-09-29

will allow offsetting emissions affected by the tax. This system considers the development and implementation of all the necessary infrastructure to offset local pollutants and other GHGs, including nature-based solutions projects, so greater interest is expected in the development of projects from private developers.

6.4 ERs transferred to other entities or other schemes

The ENCCRV ER Program corresponds to the first subnational program of result – based payments associated with REDD+ in Chile. The reductions associated to the Emission Reduction Payment Agreement signed by Chile are insured in accordance with the estimates made in the FREL. This has encouraged Chile to develop a financing package for result – based payments mainly associated with the Green Climate Fund, which despite not considering transfers, would not affect compliance with the ER Program. Thus, work has been done to improve the registration and monitoring systems to avoid double counting or payments that can generate legal or other disputes in the implementation territory, so that this and other future initiatives can be implemented correctly.

Currently, there are six REDD+ projects linked to the voluntary market implemented by VCS in Chile[20]. **According to its own records, no credits due to emission reductions have been claimed during the 2020-2021 reporting period which significantly reduces potential inconveniences**. These are:

- Valdivian Coastal Reserve Project, Los Ríos region. Project led by The Nature Conservancy (TNC), corresponding to a project in the planned degradation and deforestation REDD subcategory, generating around 58.154 VCUs per year.
- California Valley degraded land reforestation project, Los Lagos region. The initiative is led by the Agrícola y Forestal SNP Limitada Company, being an ARR project estimated to generate 1.193 VCUs per year.
- Caelus project: under validation process, with 111 estimated annual emission reductions. The project is based on GHG emission reductions and removals generated by improving forest management practices to increase the carbon stock on land by extending the rotation age of a forest before harvesting.
- Bosques Cautín S.A. proyect: under validation process, with 124,951 estimated annual emissions reductions. The project is a forest developer operating in Chile, that has traditionally operate a silvicultural model for commercial timber, and is expanding its business model to dedicate different areas of forest plantations to carbon sinks.
- Proventus project: under validation process, with 2,301 estimated annual emissions reductions. The project is based on changing the use of low productivity land to sustainable forest production systems, which will increase the forest cover and promote remnant natural forest improvement generating a landscape of biological corridors that bring about financial, social and environmental services.
- Reforestation in degradation land, in Biobío region: project in their first steps of development. With 16,864 estimated annual emissions reductions. Is a reforestation project with local land owners and considers advanced propagation technology, mycorrhizal inoculation, to help restore and convert degraded grassland into productive forests in several regions of Chile.

In addition, they do not have a record of information of geographical boundaries with public reach. Based on the above, the areas of these projects could not be excluded from the PRE analysis.

CONAF has not defined procedures and agreements to sell or assign ERs of the ER Program area to other entities under a different GHG program or standard. Indeed, these projects could trade ER for the period 2020-2021. In order to avoid double counting, CONAF considers the exclusion of the areas reported in as participants of a voluntary carbon market standard, thus avoiding considering ERs from areas committed to other buyers. In particular, for this period it was not possible to collect the geographical areas, however, transactions with other standards were not recorded either. For future reports, it is expected to have the information to exclude project areas and discount ER in case they are registered.

[20] See section 2.4 in: https://www.enccrv.cl/medicion-y-monitoreo

7 REVERSALS

Regarding the strategy that the ER Program has proposed to prevent and minimize the potential for reversals, the ERPD document proposed several measures. Given that the program has not yet been implemented, many of these actions do not present concrete progress, but other measures associated with the permanent activity of CONAF do have progress for the period of this report, which are summarized below.

In relation to the risk associated with the lack of broad and sustained support from key stakeholders, progress has been made in analyzing the risk of land conflicts before designing and executing ENCCRV projects in the territories, establishing protocols and procedures for this within the framework of environmental and social management (MGAS). In addition, the ENCCRV has continued to be developed with expanded participatory processes, ensuring that their opinions and needs are included in the design of different key components of the ER Program, such as the BSP.

Regarding the risk associated with the lack of institutional capacity and/or ineffective vertical/cross-sector coordination, an important inter and intra-institutional coordination has been maintained, carrying out multiple induction, training and dissemination activities on political and technical issues of the REDD + approach and on the ENCCRV.

Regarding the risk associated with the lack of long-term effectiveness in confronting underlying factors, progress has been made in improvements to the current forest policy and regulations, including improvements to the Native Forest Law, and the design of a new forest law that promote the recovery of areas burned by forest fires and promote reforestation with new generation plantations that take into account the country's climate scenarios and goals. Progress has also been made in governance, strengthening the issue of Climate Change at the institutional level through specific programs (wood energy, forestry extension, community forestry, others) and the strengthening of capacities in CONAF's technical structures.

Finally, the advances associated with reducing the risk of natural disturbances and disasters have focused on strengthening the efforts to prevent and combat forest fires in CONAF, including different institutional programs for education and preparation of communities for these events, as well as of improvements in infrastructures, equipment, capacities and technologies for the prediction and combat of fire. Important progress has also been made in the monitoring and evaluation of fires, relevant inputs for restorative processes in affected areas.

Regarding the reversal management mechanism, Chile proposed using the Carbon Fund Buffer to store the credits associated with the risk of uncertainty and reversals. Specifically for reversals, it was proposed to use the reversal risk assessment tool that requires a specific amount to put in the buffer for each risk factor. These factors and an update of them are presented in more detail in section 7.3.

7.1 Occurrence of major events or changes in ER Program circumstances that might have led to the Reversals during the Reporting Period compared to the previous Reporting Period(s)

During the 2020-2021 monitoring period, was evidenced that an anomalous event that occurred in the PRE accounting area impacted in the performance results of this report. The event was the Megadrought and through an investigation done in 2022, an effect in the Mediterranean and temperate forests of Chile was confirmed, presenting a browning trend in these forest areas and resulting in a diminished photosynthetic capacity of this area.

The megadrought and the warming trends of summer temperatures are two current climatological features that are not directly-antropogenic caused, but it requires further analysis to prove if these phenomena are influencing/impacting at least 25% of the accounting area of the program.

In this regard, the country developed a study on the Browning effect in the Mediterranean and temperate forests of Chile to determine and quantify the affected forest ratio and the degradation-derived emissions ratio caused by the megadrought.The mega-drought was reported to the Trustee in 2023, in a several discussions meetings.

- **Forest Fires**

Reversal risks identified in the 2016 ERPD have not experienced significant changes. Nevertheless, due to the magnitude and dynamics of the event known as Mega Forest Fire which impacted Chile in the summer of 2017, the potential of forests to acting as sinks is estimated to have been affected. Around 500,000 hectares were burnt during this event, of which an important surface corresponded to pastures, scrubs, and forest plantations, excluded by both the ER Program and the FREL/FRL. The impact on the AC Native Forest was 38,000 hectares, being the Maule region the most affected with 28,000 ha, then 10,000 ha in the Biobío region and finally 570 ha in the Araucanía region. Of the 81 million tons of gross CO_2 equivalent emissions estimated for the entire event, 7.45 million tons CO_2 were associated with the native forest of the CA. This information, along with other details associated to the analysis of the aforementioned event, can be found in the document "Additional information for the update of the Emission Reduction Program of Chile, as per recommendations by the Chair´s Summary in the 15th Meeting of the Carbon Fund" from 2018 (here).

Although direct emissions generated by these forest fires are not considered in the period of this report (2018-2019), CONAF has identified that this mega event increased emissions from Degradation in this period, given the losses of sink capabilities in the affected forests.

Fires in Chile are caused by anthropic actions and correspond to one of the main drivers of ecosystem degradation in the world. As such, it was identified as one of the drivers of forest degradation in the ERPD. Fire seasons in Chile are frequent events that occur during the summer season; also, high temperature, low humidity and drought conditions can turn these frequent events into exceptional, barely controllable events.

In order to check the sensitivity of the degradation methodology for the detection of degraded areas affected by forest fires in the reporting period (2018 – 2019), CONAF developed a preliminary study about degradation data, using forest fire occurrence spatialized coverages. A simple experiment was carried out, where the data of forest carbon losses due to forest fires during the season was compared against estimated values in areas with no fires during that year.

This analysis was conducted for the Maule (7), Ñuble (16), Biobío (8), La Araucanía (9), and Los Lagos (10) regions. The next graph uses a Boxplot to display carbon values means and distributions for these three treatments and by administrative region. The table after that shows the distribution of total CO2 values by region and treatment.

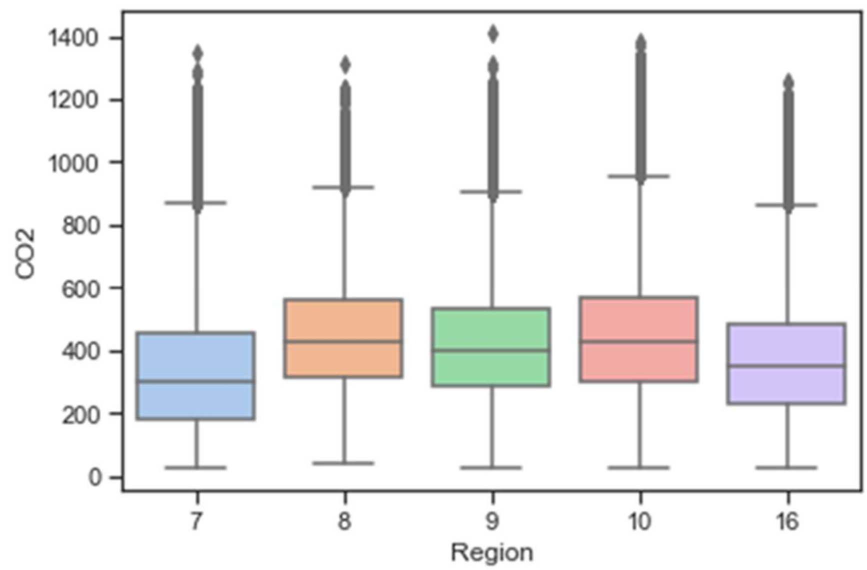


Figure 9 CO2 captures during 2019, disaggregated at the regional level.

Region	Tto	N	mean	std	min	25%	50%	75%	max
7	1	2,202	309.8	203.5	46.0	153.0	234.5	434.0	1042.0
	2	84,345	351.9	192.7	29.0	198.0	319.0	474.0	1216.0
	3	246,423	333.1	194.1	26.0	175.0	292.0	450.0	1346.0
8	1	24	367.5	188.2	95.0	224.3	327.0	535.0	714.0
	2	5,464	455.6	176.8	64.0	328.0	431.0	567.0	1215.0
	3	31,580	446.1	184.3	37.0	314.0	423.5	556.0	1311.0
9	1	1,845	302.1	184.6	57.0	170.0	247.0	391.0	1091.0
	2	63,180	407.8	184.0	37.0	269.0	383.0	518.0	1310.0
	3	255,322	423.4	182.7	23.0	288.0	402.0	534.0	1413.0
10	1	196	255.4	104.6	72.0	213.5	242.0	270.8	892.0
	2	18,365	433.2	184.2	41.0	288.0	408.0	543.0	1342.0
	3	95,808	452.9	189.9	25.0	306.0	432.0	569.0	1382.0
16	1	15	267.1	175.2	62.0	157.0	247.0	329.5	653.0
	2	4,340	362.5	191.5	31.0	220.0	337.0	477.0	1145.0
	3	66,911	372.6	187.0	24.0	232.0	347.0	486.0	1258.0

Table 4 Distribution of CO2 values by region and treatment in 2019.

The differences between burned areas and those without fires were analyzed by isolating data at the regional level and allocating a similar amount of data for each treatment. This was carried out by randomly selecting the data from treatments 2 (areas located 10 km away from the fire) and 3 (areas located 30 km away from the fire) as these areas are larger than their burned counterparts (Table 9, each pixel corresponds to 1 hectare, therefore, region 7 of treatment 1 has 2,202 ha and treatment 2 84,345 ha2). These sample sizes of the various treatments were used to identify the statistical differences that may exist between areas 1, 2 and 3.

The collected data considers large sampling sizes except for the Ñuble and Biobío regions, which were joined to correct the effect of low amounts of data for burned areas in these regions compared to other categories. Despite these sampling sizes, the data do not meet the normality assumptions, and normality is not achieved by looking for a transformation that allows to meet such assumptions either. Because of this, non – parametric variance analyses were conducted using the Kruskal Wallis method and subsequent comparisons in order to know the differences between groups, applying the Holm-Bonferroni method and the Bonferroni sequential method, less conservative than the original Bonferroni test.

Regarding the general findings from this exercise, it was found that there are significant differences between estimations from burned areas in the various ERP regions for 2018-2019, in regard to those areas located at various distances away from the fires. Therefore, there are differences in the degradation detecting capability of the methodology applied for estimating native forest degradation as a REDD+ activity, it being sensitive to the clear impacts on forest areas after a forest fire.

While fire seasons in Chile are frequent events that occur during the summer season, fire events in January and February 2017 were extreme under high temperatures, low humidity and drought conditions that caused an exceptional event known as a firestorm.

The firestorm affected 518,000 hectares, out of which 93% corresponded to vegetation formations with the Maule region being the most affected, having 54% of its total surface burned, followed by the Biobío region with 19.2%. A total of 89,347 native forest hectares were affected among the native forest vegetation formations, equivalent to 17.24% of the total burned area. The most affected forest type is Sclerophyll, with 72,064.1 ha.

A simple exercise where the surface affected by the firestorm was intersected with pixels from the degradation map, being able to isolate burned pixels, was conducted in order to assess the areas affected by this firestorm.

Among the main findings, areas under degradation in the 2018 – 2019 period affected by the 2017 Firestorm are not too representative in relation to the total degraded surface of the period, only representing 1.3%. This is because areas burned in 2017 were mostly forests of planted exotic species, which are included in the degradation analysis that only considers native forests, which were not as impacted. Also, one of the most impacted regions is that of O´Higgins, which is not in the accounting area. This translated into emissions estimated from these areas being minimal in relation to the total emissions of the period, therefore, the effects of the firestorm phenomenon do not have a major influence in the degradation results for the monitoring period. In addition to this, there is on – site evidence of the post fire restoration process as of 2020 (3 years later) which makes it important to evaluate the state of this forest condition before confirming the dismissal of the areas burned by the 2017 mega fire.

- **Drought**

The important increase in degradation during the period is linked with the impact of drought and climate change on the state of vegetation, which has been scientifically proven by analyzing the impact of the decrease in rainfall on browning signs representing loss of vigor, especially in sclerophyll forests. In addition, this fosters environmental conditions for forest fires to occur and propagate, which is one of the main causes of forest degradation identified.

Chile has experienced over a decade of drought nationwide. The precipitation deficit since 2010 is 30% (CR2, 2015). The center-south of the country, that is, the north of the CA, are those that have experienced the most significant variations (ARCLIM). Although the native forest has adapted to short drought periods, the duration of the current scenario is causing a significant increase in the native forest deterioration. (CR2, 2020; Miranda et al., 2020; Garreaud et al., 2017), along with an increase in the forest fire regime. In particular, some species and forest types in the CA have displayed a higher sensitivity to precipitations and climate variables, being more affected (Venegas-González et al., 2018; Urrutia, R. & Rojas, Y., 2020).

This scenario is capable of impact the implementation and results of the Chilean ER Program, especially in the CA northern regions. While there are scientific studies that have addressed some specific aspects of the drought, CONAF has undertaken to study its impacts on the ER Program. These analyses will be aimed towards:

i) Determine the CA native forest surface being affected.
ii) Assess the magnitude of these impacts on the native forest.
iii) Estimate their effects over time.
iv) Establish a correlation between these trends with emissions and captures from the native forest, both for the ER Program and the National REDD+ Strategy.

Recent studies (Miranda et al, 2020)[21], have addressed the impact of the 2010 – 2017 mega drought on the forests of central Chile, indicating its significant impact of the productivity of Mediterranean forests. In addition, a preliminary study conducted by the Forest Institute regarding degradation outcomes analyzed the 2000 – 2020 time series, seeking to identify drought events and their relationship with forests under browning conditions. As a result, the effect on browning in sclerophyll forests is made evident, which coincides with drought events in the evaluated period. The next graph displays the annual browning surface calculated based on Landsat ETM+ and OLI satellite material, for the Maule region and the north area of the Biobío (Just before the Ñuble – Biobío division) considering NDVI ranges of <0.45 and >0.2. The following figure is a synoptic depiction of the NDVI behavior for a stand in a sclerophyll forest, as an example.

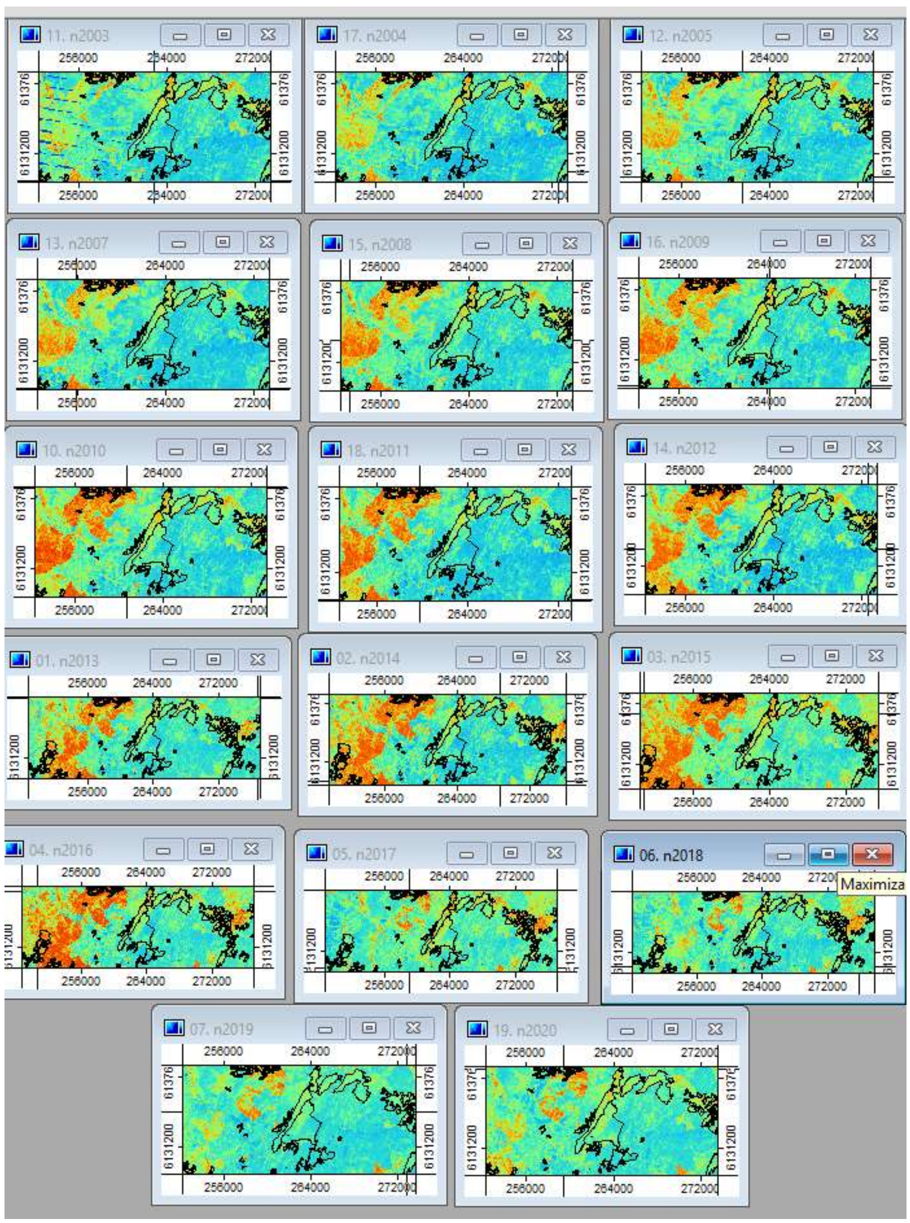


Figure 10 Synoptic view of NDVI behavior in sclerophyll forests (example).

[21] Forest browning trends in response to drought in a highly threatened Mediterranean landscape of South America, Ecological Indicators (journal homepage: www.elsevier.com/locate/ecolind).

This information was used to count the sclerophyll forest surface with signs of browning, based on the native forest registry for these regions. The occurrence of drought events in the period was added, corresponding to 2007, 2010 – 11, 2016 and 2019 – 20. As a result, the following graph summarizes the annual browning surface, highlighting the years with drought events in pink.

It is possible to conclude that, while browning is evident in the results, it would not be a new event only specific for the period associated to the mega drought, but would rather be associated to a cycle of recurring drought weather events in the last two decades, which is related to climate change. Then, the peaks showing the largest browning effect in the graph coincide with historical drought events reported in Chile and are possibly related to El Niño/La Niña phenomena. It is also worth noting the frequency of these events has increased from 6 to 7 years at 2 to 3 year rates, although their magnitude is greater with regard to the base year (2000), possibly indicating a resilience effect of this forest type.

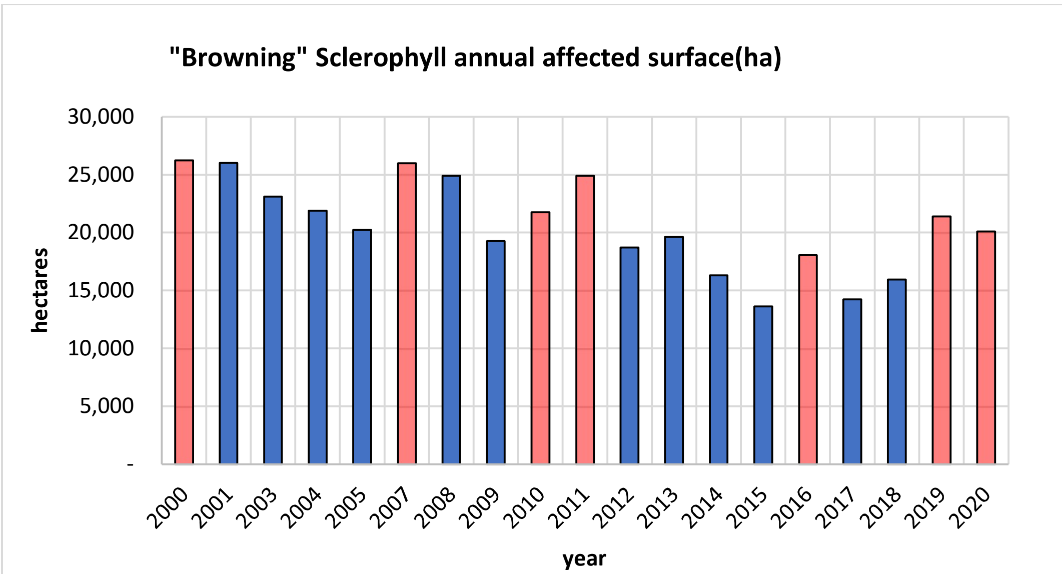


Figure 11 Annual yellowing evolution in Sclerophyll forests of the Maule region.

As demonstrated on a preliminary basis, there is evidence of a browning effect on sclerophyll forests, exacerbated by the mega drought. Nevertheless, more information is required for this to be determined. This requires more in – depth studies in order to determine the magnitude of these effects on the various forest types or some species, at different latitudes where the impacts of the effects of mega drought are also different.

To be able to specify the impact, it is required to expand the time period being evaluated including a period before the year 2000 which would allow to analyze spectral responses of forests in scenarios with no drought events, therefore knowing how plant formations respond to a lower water availability.

Literature also indicates that, along with the decline in rainfall and temperature increase, slope exposure could be an important factor in the loss of vegetation vigor, so it would be another variable worth evaluating. Definitely, once impacts have been detected on a preliminary basis, it is necessary to spatialize their occurrence in native forests, determining their effect in terms of captures and emissions.

In 2022 the GAC consulting develops a methodology to determine the effect of the megadrought in the forest remaining forest. The Chilean experts (GAC-UC) identified areas, by forest type, where vegetation anomalies in the primary productivity variable were frequent between 2001 and 2021. These areas under the impact of the megadrought are the areas affected by browning and correspond to those areas of forest that remain as forests that present phenological anomalies. So, in this study, browning was understood as an abrupt drop in the productivity of trees whose consequences translate into decreased growth or in? mortality. The study area was the accountability forestland remaining forestland (FRF) area of the ERP.

7.2 Quantification of Reversals during the Reporting Period

There have been no transfers of reduced emissions in a previous period, therefore there are no reversals of ERs that have been previously transferred to the Carbon Fund.

A.	**ER Program Reference level for this Reporting Period (tCO_2-e)**	*from section 4.1*		
B.	**ER Program Reference level for all previous Reporting Periods in the ERPA (tCO2-e).**	*from previous ER Monitoring Reports*		**+**
C.	**Cumulative Reference Level Emissions for all Reporting Periods [A + B]**			
D.	**Estimation of emissions by sources and removals by sinks for this Reporting Period (tCO_2-e)**	*from section 4.2*		
E.	**Estimation of emissions by sources and removals by sinks for all previous Reporting Periods in the ERPA (tCO_2-e)**	*from previous ER Monitoring Reports*		
F.	**Cumulative emissions by sources and removals by sinks including the current reporting period (as an aggregate accumulated since beginning of the ERPA) [D + E]**			**–**
H.	**Cumulative quantity of Total ERs estimated for prior reporting periods (as an aggregate of ERs accumulated since beginning of the ERPA)**	*from previous ER Monitoring Reports*		**–**
I.	**[G – H], negative number indicates Reversals**			
If I. above is negative and reversals have occurred complete the following:				
J.	**Amount of ERs that have been previously transferred to the Carbon Fund, as Contract ERs and Additional ERs**			
H.	**Quantity of Buffer ERs to be canceled from the Reversal Buffer account [J / H × (H – G)]**			

7.3 Reversal risk assessment

Risk Factor	Risk indicators	Default Reversal Risk Set-Aside Percentage	Discount	Resulting reversal risk set-aside percentage
Default risk	*Minimum quantity set in the ERPD*	**10%**	*N/A*	*10%*
Lack of broad and sustained stakeholder support	This risk was defined as Medium in the ERPD, considering that there are land tenure conflicts in Chile, uncertainty in the appropriation of benefit rights, and risks of an inappropriate inclusion of the different actors in the ER Program. In the period of this report, there has been progress in the country in improving these aspects, however, there are still relevant gaps that keep the risk level at medium. The main indicators of progress are: ● There is a process of participation and inclusion in the formulation and implementation of the ERP, focused on small-scale landowners and indigenous communities. ● Permanent operation of platforms to channel citizen demands, such as the CSM. ● There are communication and validation channels with opportunities for formal participation in CONAF and MINAGRI, e.g. CONAF's COSOC, CTICC. ● Adequate functioning and representativeness of the Regional REDD+ Groups. ● Efficient and transparent operation of the BSP. ● Operation of the Safeguards Information System, and other monitoring activities. Dissemination of the ERP integrated into the institutional management of CONAF at the national and regional level (forestry dissemination and extension programs).	**10%**	**Medium risk, 5% deducted**	**5%**
Lack of institutional capacities and/or ineffective vertical/cross sectorial coordination	This risk was defined as Low in the ERPD, considering the knowledge and skills gaps existing in the institutions involved and the lack of coordination between them. In the period covered by this report, Chile has taken measures to ensure an ever-greater articulation and strengthening of government institutions involved in the issue of climate change with the ER Program and the ENCCRV, with formal entities such as the Intraministerial Technical Committee of Climate	**10%**	**Low risk, 10% deducted**	**0%**

	Change (CTICC, acronym in Spanish). These advances keep the risk level low. The main indicators of progress are: ● Strengthening of the institutional capacities of CONAF (DECCSE, other departments and regional offices) for the management of the ERP. ● Improvements in institutional conditions, management and logistical aspects that allow the proper functioning of the Regional REDD+ Groups. ● Signing of the agreements required between forestry and agricultural institutions for the correct implementation of the program in the territory. ● Ensure integration and coordination between the various CONAF extension programs and MINAGRI promotion instruments in the ERP regions. ● Maintain and expand the participation –when necessary – of other institutional coordination mechanisms linked to climate change and land management at the regional level (e.g. the Inter-ministerial Technical Committee on Climate Change, CTICC). ● Secure the additional financing required for the institutional operation of the ERP.			
Lack of long term effectiveness in addressing underlying drivers	This risk was defined as Medium in the ERPD, considering the deficiencies and limited scope of forest laws and their promotion instruments, which did not adequately address the causes and agents of deforestation and degradation. Risks of ineffectiveness in governance and the lack of continued funding to implement the ENCCRV action measures were also considered. In the period of this report, there has been progress in the country in improving these aspects, however, there are still relevant gaps that keep the risk level at medium. The main indicators of progress are: • Institutional commitment to address both ENCCRV and PRE implementation. Approval of the ENCCRV by the Council of Ministers for Sustainability, submitting the ENCCRV at the UNFCCC. • Integration of ENCCRV into the environmental and climate policies of Chile for REDD+ compliance. Climate Change Adaptation Plan in the Agroforestry Sector, National Climate Change	**5%**	**Medium risk, 2% deducted**	**3%**

	Action Plan 2017-2022, NDC of Chile (2020 update). • Financing for the institutional management of the ENCCRV and the ERP at the national and regional level, and leverage of additional funds for its execution in the territory (UN-REDD, GCF). • Search for new long-term financing models. • Alignment of the action measures of the ENCCRV and the ERP with the actions defined under the national forest legislation (Law 20,283 and Decree 259) and forest extension regulation that ensures their execution over time.			
Exposure and vulnerability to natural disturbances	This risk was defined as Medium in the ERPD, considering that although there is a permanent risk of earthquakes, volcanic eruptions and droughts in the AA, most of these disasters do not cause extensive damage to the forests and their temporary recurrence it is low. As evidenced in 7.1, droughts increased their recurrence in the AA, so the level of this risk should increase to a high risk. On the other hand, forest fires cause a lot of impact, degradation and emissions, but in Chile these events are classified as 100% of anthropogenic origin, therefore, they are not considered natural disturbances. It is then considered that this factor should increase its risk to a high level, in the period of this report. The main indicators of progress are: • High risk due to natural disasters, which could directly affect the capacity of the native forest in the intervention area to capture and store carbon, since these forests are one of the main sinks that contribute to the regulation of the water regime, through the precipitation and runoff regulation, the conservation and protection of soils, especially against erosion, and the conservation of biodiversity. Despite the fact that forest fires cause significant degradation, 99.7% of these fires are due to anthropogenic causes, which may be intentional, accidental or unknown, and only 0.3% are due to natural causes (volcanic eruptions, lightning strikes). However, as a result of the effects of climate change (rising temperatures, rising sea levels, retreating glaciers, and intensification of extreme weather	**5%**	**High risk, 0% deducted**	**5%**

	events, such as droughts and floods), forest fires could increase in the future. This would increase the negative effects of the mega-drought in the northern regions of AA. ● Increase and strengthen programs to reduce the occurrence, magnitude, and intensity of forest fires and strengthen institutional capacities to restore and conserve native forests that are most vulnerable to drought (through environmental education programs, fire prevention programs, post-fire mitigation programs).			
		Total reversal risk set-aside percentage		**23%**
		Total reversal risk set-aside percentage from ER-PD or previous monitoring report (whichever is more recent)		**23%**

In accordance with the indications for evaluating the risk of reversals established in the Buffer Guidelines[22], the total risk of reversals calculated for Chile is 23%. However, during September and October 2023, through discussions held with the Carbon Fund donors where Chile presented an adjustment to the emissions accounting methodology, it was proposed to apply the maximum risk of possible reversals established in the Buffer Guideline.

In this way, applying a completely conservative criterion and given the methodological adjustment in which the occurrence of non-anthropogenic disturbances is assessed, it was decided to apply 40% as the total risk of reversals.

[22] https://www.forestcarbonpartnership.org/system/files/documents/fcpf_buffer_guidelines_may_2022_version_3.1.pdf

8 EMISSION REDUCTIONS AVAILABLE FOR TRANSFER TO THE CARBON FUND

A.	**Emission Reductions during the Reporting period (tCO_2-e)**	*from section 4.3*	2,011,810
B.	**If applicable, number of Emission Reductions from reducing forest degradation that have been estimated using proxy-based estimation approaches (use zero if not applicable)**		-
C.	**Number of Emission Reductions estimated using measurement approaches (A-B)**		2,011,810
D	**Percentage of ERs (A) for which the ability to transfer Title to ERs is clear or uncontested**	*from section 6.1*	*100%*
E	**ERs sold, assigned or otherwise used by any other entity for sale, public relations, compliance or any other purpose including ERs accounted separately under other GHG accounting schemes or ERs that have been set-aside to meet Reversal management requirements under other GHG accounting schemes.**	*From section 6.4*	-
F	**Total ERs (B+C)*D-E**		2,011,810
G	**Conservativeness Factor to reflect the level of uncertainty from non-proxy based approaches associated with the estimation of ERs during the Crediting Period**	*from section 5.2*	15%
H	**Quantity of ERs to be allocated to the Uncertainty Reversal Buffer (0.15*B/A*F)+(G*C/A*F)**		301,771
I	**Total reversal risk set-aside percentage applied to the ER program**	*From section 7.3*	40%
J	**Quantity of ERs to allocated to the Reversal Buffer (F-H)*(I-5%)**		598,514
K	**Quantity of ERs to be allocated to the Pooled Reversal Buffer (F-H)*5%**		85,501
L	**Number of FCPF ERs (F-H-J-K).**		1,026,024

- **ANNEX 1: INFORMATION ON THE IMPLEMENTATION OF THE SAFEGUARDS PLANS**

ANNEX 2: INFORMATION ON THE IMPLEMENTATION OF THE BENEFIT-SHARING PLAN

ANNEX 3: INFORMATION ON THE GENERATION AND/OR ENHANCEMENT OF PRIORITY NON-CARBON BENEFITS