

Country Forest Note

Chile's Forests: A pillar for inclusive and sustainable development



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Acronyms and Abbreviations

APF	Preferably suitable for forestry
BCC	Central Bank of Chile
CBD	Convention on Biological Diversity
CC	Climate change
CERTFOR	Chilean Sustainable Forest Management Certification System
CIFEC	Continuous Inventory of Forestry Ecosystems of Chile
CIREN	Natural Resources Information Center
CNE	Chilean Energy Commission
CO ₂	Carbon dioxide
CO ₂ eq	Carbon dioxide equivalent
CONAF	National Forestry Corporation
COP	Conference of the Parties
COREF	Reforestation Corporation
CORFO	Chilean Economic Development Agency
CORMA	Chilean Wood Industry Association
CPF	Forest Policy Council
DIPRES	Dirección de Presupuestos
DLDD	Desertification, land degradation, and drought
DL 701	Decree Law No. 701 of 1974 on Forest Development
ECLAC	Economic Commission for Latin America and the Caribbean
ENCCRV	Chilean Strategy for Climate Change and Vegetation Resources 2017–25
ERPA	Emissions reduction payment agreement
ES	Ecosystem services
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FCBN	Conservation, Recovery, and Sustainable Management of the Native Forest Fund
FCPF	Forest Carbon Partnership Facility
FIBN	Native Forest Research Fund
FMP	Forest Management Plan
FOB	Free on board at port of origin
FPC	Forest Policy Council
FPM	Fine particulate matter
FRL	Forest Reference Level
FSC	Forest Stewardship Council
GoC	Government of Chile
GCF	Green Climate Fund
GDP	Gross domestic product
GEDEFF	Department of Forest Development and Promotion (CONAF)
GEF	Global Environment Facility
GHG	Greenhouse gases
GTZ	German Cooperation Agency
GWh	Gigawatt hours
Ha	Hectares
HDF	High-density fiberboard
IMF	International Monetary Fund

INDAP	Agricultural Development Institute
INE	National Statistics Institute
INFOR	Forestry Institute
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
LBN	Native Forest Law
LULUCF	Land use, land-use change, and forestry
m ³ swb	Cubic meter of solid wood without bark
MAIA	Andean Intercultural Environmental Model
MDF	Medium-density fiberboard
MDP	Medium-density panel
MIDESO	Ministry of Social Development
MINAGRI	Ministry of Agriculture
MMA	Ministry of the Environment
MOFIN	Mapuche Intercultural Forestry Model
MSME	Micro, small and medium enterprise
MW	Megawatt
NBS	National Biodiversity Strategy
NDC	Nationally determined contribution
NGO	Nongovernmental organization
NPPFFF	National Plan for Preventing and Fighting Forest Fires
NWFP	Nonwood forest products
OECD	Organisation for Economic Co-operation and Development
OSB	Oriented strand board
PA	Protected areas
PCI	Private conservation initiatives
PEFC	Program for the Endorsement of Forest Certification
PES	Payment for environmental services
PGRVTI	Management Plan for Vegetation Resources in Indigenous Lands
REDD+	Reducing Emissions from Deforestation and Forest Degradation
SAG	Agricultural and Livestock Service
SBAP	Biodiversity and Protected Areas Service
SERNAFOR	National Forest Service
SFM	Sustainable forest management
SIMEF	Integrated System of Monitoring and Evaluation of Forest Ecosystems
SNASPE	National System of State-Protected Areas
UACH	Universidad Austral de Chile
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Program
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USD	United States dollar
UTEM	Metropolitan Technological University
WB	World Bank

Note: Unless otherwise noted, all dollars are US dollars; all tons are metric tons.

Executive Summary

Benefiting from an increasing—mostly urban—population and a rich ethnic and cultural heritage, Chile has been one of the fastest growing economies in Latin America. Some 88.4 percent of its 19 million inhabitants live in urban areas, while 12.8 percent belong to nine recognized native groups. Over the past decades, Chile has managed to achieve a significant decline in poverty with its gross domestic product (GDP) reaching \$298 billion in 2019. Main contributing sectors are mining, manufactured products (food, chemicals, wood), and agriculture. In 2019, the services sector accounted for 57.6 percent of GDP and employed around 68.2 percent of the working population, while the industrial sector accounted for 30 percent of GDP and employed 22.8 percent of the working population.

Forests are a vital resource, providing economic as well as direct and indirect environmental benefits, and are highly valued by society. Located mainly between the Maule and the Magallanes regions in the south-central part of the country, the diversity and distribution of Chile's forests are mainly a result of the country's climatic complexity and physical features. Its forests cover 17.9 million hectares, representing 23.9 percent of its territory. Roughly 82 percent are native forests (14.6 million hectares), 17 percent are planted forests (3.1 million hectares), and 1 percent are mixed forests (179,125 hectares). While native forests are extremely diverse and characterized by rich biodiversity, about 95 percent of planted forests are highly productive pine and eucalyptus. Forest land ownership is dominated by the private sector; almost all forest plantations and more than 65 percent of native forests are privately owned.

Chile's forests are critical for the country's biodiversity and natural heritage, with endemic rates of its flora and fauna close to 25 percent, and 46 percent for vascular plants. The temperate Valdivian rain forest holds special importance for the conservation of global biodiversity and is considered one of 35 biodiversity hotspots in the world. Since the creation of the first protected area (PA) in 1907, Chile has increased the extent of its PAs under the National System of State Wildlife Protected Areas (SNASPE) to over 18 million hectares today, representing 21.2 percent of the national territory. Through SNASPE, almost 29 percent of the country's native forests are currently protected. Furthermore, 1.2 million hectares of land are protected under private conservation initiatives.

The contribution of the forest sector to Chile's development is marked by the successful evolution of the forest industry. Based on a long-term afforestation policy, the country was able to recover its forests through forest plantations and the development of a strong forest industry. Initiated to recover millions of hectares of degraded soils—resulting from the systematic destruction of native ecosystems between the eighteenth and the mid-twentieth century—forest policy has focused on exotic fast-growing plantations, promoted by the state and executed by private entrepreneurs. While this public-private partnership started in 1931, until the 1970s, the sector had a secondary role in the national economy. This changed with the passing of Decree Law 701 from 1974 on Forest Development (DL 701), which led to the rapid growth of forest plantations. This law established the legal framework for forest land—or land preferentially suitable for forestry—and set promotion standards that boosted the growth of the sector. Forest cover has increased more than 10 percent in the last 25 years, benefiting from an estimated total investment of around \$69 billion, both private and public, allocated not only for the establishment of forest plantations, but also for the associated infrastructure, industrialization, transport, marketing, export, innovation, and human capital. These investments have resulted in the creation of important industrial clusters in the south-central region of the country. The DL 701 incentive system was in force for almost 40 years until it expired in December 2012.

Today, the forest industry constitutes one of the pillars of the Chilean economy, accounting for 2.1 percent of national GDP. Domestic demand for timber and wood stands at approximately 48 million cubic meters (m³) each year, 99 percent of which comes from planted forests, given restrictions on wood from native forests. In 2018, employment in the sector reached 113,769 jobs, 1.5 percent of the country's

workforce. Additionally, the forest sector creates approximately 300,000 indirect jobs through production chains linked with other sectors of the economy. Forestry exports have climbed steadily, reaching in 2018 a record of more than \$6.8 billion, representing 9.1 percent of Chilean total exports and placing the forestry sector as the third biggest exporting industry after mining, and fishing and aquaculture. The national forest industry has managed to diversify its production to over 370 forest products. The forest sector also makes an important contribution to the country's energy security through the generation of nonconventional renewable energy based on forest biomass. In 2019, biomass contributed 2.6 percent to the installed capacity of electricity generation in the country (1,948 GWh). Moreover, nonwood forest products (NWFP) have gained increasing importance in the Chilean economy, with significant benefits for rural communities.

Chile has become a leader in forest sector innovation and knowledge. Genetic improvement programs have helped improve the productivity of fast-growing species like pine and eucalyptus. The sector has also developed sophisticated monitoring and evaluation systems, providing a wealth of scientific data to support forest management policy and decision making by both public and private actors. These include the “Cadaster and Evaluation of Native Plant Resources Chile” administered by CONAF, and the “Continuous Inventory of Forest Ecosystems of Chile” administered by INFOR. INFOR also is the institution responsible for maintaining statistical data and economic accounts for the sector.

While these developments have helped Chile to reverse net deforestation, challenges lie ahead. Notwithstanding a strong focus on plantation development and steady increase of forest cover over the past decades, native forests have become seriously degraded and present policies are insufficient to reverse this trend. In addition, Chile is particularly sensitive to the effects of climate change. Over the last decade, the country has been significantly affected by droughts and forest fires. The 2016–17 forest fire season set a record, destroying 570,197 hectares of forests and woodlands, a tenfold increase over the annual average. Furthermore, with the afforestation rate decreasing, as a result of the expiration of the DL 701 incentives scheme and limited availability of suitable forest land, the country is likely to experience serious wood deficits in the coming years. Managing these challenges will require careful planning and a number of short- and long-term interventions.

As forests must adjust to a changing environment, Chile's forest policy and management approach also are changing. Forest policy has evolved from regulations and incentives that boosted the sector since the 1970s to a growing interest in the implications for native forests, carbon emissions, and land management. New efforts are underway to adjust the focus on large-scale forest plantations toward a more comprehensive approach that includes native forests as well as small- and medium-sized plantations. The forest sector is now recognized—as confirmed in the “Forest Policy 2015–35”—as an important driver of economic development, poverty reduction, and environmental protection. This critical policy document outlines improvements in forest plantation management and relations with society. It effectively incorporates native forests into sustainable forest development, significantly participating in the generation of wealth at the national and regional level. In the context of the country's high vulnerability to climate change, Chile adopted the National Plan for Preventing and Fighting Forest Fires (NPPFFF), with a combined private-public investment of around \$150 million. To comply with national and international commitments, the government has developed a Strategy for Climate Change and Vegetation Resources (ENCCRV). This policy instrument guides and integrates the activities and measures to be adopted for mitigating and adapting to climate change, as well as combating desertification, land degradation, and drought.

Chile's Nationally Determined Contribution (NDC) Update acknowledges the importance of forests on climate change mitigation and adaptation. The NDC Update (GoC 2020) incorporates a new integration component encompassing the role of oceans, forests, peat bogs, and ecosystems (plus the circular economy) as elements that contribute to both the causes and the effects and impacts of climate change. This is an effort to advance toward an integrated vision in the design and implementation of climate action in Chile. At the national level, the coordination of climate action with adaptation will be strengthened through the National Adaptation Plan. Adaptation plans for eleven priority sectors—including forests—

incorporate lessons learned from the implementation of earlier plans. The NDC notes that one of the most important effects of climate change is the occurrence of wildfires and the increase in their magnitude. Tackling these issues is another important challenge for mitigation and adaptation efforts. In this context, the conditions for wildfire occurrence and propagation must be minimized. The NDC stresses that strengthening sustainable forest management reduces the land area impacted by these catastrophic events, while also preventing the development of conditions that enhance the vulnerability of an ecosystem.

Although forest management in Chile is based on long-standing public and private institutions that have played an important role in the sector's development, the institutional framework needs to adjust to fulfill its increasingly complex public duties. The National Forestry Corporation (CONAF) and the Forestry Institute (INFOR) were established to support and implement the country's forest policies. Both institutions have made strenuous efforts to help regulate and support the management of plantations and native forests and look forward to developing new ways to contribute and adapt to the new challenges facing the sector. However, there are concerns about the institutional dualism of CONAF and INFOR, functioning as private corporations, which will need to change given the evolving environmental and social context. With impending requirements to address land and forest degradation, an increased focus on small and medium landowners, and the forest sector's important role in achieving the goals of the country's NDC, both institutions need to be better equipped to fulfill increasingly complex and demanding public duties.

The forest sector also is facing challenges from a social perspective. Fast growth and expansion of the sector have not always kept pace with the expectations and demands for an inclusive and sustainable industry. There are increasing demands to improve the sector's relationship with local communities and indigenous peoples. The sector must focus on addressing a number of critical issues, including (a) perceived inequitable distribution of forest resources uses and benefits, and insufficient contributions to social inclusion; (b) conflicts with indigenous people, and (c) gender balance in forestry-related activities.

The economic success of the Chilean forest sector relies heavily on its forest plantations, which are facing significant challenges. Plantations are intensively managed for pulp and other wood products for export. This commercial orientation has promoted voluntary forest management and chain of custody certification and the development and adoption of the Chilean Sustainable Forest Management Certification System (CERTFOR). However, as afforestation rates decline, overall production in forest plantations is falling, which can be explained by lower productivity and management effectiveness of small- and medium-sized forest plantations. Additional challenges include (a) the environmental impact of current management practices, and (b) the possibility of a wood deficit in the coming years.

With the focus shifting away from plantations, Chile's native forests have the potential to provide an increasing range of goods and services. Native forests are generally characterized by unsustainable management practices and thus are highly degraded, often only providing firewood. While considerable research on silvicultural techniques has been conducted, only small areas have adopted sustainable forest management practices, with a focus on thinning of second-growth forests and selective cuttings. However, native forests have the potential to revitalize regional and local economies through more sustainable management systems. For this resource to be sustainably utilized, it is essential to address challenges such as degradation, decapitalization, and poor development of the goods/services market that natural forests generate. Native forests have enormous resilience, and—over time—can recover and build more sustainable production systems, consequently increasing the supply of timber and nontimber resources, as well as biodiversity and other ecosystem services.

Chilean forest sector challenges and opportunities can be addressed by different interventions identified in the CFN based on their high potential to transform the sector into an environmental, social, and economically sustainable sector, and enhance its support for other sectors. Many of the identified intervention areas are already included in programmatic documents and initiatives, notably the Chile Forest Policy and ENCCRV. The most important short-term intervention areas include institutional and legislative initiatives, addressing small and medium forest owners, and promoting more sustainable use of native

forests. Measures in these areas are prerequisites for other interventions that need a longer implementation period. This note identifies long-term interventions in five areas: (1) native forest management; (2) institutions and regulations; (3) increased productivity and management quality of forest plantations; (4) equity and social inclusion in the forestry sector; and (5) awareness and education. Some of the identified intervention areas are already, at least partially, addressed by current WB engagement and/or other funding initiatives. This CFN also highlights financing, knowledge, technical assistance, and analytical gaps that need to be addressed to achieve an integrated and sustainable management and development of the country's forest resources.

[NOTE: The COVID-19 global pandemic has put the world under great pressure, stretching public health care systems, creating a period of emotional and physical distress for millions of people, and potentially devastating the global economy. The data and forecasting regarding Chile's future economic growth may be significantly impacted by the outbreak, but it is too early to make any predictions. This note does not attempt to take these impacts into account. The World Bank has extensive outreach on this subject, which is largely available online (<https://www.worldbank.org/en/who-we-are/news/coronavirus-covid19>).]

1. Chile: Country Context

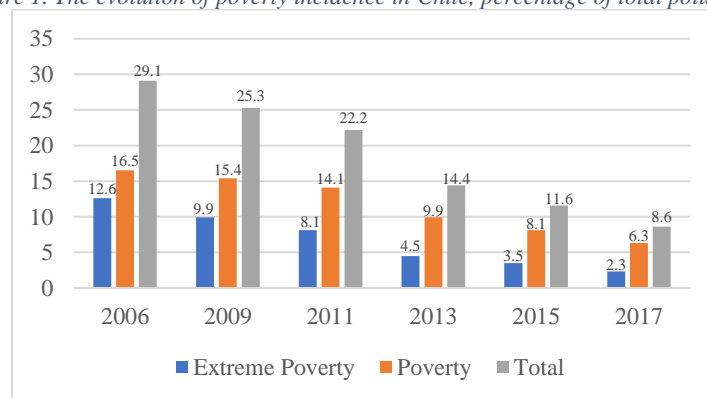
Chile's geography is unique in the world. Its territory spreads across the western and southern edge of South America, including Easter Island in Oceania and stretching south to Antarctica. Chile's total continental area is about 756,000 km² (GoC 2016). Its territory consists of four large geomorphological units: (1) the Coastal Cordillera that occupies the western part, (2) the main Andean Cordillera ranging to the east of the territory, (3) the Central Valley flanked by the two mountain ranges, and (4) the Patagonian Cordillera, the continuation of the Andes into Tierra del Fuego (Moreira-Munoz 2011). There are also other smaller scale geographical areas, such as the Coastline Plains, the Altiplano, and the Magellanic Steppe (GoC 2016). The Chilean landscape is dominated by mountains, with flat land accounting for only about 20 percent of the continental territory (GoC 2016). Volcanoes are another characteristic of the Chilean landscape, generated by the subduction of tectonic plates. There are over 2,000 volcanoes along the Andes Mountain range, a quarter of which are geologically active. Throughout history, this continuous eruptive activity has played a significant role in the development of Chilean soils, which are made up of 60 percent volcanic ash from past eruptions.

Chile has a wide variety of climates. Chile has unique climatic features, mainly determined by latitude and altitude. The main climatic zones are arid, temperate, and polar (Sarricolea et al. 2017). The climate's diversity, together with the nation's geomorphological characteristics, have produced a great diversity of plants and vegetation types.

Chile's geographical position also has a significant bearing on the country's land use, along with its history of human development. Cleared vegetation makes up about 31.7 percent of the total country area.¹ Other land types include meadows and bushes (27.1 percent), snow and glaciers (5.3 percent), wetlands (4.7 percent), agricultural areas (4.2 percent), and water bodies (1.8 percent). Urban and industrial areas represent only 0.5 percent of the total area, but are showing a sustained upward trend (INFOR 2019).

Chile is a unitary republic. Its local political-administrative structure is based on three territorial government levels: (1) administrative regions (16), (2) provinces (56), and (3) municipalities (346). An administrative region is a territorial unit having its own specific geographic characteristics and sharing common social, economic, and cultural attributes (GoC 2016).

Figure 1. The evolution of poverty incidence in Chile, percentage of total population.



Source: MIDESO (2018).

Chile's population experienced substantial growth during the twentieth century, but the growth rate slowed during the first decade of the twenty-first century and is expected to drop even further by 2050. Chile's total estimated population in 2019 was 19,107,216, with urban residents accounting for 88.4 percent of the total (INE 2017). The population is strongly concentrated in the central zone, especially in

the metropolitan region of Santiago. Urban population is dominant over rural population in all regions. Antofagasta has the highest urban population percentage, followed by Santiago and Tarapacá, where urban residents are expected to exceed 95 percent of the region's population by 2035. The regions with the highest rural proportion are Ñuble, La Araucanía, and Los Ríos, with about 30 percent of their population in rural areas (INE 2017). The National Socioeconomic Characterization Survey (*Encuesta de Caracterización Socioeconómica Nacional*) indicates a significant decline in poverty (Figure 1). The share of the population living in poverty fell from about 29.1 percent in 2006 to 8.6 percent by 2017. Similarly, the population living in extreme poverty decreased from 12.6 percent in 2006 to 2.3 percent by 2017 (MIDESO 2018). Chile's unemployment rate reached 7.4 percent in February 2020.² Despite the strides made in promoting gender equality and increasing the participation of women in the Chilean work force, their involvement remains low—only 48.5 percent of women are part of the Chilean labor market (INE 2017).

Chile has a rich ethnic and cultural heritage. Human activity has been recorded as early as 14,800 years ago. Based on data from the 2017 census, 2.18 million Chileans belong to nine recognized native groups and account for 12.8 percent of the total population. Some 79.84 percent of them identify as Mapuche, 7.17 percent as Aymara, and 4.05 percent as Diaguita. The rest of the indigenous peoples are less than 2 percent (INE 2018). In geographical terms, native peoples are deployed throughout Chile, but the regions with the highest proportion of indigenous people are La Araucanía, Arica and Parinacota, and Aysén. In proportional terms, they reach a lower educational level than the rest of the population, for both men and women (INE 2018).

Chile has been one of Latin America's fastest growing economies in recent decades, thanks in part to a solid macroeconomic framework. The country's GDP equaled \$298.23 billion in 2019. The GDP growth rate for 2018 was 4 percent. The International Monetary Fund (IMF) estimates GDP growth for 2019 at 2.5 percent; however, given the new COVID-19 scenario it is expected that in 2020 there will be a decrease of -4.5 percent in GDP, with a strong recovery projected in 2021 (5.3 percent) (IMF 2020). Chile's key activity sectors include mining (copper, coal, and nitrate), manufactured products (food processing, chemicals, wood) and agriculture (fishing, viticulture, and fruit). The industrial sector in Chile contributed 30 percent of GDP in 2019 and employed 22.8 percent of the working population. The sector increased by 4.3 percent in 2019, showing signs of improved productivity. The agricultural sector contributed 3.6 percent of GDP and employed 9.1 percent of the active population in 2019. Agriculture and livestock farming are the main activities in the central and southern parts of the country. The services sector contributes 57.6 percent of GDP and employs around 68.2 percent of the population. The Chilean economy faces three main challenges: (1) overcoming its traditional dependence on the price of copper, as copper production represents 50 percent of the country's exports; (2) developing a self-sufficient food supply, as agriculture currently produces less than half of domestic needs; and (3) increasing its productivity, especially in the mining sector.³

Chile is particularly sensitive to the effects of climate change because it has most of the vulnerability characteristics established by the UNFCCC (MMA 2017). Chile is exposed to seven of the nine vulnerability criteria⁴ listed by the UNFCCC, including its low coastline; the snow and glacier regime of its rivers; its forests, which Chile is trying to protect and restock; and its ocean waters, which supply the fishing industry, a key resource for the country. Chile has already been affected by an increase in droughts and fires. The government has committed to protect the environment to ensure the long-term sustainability of its economic growth, as well as to respond to Chile's status as a member of the Organisation for Economic Co-operation and Development (OECD) and to meet its international commitments under the UNFCCC. Through its NDC as part of the Paris Agreement, the government has clearly signaled its commitment to contribute to global efforts to mitigate GHG emissions, including the expansion of renewable energy, reductions in energy consumption, and increased forest carbon sequestration and management. Chile's NDC includes an unconditional commitment to a GHG emission budget not exceeding 1,100 MtCO₂eq between 2020 and 2030, with a GHG emissions maximum (peak) by 2025, and a GHG emissions level of 95 MtCO₂eq by 2030 (NDC 2020), aiming to achieve carbon neutrality by 2050.

The NDC also notes that wetlands—especially coastal, urban, and peatlands—are highly threatened by land use change, unsustainable exploitation, the expansion of urban areas and infrastructure, and the effects of climate change, which threatens long-term sustainability. It is important to improve our knowledge of these ecosystems and establish standardized metrics to assess their capacity for climate change adaptation and mitigation, and to measure the cobenefits of these areas, implementing actions for conservation and sustainable use. On this basis, Chile by 2025 has committed to identify in a national inventory peatland areas and any other types of wetland. By 2030, standardized metrics will be developed to evaluate the capacity of wetlands (especially peatlands) for climate change adaptation or mitigation, implementing actions to enhance these cobenefits in five pilot sites in public or private protected areas in the country.

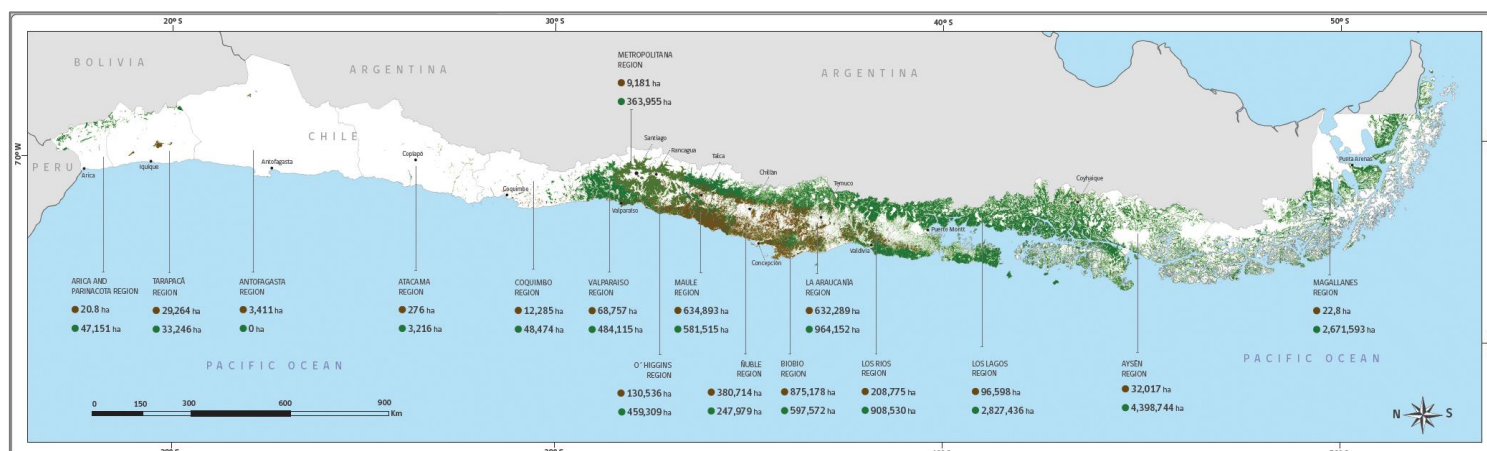
By 2021, a National Plan for the Restoration of Landscapes will be developed. This plan will consider restoration of 1 million hectares of ecosystems, prioritizing those facing the greatest social, economic, and environmental vulnerabilities.

2. Forest Resources

2.1. Forest coverage

Chile is one of the few countries in the world that has managed to reverse deforestation, with its net forest cover continuously increasing over the past decades. Forests cover 17.9 million hectares, representing 23.9 percent of the territory. Of this total, native forests account for approximately 82 percent (14.6 million hectares), planted forests for 17 percent⁵ (3.1 million hectares), and mixed forests for 1 percent⁶ (179,125 hectares). More than 90 percent of the nation’s forest resources are located between the Maule and the Magallanes regions in the south-central part of the country (INFOR 2019) (See Annex 2). The latest “Global Forest Resources Assessment” of the Food and Agriculture Organization (FAO) reports a net increase in forest area from 15,263,000 hectares in 1990 to 17,735,000 hectares in 2015, placing Chile as the third country worldwide to increase its forest area between 2010 and 2015. The increase of 301,000 hectares—a growth rate of 1.8 percent—was surpassed only by China and Australia (FAO 2015). In addition, Chile is among the twelve countries that enlarged its forest area by more than 10 percent in the last 25 years.⁷ The expansion of the forest area in Chile is due to planted forests. (For more detailed resolution in Figure 2, please refer to Chile Country Forest Map in Annex 1).

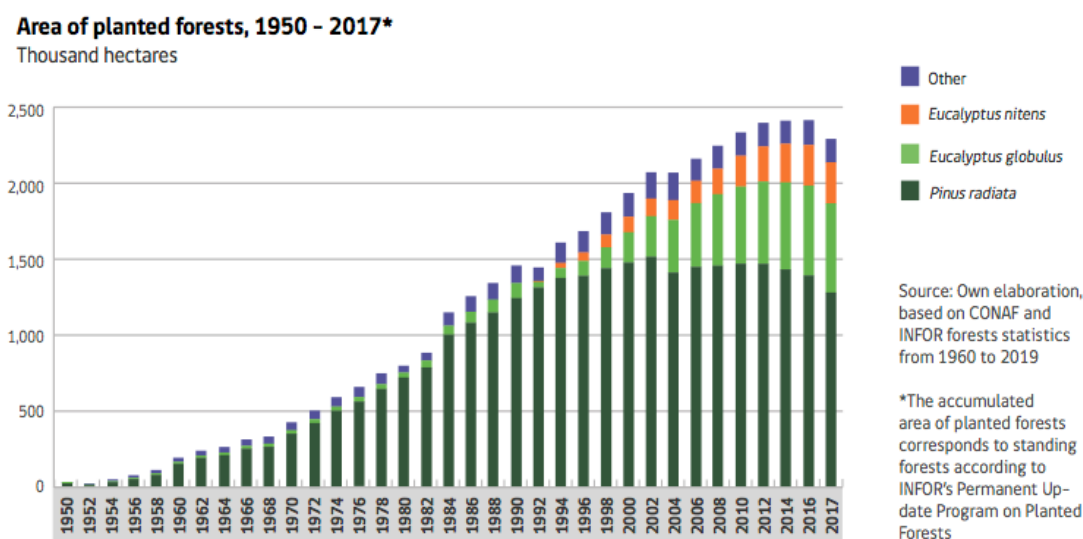
Figure 2. Chile forest cover map



Source: CONAF. (2019).

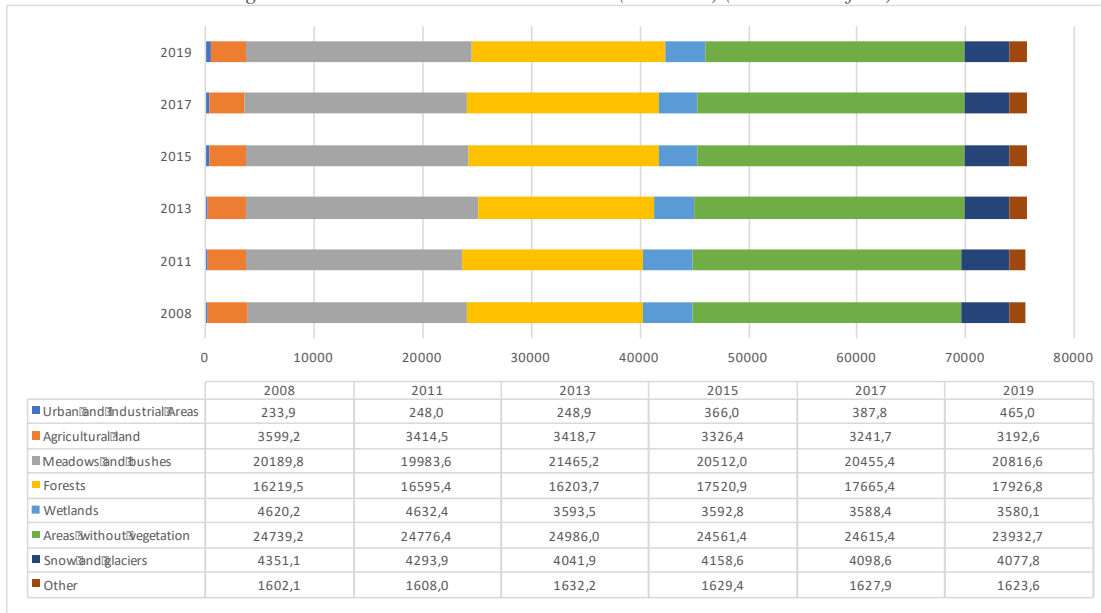
Chile has maintained high afforestation and reforestation rates for many years as a result of a joint effort between public and private players to restore the country's degraded lands. From the sixteenth century to the middle of the twentieth century, intensive farming and unregulated logging depleted the forests and degraded productive lands in much of the national territory. This reality pressured the state to regulate the logging of native forests and implement a long-term afforestation policy, which resulted in the General Logging Regulation of 1837, the Forest Law of 1931, and the adoption of DL 701 regarding forest development. This law established a series of private sector incentives, strongly boosting large-scale afforestation (Figure 3). The total amount of public investment to date is estimated at approximately \$560 million (INFOR 2019; Aninat et al. 1982). Over a long period of time and until 2013, forested areas (new forests planted on uncovered areas) and reforested areas (plantations on land recently covered by forests) surpassed an average of 100,000 hectares per year (INFOR 2014). The annual afforestation rate reached a maximum of 95,933 ha in 1992. In recent years, the afforestation rate is facing a significant drop as a result of the end of the incentives established in DL 701 in 2012, and also due to the limited availability of land suitable for planting. The afforestation rate reached a low of 1,525 hectares in 2018.

Figure 3. Area of Planted Forests, 1950–2017 (thousand ha)



The land use cover analysis indicated that forest cover has increased while land uses like wetlands, areas without vegetation, and agricultural land have decreased. (Figure 4) In the last 10 years, the forest cover increase can be associated with a decrease in agricultural land, wetlands, and areas without vegetation cover. This indicates that, at the country level, agriculture and urban/industrial areas do not constitute a driver for deforestation. Of course, this overall country analysis may hide situations where agriculture and urban/industrial extension affect forest surfaces, but these are a few specific cases. A similar situation can be seen in the case of native forest coverage—the total surface has been increasing in the last 10 years (Figure 5).

Figure 4. Chile land use cover evolution (2008–19) (thousands of ha)

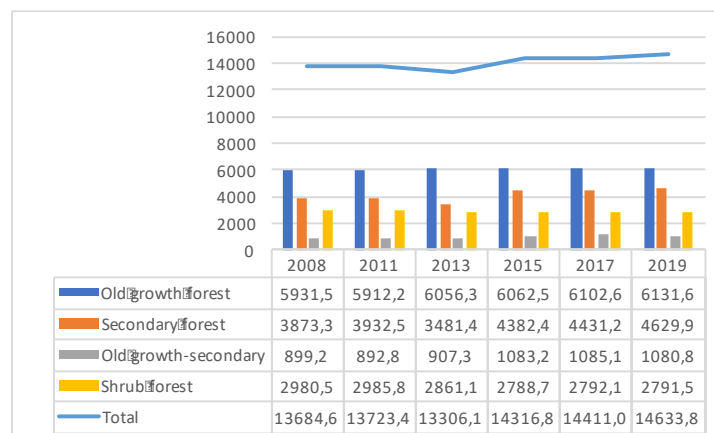


Source: INFOR (2008, 2011, 2013, 2015, 2017, 2019)

2.2. Native forests

Native forests⁸ are extremely diverse and very valuable from a biodiversity perspective. The natural limits of Chile greatly isolate it and prevent invasions from other forests in the continent. For these reasons, Chilean forests, which include mediterranean forests and temperate rainforest, can be considered a biogeographical island (Donoso 1993). Generally, the forests are characterized by an unusual biodiversity and endemism of different life forms, a preponderance of angiosperms over gymnosperms, and of broadleaved over deciduous species (Armesto et al. 1995). The types of native forests (See Annex 2) with the highest representation are the *Lenga* (3.6 million hectares, 24.8 percent), the *Evergreen* (3.5 million hectares, 24 percent), the *Coihue de Magallanes* (2 million hectares, 13.7 percent); the *Roble-Raúl-Coihue* (1.7 million hectares, 11.3 percent), and the *Esclerófilo* (1.6 million hectares, 11.1 percent). From a structural point of view, Chilean native forests are classified as old growth forest⁹ (bosque adulto, (41.9 percent), secondary forest (31.6 percent), old-growth/secondary forest (7.4 percent), and shrub forest (19.1 percent) (INFOR 2019).

Figure 5. Chile native forest coverage evolution, 2008–19



Source: INFOR (2008, 2011, 2013, 2015, 2017, 2019)

Chilean native forests have consistent wood stocking and sustained growth rates. The total standing volume of the native forest has been estimated at 3.652 million m³ (INFOR, 2019)(meaning an average standing volume of 272 m³/ha), increasing from 3.487 million m³ in 2016 (INFOR, 2017), and the annual growth have been estimated at 100.1 million m³ (INFOR 2019), increasing from 88,7 million m³ in 2016 (INFOR, 2017).

Table 1. Native forest landownership features in Chile

Tenure types	No. of exploitations/Farms		Area	
	No.	%	Ha	%
A. Small owners (1+2+3)	74,010	91	1,225,749	9.3
1.Individual owners	73,817		1,101,359	
2.Indigenous people communities ^a	158		105,888	
3.Agricultural communities ^b	35		18,502	
B. Medium size and large owners	7,239	8.9	7,830,290	59.4
C. Protected Areas	88	0.1	4,135,677	31.4
TOTAL (A+B+C)	81,337	100	13,191,716	100

Source: CONAF (2013)¹⁰, INFOR (2019).

Notes: a. 5,530 members of indigenous people communities. b. 2,759 members of agricultural communities (associations of owners without a legal contract or incorporation, and communal producers (ODEPA 2017).

Native forests have a high number of small-sized forest owners, including indigenous people, agricultural communities, and female owners. At the national level, different sources (INE 2007; CONAF 2013) estimate that there are 81,249 private farms with native forest that control a total area of 9.0 million ha. About 4.1 million ha of native forest is included in protected areas (PA). Approximately 28 percent of native forest owners are women, and 20 percent of the native forest owners belong to a native population (CONAF 2013).

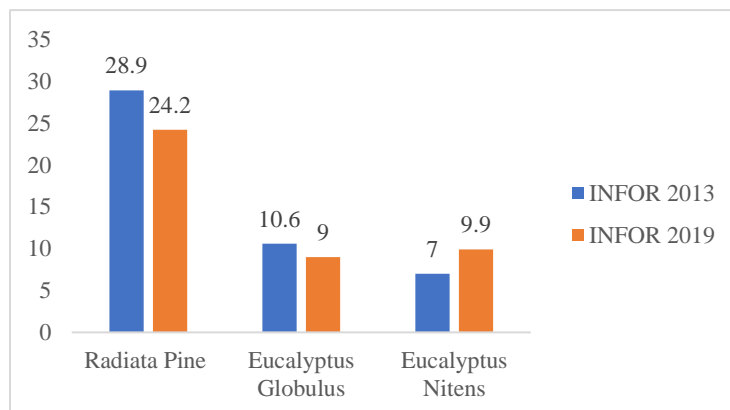
2.3. Forest plantations

***Pinus radiata* and *Eucalyptus* sp. are the most important species used for forest plantations.** *Pinus radiata* forest plantations cover most of the area (56 percent), followed by eucalyptus plantations (38 percent), where two species, *Eucalyptus globulus* and *Eucalyptus nitens*, stand out. From 2007 to 2012, the radiata pine planted area stabilized at around 1.47 million hectares. In 2013, this area began to decline, experiencing a major drop in 2017 as a result of the megafires in the summer of that year (INFOR 2019). The accumulated area of eucalyptus has generally increased each year, except for a slight reduction from 2016 to 2017. For every planted hectare of eucalyptus, there are approximately 1.5 hectares of radiata pine. This is a significant change since the early 1990s, when this relation was closer to 1:8. Forest plantations are concentrated in the Biobío region, where they account for 3 percent of the surface (895,648 hectares). Surfaces planted with native species (mainly *Prosopis* spp., *Quillaja* spp. and *Nothofagus* spp) are very limited: between 1999 and 2015 only 3,427 ha were planted (Lara et al., 2016).

The growth rates of forest plantations are much higher than native forests, but present estimates indicate a reduction in wood availability from plantations. For *P. radiata*, the average growth rate is around 25 m³/ha/year, while for *Eucalyptus* sp. it is around 40 m³/ha /year, depending on the species.¹¹ Regarding the wood resources of forest plantations, INFOR has detailed projections on wood availability, based on the present volumes, increments, and the future evolution of the plantations' surfaces and productivity.¹² For 2020, INFOR estimated a total available wood volume of 42.6 million m³ (24.1 million m³ *Pinus radiata* and the rest *Eucalyptus*). In the modeling scenario used by INFOR, the available wood volumes from plantations will slowly increase to 43.2 million in 2030. At the species level, for the period

2038–40, and since the previous report (INFOR 2013), the volume of *radiata pine* is expected to decline from 28.9 million m³ to an estimated 24.2 million m³. The same trend can be seen in *Eucalyptus globulus*, which shows a reduction from 10.6 to 9.0 million m³. In the case of *Eucalyptus nitens*, the projected supply is expected to increase from 7.0 million m³ to an estimated 9.9 million m³.

Figure 6. Volume of wood supply, 2038–40 (million m³)

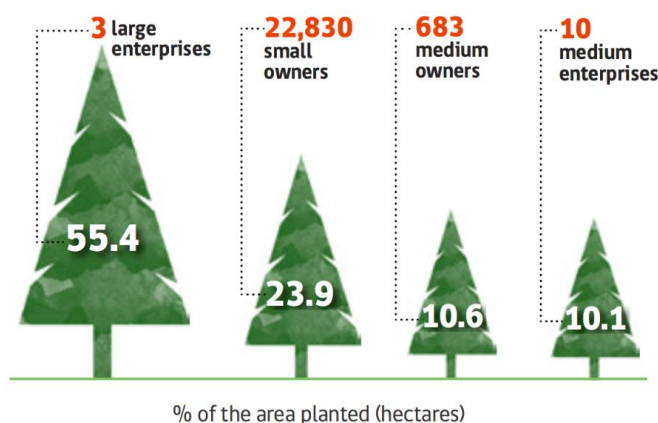


Source: INFOR (2019)

The main causes of the drop in wood availability are (a) an increasing tendency, especially in small and midsize owners, to replace pine plantations with eucalyptus plantations; (b) expiration of the promotion to new plantations based on DL 701; (c) a drop in yields of some species in the past few years, especially in *Eucalyptus globulus* plantations due to the attack of the defoliator *Goniapterus platensis*, and the long drought in the country's central zone, and (d) the forest fires in 2017, which affected 198,800 ha of standing plantations in the O'Higgins, Maule, and Biobío regions, 79 percent being radiata pine plantations, and the rest eucalyptus plantations (INFOR 2018).

Today, almost 100 percent of Chilean forest plantations are privately owned. During the first half of the twentieth century, both private companies and the state began establishing forest plantations. Later, in the 1970s, the government privatized most of the publicly owned forest plantations, while promoting the incorporation of new lands to the country's forest development through afforestation incentives. This public subsidy policy allowed for the creation of a private forest cover of almost 3.1 million hectares by 2018. At present, approximately 55.4 percent of this estate belongs to three large companies with a global reach that supply raw materials to their industrial facilities, and export most of the sector's total production. In addition, there are 10 medium-sized¹³ forestry companies (683 medium-sized owners and 22,830 small-sized owners (INFOR 2019).

Figure 7. Chile forest plantation ownership



Source: INFOR (2019)

3. Forest governance

3.1. Institutional framework

The main public institution of the forest sector is the National Forestry Corporation (CONAF), established in 1970. Legally, it is a private nonprofit corporation that has been given authority and public functions through special laws. At present, it fulfills the function of a state forest service, responsible for (a) contributing to the country's development through the sustainable management of forest ecosystems and natural components associated with them through the promotion, establishment, restoration and management of forests and xerophytic plant formations; (b) increasing trees in urban areas; (c) mitigating climate change and promote adaptation; (d) providing oversight of forest and environmental legislation; (e) protecting vegetation resources; and (f) administering SNASPE. CONAF has an annual budget of approximately \$80 million and is structured in regional offices in the sixteen regions of Chile, as well as a special provincial office in Rapa Nui (Easter Island).

CONAF has continuously played a central role in forest policy implementation and forest sector monitoring. Since 1974 it has been the enforcing entity for DL 701, the agency in charge of qualifying the land suitability for forestry, guiding the management planning process, and approving forest management plans (FMP). CONAF also is legally responsible of monitoring forest resources through the “Cadastral and Evaluation of Native Plant Resources Chile” (CERN), a tool that has provided basic data for government management, whether for matters of forestry, environment, or management and conservation of these resources. Additionally, CONAF is legally bound to contribute to the mitigation of climate change and the adaptation to its effects, through promotion, control of forest-environmental legislation, and protection of vegetational resources. In this regard, CONAF has led the development of ENCCRV, which guides and integrates the activities and actions to be taken as a country in order to mitigate and adapt to climate change, as well as to fight desertification, land degradation, and drought. In this sense, another key role of CONAF is forest firefighting and pest management. In coordination with other state institutions, CONAF is a member of the National Plan for Preventing and Fighting Forest Fires (NPPFFF). It operates a complex fire detection system that includes observation towers, and the hiring of helicopters, light airplanes, and larger aircraft.

Currently, the main focus of CONAF is supporting small- and medium-sized forest landowners, usually located in highly rural counties.

The main forestry research agency in Chile is the Forestry Institute, INFOR. It is a service attached to the Ministry of Agriculture and, legally, is a private corporate entity. Its origin dates to 1961, when it began its activities as a joint project between FAO and the GoC, with the purpose of supporting the country's forest development. It was later officially created by the GoC in 1965. The institution has five regional offices and is considered a reference of quality information and research. INFOR is funded not only from public sources but also, in significant amounts, from the private sector or international organizations. INFOR focuses on the following research areas: (a) data gathering, statistics and forestry economics; (b) forest ecosystem monitoring, mitigation of climate change and adaptation to its effects; (c) management of native and exotic forest ecosystems; (d) development, which includes the restoration and recovery of plant formations; (e) conservation and genetic improvement; (f) improvement of forest plantations productivity; (g) NWFP; and (h) technology and wood products, which aims at characterizing and developing wood engineering products to generate value-added alternatives. INFOR also is responsible for the Forest Plantation Continuous Update Program and the Continuous Inventory of Forestry Ecosystems of Chile (CIFEC), as well as the Integrated System of Monitoring and Evaluation of Native Forest Ecosystems (SIMEF).

Chile has public schools of forest engineering with a tradition of over 50 years. Forestry education has a long tradition in Chile. Formal forestry training in Chile came with the founding of two forestry schools in the mid-1950s at the Universidad de Chile and the Universidad Austral de Chile. During the boom of the

forest sector, from the 1970s to the mid-1990s, several new forestry schools were opened in the country, notably Universidad de Concepción in 1976. There are three doctoral programs in forestry (i.e., Universidad Austral de Chile, Universidad de Chile, and Universidad de Concepción). All forestry schools have been instrumental in developing the forest industry and its institutional framework. Both public and private universities have placed emphasis on basic research of the forest sector in collaboration with companies, nonprofits, public authorities, and international organizations.

Trade associations are important stakeholders in the Chilean forest sector. Among the country's trade associations is the Chilean Timber Industry Association (CORMA), which is the main private organization that brings together the most prominent forest companies, not only large but also medium-sized, as well as professionals and forest contractors. The highest body of CORMA is the member assembly, formed by representatives of forestry companies, companies related to forestry, individuals, and higher education and training institutions, among others. CORMA actively participates in different instances of public-private collaboration. The main issues addressed by its members are forest fire control programs, pest control, genetic improvement programs, national simulation models, and studies on the future availability of timber, among many others.

In 1982, the Society of Forest Engineers (Colegio de Ingenieros Forestales A.G.) was created, as a continuation of the Chilean Association of Forest Engineers. The Society of Forest Engineers is an association aimed at promoting the rationalization, development, prestige, and protection of the forest engineering profession. It represents its members before the public and other organizations, both domestically and internationally. It also represents forestry professionals in the Forest Policy Council and other national bodies.

Created in 2016 with the objective of designing and structuring a forest policy for Chile, the influence of the Forest Policy Council (CPF) is increasing in response to the rapidly evolving socioeconomic realities of the forest sector. The elaborated forest policy (CFP 2016) has a sustainability approach that promotes harmonious progress among environmental, economic, social, labor, technological, and political issues. The council is made up of 15 members that represent various fields, such as universities, scientific entities, groups of small forest owners, indigenous organizations, workers organizations, environmental NGOs, unions, and companies. Chaired by the national director of CONAF, the council is advisory in nature. One of its challenges is designing actions to help strengthen small- and medium-sized forest enterprises, so that they can access the development benefits the industry has enjoyed.

There are other state organizations linked to the forest sector. The Agricultural and Livestock Service (SAG) is responsible for the control and eradication of forest pests and diseases. The Agricultural Development Institute (INDAP) manages assistance programs mainly aimed at small forest owners in order to help them improve their business and organizational capacity, as well as their integration into the rural development process. The Natural Resources Information Center (CIREN) is a technical support unit for the Ministry of Agriculture (MINAGRI) providing data on natural and production resources through the use of information technologies and geospatial applications, making them accessible and useful for decision making. In terms of development and financing, the Chilean Economic Development Agency (CORFO) is a state development agency that had an active role in the forest industry during the 1960s. However, its involvement today is limited to the development of programs primarily aimed at construction using timber and entrepreneurship. The allocation of financing for small- and medium-sized enterprises in the forest sector is done through nine financial institutions that include a line in their organizational structure that focuses on this segment; out of these, eight are private commercial banks and one is a state-owned bank (BancoEstado), which, like CORFO, had an active role in the past due to the greater governmental participation in financing policies and programs.

3.2. Legal framework

Chile's forest sector is governed by an integrated system of norms and laws. There has been a continuous and complex process of updating and adapting the legislative framework to the development of the forest sector and the country's economic, social, and environmental needs. The most important norms that govern the forest sector in Chile are described in Annex 4 (CONAF 2016).

Decree Law No. 4,363 of 1931 (Forest Law) issued by the Ministry of Land and Colonization is the first still valid¹⁴ law that regulates the protection and the use of forests. This act recognizes the importance of forest resources from an ecological, economic, and social point of view. It sets a precedent in terms of forest regulations and creates the basis for a long-term incentives-based approach. The forest law also created the legal frame for protected areas (PA) establishment, enabling Chile to declare 26 national parks by 1965. Since the adoption of the forest law, the Chilean authorities were continuously interested and proactive in developing a series of legislative initiatives focused on the creation of development instruments aimed at protecting native forests, increasing forest resources, and promoting their economic contribution and sustainable forest management.

Box 1. Important definitions introduced by DL 701

- Forest: A place populated with vegetal formations—predominantly trees—that occupy an area of at least 5,000 m², with a minimum width of 40 meters, and with a treetop coverage of over 10 percent of the total area in arid and semi-arid conditions and 25 percent in more favorable conditions.
- Forest Management Plan: An instrument that, in compliance with the requirements established by this piece of legislation, regulates the rational use and exploitation of renewable natural resources on certain lands, with the objective of obtaining a maximum benefit from these resources, while at the same time ensuring their preservation, conservation, improvement, and growth, as well as that of their ecosystem.
- Land Preferentially Suitable for Forestry: All the land that because of climate and soil conditions should not be permanently plowed, whether or not covered by vegetation, excluding the land that can be used in agriculture, fruit-growing, and intensive cattle raising.

Source: DL 701.

The Decree Law 701 of 1974 on Forest Development (DL 701) issued by the Ministry of Agriculture and its subsequent regulations,¹⁵ regulates, together with the updated 1931 Forest Law, the most important aspects of forestry activity. The law requires that all forest management be carried out in a coherent approach, and empowers CONAF to elaborate management norms for specific forest types to ensure sound professional management. Forest management is only allowed after a forest management plan (FMP) has been reviewed and approved by CONAF. According to the Chilean legislation, forest management is allowed if FMPs have been elaborated by consulting companies or individuals that obtained the specific permit and only after CONAF has approved the content of the FMPs.¹⁶ DL 701 includes the classification of lands preferentially suitable for forestry (APF)¹⁷ as the base upon which a whole structure of incentives for afforestation is built, aiming at rapidly increasing the area of planted forests. The incentives stipulated in DL 701 can be summarized in three categories: (a) those that guaranteed the right to property and assured that APF lands would not be expropriated (APF should be demonstrated with a technical qualification study, approved by CONAF); (b) tax-related incentives, which granted an exemption on land tax to territories that had subsidized plantations; and (c) financial incentives, which granted plantations established in APF land a 75 percent bonus of the net afforestation costs for one-time only on the same area. The structure and regulation of DL 701 establishes that private landowners must reforest after each forest harvest.

DL 701 was amended in 1998 by Law 19,561 aiming to encourage afforestation in degraded areas, especially by small forest owners, to protect fragile and degraded soils and encourage soil remediation practices. This legal amendment incorporated two types of incentives: (1) smallholders bonus for afforestation and management preferably planted in soils of forest character; and (b) bonuses for

afforestation, land reclamation, and/or dune stabilization in fragile soils, Ñadis or desertification process in degraded soils with slopes greater than 100 percent. The aim of the amendment was to achieve greater integration of small- and medium-sized landowners to the benefits derived from forestry development, as well as to encourage the protection and recovery of eroded soils, and modernize the bonus system management procedures.

Since December 31, 2012, the incentive system term has expired (Article 12 of DL 701), and afforestation and other activities carried out from January 1, 2013 are not subject to fiscal incentives.

Law N° 20.283 on Native Forest Recovery and Forest Development (LBN) issued in 2008 regulates the use of the native forest and promotes sustainable forest management. LBN establishes: (a) the management plan as the main regulatory instrument for the sustainable use of the native forest; (b) incentives for the management of timber production, nontimber production, and preservation under the Conservation, Recovery and Sustainable Management of the Native Forest Fund (FCBN); and (c) research support through the Native Forest Research Fund (FIBN). With the development of the LBN, the government formed an ad-hoc commission to negotiate between key actors (including industry and nongovernmental organizations) to seek consensus on the future of native forests. The proposal that emerged allowed a degree of forest conversion (25 percent of the areas with less than 45 percent slopes), offered incentives for its management (which the 1931 Forest Law did not do), and provided support for small- to medium-sized owners (addressing social equity, unlike DL 701).

Law 18.362 of 1984—Law of the State Protected Areas—governs the creation of SNASPE administered by CONAF. This system is composed of three types of territories: national parks, national reserves, and national monuments.

3.3. Policy framework

Chilean forestry development has been founded on a long-term public-private alliance that supported the expansion of plantations for commercial purposes, while native forests have received far less policy attention. Initiated with the aim to recover millions of hectares of degraded soils, resulting from the systematic destruction of native ecosystems between the eighteenth and the mid-twentieth century, the Chilean forest policy has been focusing on exotic fast growing plantations, promoted by the state and executed by private entrepreneurs. The forest plantation extension policy resulted in supplying a successful export-oriented forest industry, whose ownership is highly concentrated. However, the expansion of plantations also has had negative socioeconomic and environmental impacts on local communities and indigenous peoples, resulting in growing inequalities and conflicts at the local level (Reyes and Nelson 2014). The Environmental Justice Atlas (ejatlas.org) shows as an active conflict the “Monoculture plantation in Araucania, Chile.” This report has been acknowledged by the OECD and ECLAC in their “Environmental Performance Review: Chile 2016 (OECD 2016).” Nonetheless, the Chilean Government is addressing this conflict through initiatives like the “Management Plan for Vegetation Resources in Indigenous Lands (PGRVTI),” which seeks to improve the quality of life of Chile’s indigenous peoples through the sustainable management of forest resources with an intercultural approach.

Box 2. Afforestation and pulp industry development prior to DL 107

The first afforestation and forestry development incentive in the country dates back to 1873, and continued later in 1931 with the adoption of the Forest Law that stipulated tax exemptions on private lands planted with forest species. The incentives of the Forest Law resulted in around 300,000 hectares of degraded soils being forested between 1931 and 1974, mainly with radiata pine (Prado 2015). This land became the foundation for the development of the national pulp and paper industry, particularly the forest areas in Concepción planted by Compañía Manufacturera de Papeles y Cartones and those of the Maderas Prensadas Pinos de Cholguán industrial complex, developed in 1953. CORFO played an active role in forestry development through the planning and execution of reforestation programs, forest inventories, forestry trials, cooperation agreements with

international organizations, and capital investments for industrial development. During the 1950s, this agency drew up a Forestry Development Plan that included the promotion and financial assistance of major forestry enterprises from individuals, the expansion of pulp and paper production capacity, and the promotion of an Institute for the Development of Forestry Resources and Industries that led to the creation of the Forestry Institute, INFOR. The pulp industry in Chile grew enormously with the construction of the Nacimiento Mill in 1964 and the Laja Mill in 1965. Consequently, in the mid-1960s, CORFO decided to promote, as a majority partner, the creation of two new pulp companies in areas with high poverty rates: Celulosa Arauco SA (1967), in the Biobío region, and Celulosa Constitución S.A. (1969), in the Maule Region. Both companies would end up being privatized in 1977 and 1979, respectively.

During the 1950s and 1960s, there is a milestone in terms of massive plantations with the establishment of several afforestation and reforestation programs. Since the mid-1950s, the country decided to face the problem of soil erosion and degradation through the development of extensive regional reforestation programs. One of the most emblematic programs was the Colchagua Plan, which sought to recover the most degraded lands and incorporate them into the economy of the area as the basis for the future implementation of forest industries. The program provided for the completion of reforestation agreements in association with agricultural owners that allowed planting approximately 40,000 hectares. The positive experience of this plan gave rise to the creation of the Reforestation Corporation, an institution that had a brief duration but a lasting impact. In 1970, its statutes were amended to give way to the CONAF, which was not only assigned the tasks of its predecessor, but others related to the protection of forests and the conservation of natural resources, including the management of protected wildlife areas owned by the state.

Source: Nazer (2009), Prado (2015).

The main policy tool that led to the rapid growth of forest plantations was DL 701, which established the legal framework for forest land or land preferentially suitable for forestry, and set forth promotion standards that boosted the growth of the sector. Aimed at the protection, expansion, rational management, and promotion of forestry activities, DL 701 triggered the active involvement of the private sector. It allowed shaping big industrial projects that were implemented in subsequent decades. Gradually, the favorable reaction of the private sector to the stimulus included by DL 701 transformed the afforestation efforts into a private sector matter.¹⁸ DL 701 achieved its objective of increasing forest plantations: between 1976 and 2013, the annual plantation rate, considering afforestation and reforestation, averaged over 100,000 hectares per year. Today in Chile, forest plantations cover close to 4 percent of the national territory, and represent just over 17 percent of the national forest land. DL 701 also achieved its objectives in terms of forest industry development: the increasing surface of fast-growing plantations supplied export-oriented forest manufacturers that gradually grew into a developed modern forest industry. However, it was recognized that it owed a debt to smallholders, so, as of 1998, Chile moved toward a more inclusive model. Law N° 19.561 in 1998 amended DL 701. Under the amended DL, the distribution of resources used by the state allowed for 38 percent of the bonuses to be awarded to small forest owners, a number significantly higher than the 5.8 percent achieved during the first period (1974–98) (Prado 2015). The incentive system was in force for almost 40 years before it expired in December 2012.

The industrial and commercial success of the Chilean forest plantation policy was enhanced by other measures that boosted the international commerce of Chilean forest products. Companies and public assets were privatized, trade liberalization occurred, and the regulatory role of the state was diminished (Niklitschek 2006). Trade liberalization was initiated in the mid-seventies and subsequently reinforced during the period of *Concertación* governments, which created a development model based on natural resource exports (Leight 2008). To facilitate this process, between 1990 and 2009, more than 45 free trade agreements or economic complementation agreements were signed with countries or groups of countries around the world, converting Chile into one of the most open economies in the world for international trade (Reyes and Nelson 2014).

Table 2. Outcomes from the plantation extension policy

Level	Outcomes	
	Positive	Negative
Socioeconomic outcomes		
State	Increase in GDP Export earnings Employment Lower timber prices	Economic concentration Monopolistic behavior Low wages Unequal distribution of benefits and costs
Regional/Local communities	Business opportunities	Health problems associated to water pollution (pesticides) Death of livestock, poultry, and bees (pesticides) Difficulties trading native timbers (dumping) Isolation of rural population Lower Human Development Index (at a municipal level)
Environmental outcomes		
Global	Carbon sequestration	Biodiversity loss
National	Soil protection	Loss/degradation of native forests
Local		Pollution Adverse effects on water supply Erosion related to large clear cuts

Source: Adapted after Reyes and Nelson (2014).

In contrast with forest plantations, native forests have received far less policy attention, as they were not seen as a potential source of export earnings. DL 701, while promoting afforestation, also tried to regulate native forest management through requiring an FMP before harvesting a forest stand. This has been the main policy and legal requirement governing native forests for more than 40 years; yet, most wood harvesting operations and markets are outside the current regulations (Lara et al. 2016). The failure of the policy to stem the increasing loss and degradation of native forests pressed politicians to initiate policies aimed at improving native forest management. LBN, passed in 2008, introduced economic incentives for the sustainable forest management of native forests through subsidizing silvicultural activities (thinning, pruning, etc.). The effectiveness of this policy is, however, debatable. Between 2008 and 2018, only 15,150 applications for management plans were approved for an area of 220,367.91 hectares; that is, only 2 percent of the country's potential.¹⁹ Only 28 percent of the awarded projects have been granted the subsidy payment, whereas the annual subsidies amount—in comparison with the total awarded through tenders—only reaches 16 percent.

Chile's forest policies in the last decades resulted in meaningful economic, social, and environmental outcomes (Table 2). The policies contributed to a strong increase in the afforestation rate and wood supply for a modern developed forest industry that proved a huge economic success. But this economic wealth has been unevenly distributed,²⁰ to some extent triggering market distortions that were not favorable to small and medium producers, especially manufacturers using wood from native forests. Different studies also revealed issues related to the isolation of local communities (Catalan and Ramos 1999), water pollution associated with the use of pesticides (Gerber 2011), and negative impacts on livestock (Montalba-Navarro and Carrasco 2003). The positive environmental outcomes are significant in terms of carbon sequestration and soils stabilization, but there are also negative environmental outcomes. In many areas, the exotic plantations replaced native forests (Donoso and Otero 2005) with consequences in terms of biodiversity loss, although it has been estimated that less than 10 percent of forest plantations replaced native forests (Donoso and Otero 2005). The use of agrochemicals generated soil and water pollution (Clapp 1998), while large clear-cut areas affected water supply, especially in summer (Quintana and Aceituno 2012). Moreover, it seems that the plantations are not really reducing the pressure on native forests by providing the vast majority of the industrial wood supply, as long as there is a huge local demand for firewood that is still satisfied from native forests, mostly in an informal manner (Lara et al. 2016).

In this context, the CFP elaborated, after one year of analysis and debate, the Chilean Forest Policy 2015–35. The new programmatic document takes into consideration the present achievements and issues

of the forest sector and aims at a generous vision, including: (a) forest plantations complying with world-class environmental standards, adjusted to regional and local conditions, especially regarding their silvicultural practices according to production objectives and their relationship with the surrounding communities, and (b) native forest effectively incorporated into sustainable forest development and the rural economy, significantly participating in the generation of wealth at the national and regional level, increasing the indicators associated with a managed surface, in the generation of employment and products of high economic, social, and environmental value (Box 3) (CFP 2015).

Box 3. General objectives of the Forest Policy 2015–35

1. **Forest institutions:** Establish a public forestry institutional framework in accordance with the strategic importance of the sector, organized and comprehensive, endowed with financial resources, professional and operational capacity for the management and implementation of forestry policy and its orientation toward sustainable forestry development.
2. **Productivity and economic growth:** Promote forestry, industrialization, and the full use of forest resources, so that they contribute to increased productivity and the production of goods and services, as a significant contribution to the economic and social development of the country.
3. **Social inclusion and equity:** Generate the necessary conditions and instruments so that forest development reduces social and technological gaps, improves the conditions and quality of life of forest workers and their families, and respects the tradition and culture of rural communities and indigenous people who inhabit or are embedded in forest ecosystems.
4. **Protection and restoration of forest patrimony:** Conserve and increase the country forest heritage, develop environmental goods and services, and restore and protect the biodiversity provided by forest resources and ecosystems.

Source: CPF (2015).

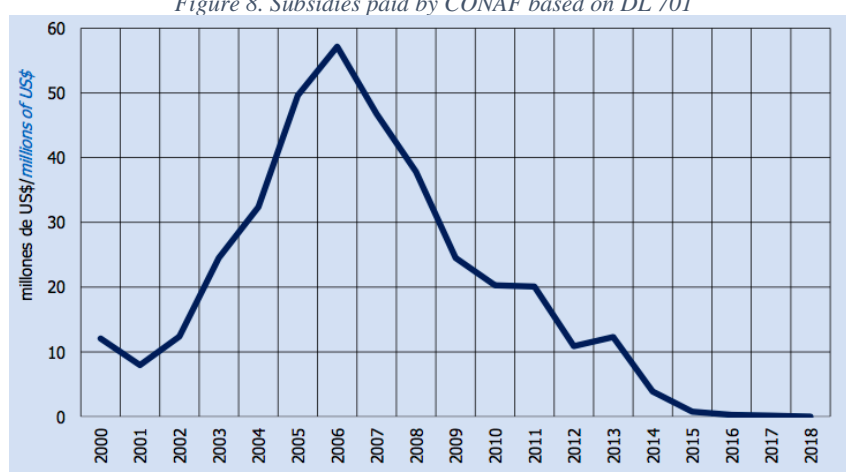
Chile ratified the Convention on Biological Diversity (CBD) in 1994 and committed to biodiversity management through the preparation, approval, and submission to the CBD of its Biodiversity National Strategy in 2003. An updated version of the strategy was published in 2016 (NBS 2016). It emphasized the importance of native forest sustainable preservation and management, as it hosts an important part of the country's biodiversity.

In order to comply with national and international commitments in the fight against climate change, desertification, land degradation, and drought, the Ministry of Agriculture has developed the ENCCRV (see Annex 6). Resulting from a broad participatory process, the ENCCRV is a public policy instrument in the field of Chilean native vegetational resources that guides and integrates the activities and measures to be adopted as a country for mitigating and adapting to climate change, as well as combating desertification, land degradation, and drought. ENCCRV is led by CONAF's Climate Change and Environmental Services Unit (UCCSA) and comprises a total of nine strategic actions designed to address the key drivers of deforestation, forest degradation, and barriers to the enhancement of forest carbon stocks that are implemented through sixteen enabling and twelve direct mitigation measures.²¹ This strategy has allowed Chile to become an international pioneer by obtaining results-based payments from the implementation of REDD+ activities that enabled the country to assess the carbon sink environmental service provided by forests, such as the Emission Reductions Payment Agreement (ERPA) from The Carbon Fund under the Forest Carbon Partnership Facility (FCPF) and the Green Climate Fund (GCF), reaching some 12.7 million tons of CO₂eq between 2014–16 due to the reduction of emissions from the degradation of the native forest. At the outset, ENCCRV focused on five of the country's most forested regions where GHG emissions from deforestation and forest degradation were the highest: Maule, Biobio, La Araucania, Los Rios, and Los Lagos. This area covered about 15.3 million hectares and represented the GHG accounting area of the ERPA. It is expected to have a transformative impact on Chile's policies, regulations, and practices associated with the management of the country's native forest resources (WB 2018).

3.4. Fiscal framework

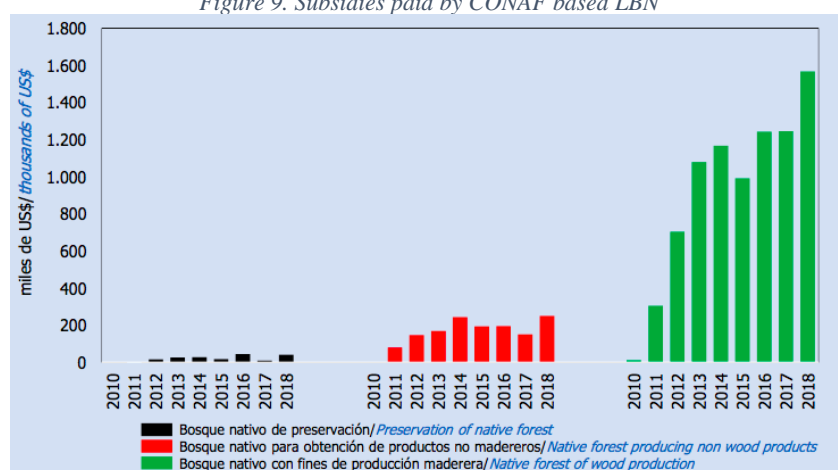
CONAF is the main entity through which the state is financing the management of country's forest resources. Due to its legal structure (as a private nonprofit organization, through which the Chilean State contributes to the development and sustainable management of the country's forest resources), CONAF financing heavily relies on the Fiscal Budget Law. According to the 2020 Budget Law, CONAF receives financing for five programs (DIPRES 2019): Forest Fires Program (\$42.6 million), SNASPE (\$24.8 million), Forest Management (\$26.3 million), Urban Forestation Program (\$2.0 million) and Employment Program (\$3.1 million). In the Forest Management Program, additional operational income might be added through the application of fees considered in the Supreme Decree N°66 of 1992, which set rates for actions and inspections that must be performed by CONAF and, additionally, income gained by the collection of entrance fees to CONAF's estates. The Budget Law for the year 2020 estimates CONAF's operational incomes at \$3.8 million.

Figure 8. Subsidies paid by CONAF based on DL 701



Source: INFOR (2019).

Figure 9. Subsidies paid by CONAF based LBN



Source: INFOR (2019).

CONAF is also the entity in charge with implementation of subsidy systems included in DL 701 and LBN. In the last 20 years, the level of amounts paid by CONAF for DL 701 established subsidies varied within wide limits (**Error! Reference source not found.** and 9). The Conservation Fund established by L

BN is charged in the 2020 Public Budget Law (DIPRES 2019) with \$2.2 million to be executed through CONAF.

3.5. Management of forest plantations

Forest plantations are managed using highly intensive silvicultural practices, chemicals, and large-scale and mechanized harvesting for pulp and other wood products for export. Radiata pine in Chile is managed as monoculture plantations, and management practices vary considerably according to factors such as final product, site, and ownership (Jelvez et al. 1990). Two silvicultural regimes—pulp-oriented and clearwood-oriented—are typically applied to radiata pine plantations owned by forestry companies. For pulpwood, the stands are established with 1,600–2,500 trees/ha, thinned once, and cut when they are between 18 and 25 years old, yielding 350–800 m³/ha with about 800–1,000 trees/ha. For roundwood, stands are planted with 1,200–1,300 trees/ha, pruned two or three times to maintain a clear bole up to 4–6 m, generally thinned twice, and finally cut between 20 and 24 years, yielding 450–600 m³/ha from 450 trees/ha. In both regimes, plantation establishment is highly intensive, and the final cut is only through clear-cutting. However, there are almost no limitations to the size or slopes where clear-cuts are done, which produces large clear-cut areas in the landscape of up to 499 ha (Salas et al. 2016). In contrast to radiata pine plantations owned by forest companies, plantations owned by small landowners are mostly unmanaged (Gerding 1991) and therefore best suited to produce pulp logs. *Eucalyptus* species are largely used for pulp, and therefore they are neither thinned nor pruned. They are usually harvested around 14–15 years, with growth rates of 30–40 and 40–50 m³/ha/year for *E. globulus* and *E. nitens*, respectively (Geldres and Schlatter 2004; Muñoz et al. 2005).

Due to the commercial orientation of forest plantations in Chile, voluntary forest management and chain of custody certification gained increasing interest and rates of adoption in the last decade. Chile has developed and implemented its own certification scheme, known as CERTFOR. It was established in 2004, benefiting from the involvement of important public and private institutions in the country: CORFO, the Chile Foundation (*Fundación Chile*), and INFOR. CERTFOR has been internationally endorsed by the Programme for the Endorsement of Forest Certification (PEFC). The principles of CERTFOR are described in Annex 7. Presently, CERTFOR-PEFC records indicate a total of 1.31 million hectares of forest plantations certified throughout the country, which represents 61.5 percent of the total. Another certification scheme that has a solid presence in Chile is the Forest Stewardship Council (FSC), with 1.55 million hectares certified in Chile, which means that 72.4 percent of the Chilean forest plantations comply with FSC standards. In 2018, FSC also carried out the first certification of ES provision in the country. Both certification schemes also provide CoC certification. Both certification schemes in Chile have promoted legal compliance; FSC certification is encouraging improvements beyond legal compliance, and deepening the changes initiated by CERTFOR (Tricallotis et al. 2018). There is no certified management of native forests.

There are significant impacts of certification in the plantation forestry sector and for larger businesses. These impacts include rehabilitation of natural ecosystems, greater benefits to local communities, and the development of a positive dialogue between forestry businesses and their stakeholders. However, certification has not resolved some long-standing conflicts between forestry businesses and other actors, notably in relation to indigenous peoples' land claims and workers' rights (Tricallotis et al. 2018).

The expansion of forest plantations in Chile relied heavily on the contributions of forest research and innovation. A solid knowledge base was built within INFOR since the 1961 FAO project, including demonstration plots that were fundamental to the development of the new plantations. INFOR was a pioneer in developing intensive silvicultural approaches for forest plantation management by establishing methods for seed selection and management, as well as techniques for plant nursery and plantation development.

Silvicultural management practices have been continuously evolving from the establishment of the first plantations in the 1960s, inducing a wide progressive application of innovative site preparation techniques including fertilization, ripping, and other procedures that are ensuring high productivity, especially in the second rotation. Research programs for genetic improvement have been essential in improving the productive capacity of exotic species. Most of the efforts in the field have been focused on fast-growing species, such as pines and eucalyptus trees due to their commercial and industrial importance. Genetic improvement techniques have been mostly applied by companies in the sector looking not only to increase tree growth, but also to improve the quality of the timber produced, and resistance to pests and diseases, among other properties. In general, about 95 percent of planted forests in Chile come from improved genetic material (CONAF-FAO 2011) obtained in high-tech nurseries, allowing the insolation of seedlings. Eucalyptus plantations, which were previously managed through sprout regeneration, are currently reforested with genetically improved plants. INFOR is responsible for the Forest Plantation Continuous Update Program, which is one of the oldest projects of the Institute, dating back to 1979–80.

After more than forty years since plantation-based forestry was first established, there is still a lot to be learned. Maintaining productivity in the long run; the impact of new harvesting practices; the use of waste in energy generation and its effect on long-term productivity; the impact of plantations on water resources; the social impact of plantations; and the impact of climate change on plantations are some of the key issues of a new era of national forest research that will allow Chile to take a significant leap in terms of forest sector knowledge. Some of these issues are clearly within the state's responsibility, while others fall within the domains of companies and universities, which are jointly strengthening their research capacity (Prado 2015).

3.6. Management of native forests

From the forest management perspective, Chile's forest sector is uneven, with important differences between forest plantations and native forests (Donoso and Otero 2005). Forest plantations are intensively managed, whereas natural forests are often mismanaged and selectively harvested,²² mainly yielding firewood (Donoso and Otero 2005; Frene and Nunez 2010)

Only small areas of native forests have undergone silvicultural treatments, especially thinning of second-growth forests and selection cuttings (Salas et al. 2016). One reason might be the fact that natural stands have been subject to unregulated cuttings (sometimes illegal) of the best trees, and therefore require further economic investment to become potentially productive units through thinning, supplementary planting, and other restoration activities (Salas et al. 2016). This economic investment could be done mostly by forestry companies, but is much more difficult for small landowners, given that there is a lack of suitable policy initiatives to support this long-term investment and the market for natural forest products is not as well-developed as it is for plantations.

Although a good amount of silvicultural research has been conducted in relation to native forests, the research results are applied only in small areas. The native forest silviculture research was oriented toward second-growth stands of roble-raulí-coigue, lenga, and evergreen forests, but only small areas have undergone silvicultural treatments, especially thinning of second-growth forests and selection cuttings (Salas et al. 2016). Natural stands of roble-raulí-coigue are silviculturally important because of their high timber value and good growth rates. Research also has been conducted regarding the use of native species for plantations. They are focusing on roble, raulí, and coigue, considered as being promising species for plantations. In the last 30 years, some research trials with plantations of these species have been established; during the last 10–15 years, commercial plantations have been established as well (Salas et al. 2016). More research is needed to face the challenges arising from native forest degradation, intended implementation of sustainable forest management, as well as related to their climate change adaptation potential.

3.7. Biodiversity conservation

With rich biological diversity, Chilean forest resources are a key component of a long tradition of PAs establishment and management. Although the richness of species and the degree of endemism are heterogeneously distributed throughout the national territory, in the forested central and southern zones of the country there is an unusual concentration of endemic species.²³ This explains why this zone was classified as one of the 35 global hotspots for biodiversity (Mittermaier-Russel et al. 2004), as well as one of the regions with the most threatened forest ecosystems in the world (Olson and Dinerstein 1998). More than 29 percent of the Chilean native forests are part of the SNASPE. With the first biodiversity protection initiative dating back to 1907,²⁴ Chile witnessed a process of protected areas establishment and biodiversity conservation initiatives implementation that resulted in the adoption of the Law N° 18.362 in 1984, which defined the objectives and structure of the current SNASPE. Native forests are a critical component of biodiversity conservation due to their original diversity, the complexity of their ecological processes, and functional interrelations with ecological, visual, cultural, and perceptual characteristics of the territory (NBS 2016). In the central and south-central zones, there was significant pressure to replace native vegetation with forest plantations (NBS 2016). In the last decade, in the context of the implementation of the management certification schemes and the Law N° 20.283, this pressure has significantly lessened.

The total area of SNASPE is a little over 21 percent of the national territory,²⁵ and the conservation objectives are complex. SNASPE covers an area of over 18 million ha, 4.1 million of which are native forests. According to the present regulatory framework, besides biological diversity conservation, SNASPE provides an effective degree of protection to forest ecosystems and the environmental services they provide, including their functions as reservoirs for carbon and biological diversity, as well as areas of natural and scenic beauty that allow for the development of recreational activities. SNASPE is also an important contributor to the conservation of the country's identity and cultural diversity, given that in many of these areas there is a significant presence of indigenous peoples.

Box 4. Types of protected territories in Chile

- **National Parks (41 units; 13,193,676 ha):** *Large areas with unique environments and habitats and representative of national biodiversity, which have remained virtually unchanged by human action and possess the ability to be self-perpetuating. Its species of plants and wildlife also have great importance and interest for science and education. The purpose of the national parks is to preserve these environments and remain compatible with educational, research, and recreational activities.*
- **National Reserves (64 units; 5,388,733 ha):** *Tend to be smaller than national parks, where conservation and care is necessary because of the danger that this unique environment may suffer irreparable changes and damage the environment and welfare of the community.*
- **Natural Monuments (18 units; 34,356 ha):** *Small and specific areas around a geographic place of great archaeological, cultural, or natural importance surface. They are characterized by the presence of unique geological or native species of flora and fauna sites.*

Source: Law N° 18,362; INFOR (2019).

CONAF administers the national system of protected areas, although their institutional and regulatory framework is under revision. In 2010, with the modification of the Environmental Framework Law (Law No. 20.417 / 2010), the environmental institutional framework was profoundly reformed, creating the Ministry of the Environment, the Environment Agency, and the Environmental Assessment Service. The law also mandated the creation of the Biodiversity and Protected Areas Service and the National System of Protected Areas. The latter institution will be in charge of the conservation of biodiversity and the administration of the integral management of the country's protected areas.

While the state has been the main driving force for the establishment of PAs, over the last three decades the private sector also has made important efforts to safeguard the country's critical ecosystems. Private PA initiatives are well known in Chile. The Conservation Land Trust initiative

concluded in March 2017 with the donation to the state of 407,625 hectares of land, which allowed for the creation of the Network of National Parks of the Chilean Patagonia, which were ultimately incorporated in 2019 under CONAF's administration. To promote conservation by private individuals, in 2016 Law N° 20.930 was enacted, establishing a voluntary mechanism that allows the owner of a natural area to conserve the natural capital of his property. As of 2017, according to the records of MMA, 246 private conservation initiatives (PCI) have been established, adding another 1,258,120 hectares to the country's conservation efforts, representing close to 1.5 percent of Chile's insular and continental territory. PCIs are focused in the southern parts of the country, with 82 percent of them located in four regions: Magallanes and the Chilean Antarctic, Aysén del General Carlos Ibáñez del Campo, Los Ríos, and Los Lagos. In addition, a contribution to the protection of biodiversity is also made by the 33 conservation initiatives of indigenous peoples, which cover an area of 257,412 ha (NBS 2016). Other national and international conservation organizations have also engaged in the protection of wildlife areas, Chile being also part of several important international agreements.²⁶

Chile's national parks and wildlife areas also contribute to ecological and cultural tourism, one of the fastest growing economic activities in the country. In 2017, this sector generated \$3.1 million from incoming tourism alone, equivalent to 3.3 percent of national GDP, and employed more than 346,000 people. Of this total, the highest income segment was produced from adventure and nature tourism, with official PA as its main attractions. In the 2017–18 season, the country's PAs combined reached a record 3.41 million visitors, 13 percent more than the 2016–17 season.

3.8. Monitoring of forest resources

Assessing and quantifying forest resources has been one of the priority tasks of Chile's forestry policy since the 1990s. In 1994, the CERVN project was initiated, aimed at compiling a cadaster of land uses and vegetation cover for the entire country, with a special focus on native forests, forest plantations, and secondary forests, thus establishing a baseline of cartographic information for the vegetation resources of each region, province, and county in the country. The registry is periodically updated by CONAF through a continuous process of generating new maps for each of the country's regions by using satellite images with continuously increasing spatial resolution, with the purpose of monitoring land-use changes between measurement periods and identifying their causes. This has allowed for the creation of regional registries with a minimum cartographic unit of 0.5 hectares for the forest use class. This approach has established the registry and its updates as an essential digital cartographic support system that provides data on the location, distribution, size, structure, and state of vegetation resources for Chile's different ecosystems. It has proven to be an essential decision-support tool for the government, providing key data to inform public policies related to the management of forest resources and the environment. The cadaster also is a key tool for the compilation of Chile's national greenhouse gas inventory to the UNFCCC.

Since 2000, Chile also created a permanent National Forest Inventory to continuously monitor the country's forest resources and ecosystems. Under the responsibility of INFOR, the main function of this tool, known as the Continuous Inventory of Forest Ecosystems of Chile, is to periodically measure and assess a set of key taxometric parameters in permanent plots, distributed between the Coquimbo and Magallanes regions. The first cycle of the inventory took place between 2001 and 2010 and included the baseline measurements and the first update. INFOR currently runs the inventory in four-year cycles, measuring 25 percent of the plots each year, and projecting the remaining 75 percent. In addition, INFOR is responsible for collecting economic and industry statistics with the objective of generating strategic data and information that is relevant to both public and private actors engaged in the forest sector.

INFOR is keeping accurate records on policy implementation, especially DL 701 and Law N° 20.283. Statistical yearbooks of forestry are published annually, containing all information that is collected and monitored by CONAF, INFOR or other state data processing institutions, including macroeconomic indicators related to forestry, forest resource data (including the financial information regarding the DL701

and LBN incentives implementation and SNASPE data), roundwood consumption and forest production, international trade, forest product prices, forest product transportation, future wood availability from plantations, and forest employment. (INFOR 2019).

Since 2014, Chile has established an Integrated System of Monitoring and Evaluation of Native Forest Ecosystems (SIMEF), a digital platform for integrating all forest monitoring data. With the international support of the Global Environment Facility (GEF) and FAO, the platform seeks to integrate and provide access to data from various sources on the state and evolution of Chile's native ecosystems.

4. Forests' Contribution to Livelihoods and Sustainable Development

4.1. Economic contribution of forests

4.1.1. Direct economic contribution of forest sector

The forest sector accounts for 2.1 percent of the country's GDP (INFOR 2019). The forest sector is the third largest exporting sector in the country, and is largely based on forest plantations of radiata pine and eucalyptus (Salas et al. 2016) supplying 99 percent of the country's forest industry (INFOR 2019). In the 1970s, the significance of the forest sector in the national economy was secondary. Today, however, it has become one of the most relevant economic activities in the country. The uneven distribution of forest resources is reflected in the forest sector's contribution to regional GDP based on soil and climate conditions. In the Biobío, Maule, and Araucanía regions, the forest industry makes a greater contribution to regional GDP; for example, in the Biobío region it accounts for 15.8 percent of the regional GDP. In other regions (e.g. Metropolitana and Valparaíso), the contribution to regional GDP is under 1 percent. Among the subsectors, the pulp and paper industry contributes more to GDP, accounting for 40 percent of the forest sector contribution. The sawn timber industry, the subsector that is next in importance, has a 31 percent share, while silvicultural activities account for 23 percent, and the furniture industry for 6 percent (INFOR 2019).

Thanks to the investments made, forestry has added much more value to the national economy than the average of the industrial sector. Between 1970 and 2014, the national industry growth rate was 1.8 percent. The growth rate of the forest industry was 5.3 percent, 2.86 times more than the industrial total (CORMA 2014). This figure shows how the forest sector, due to value-added dynamics, decoupled from the growth rate of the national industry. According to figures from the Chilean Wood Industries Association (CORMA), more than 80 percent of the investments are allocated to pulp production, wood panels, and veneer production, activities associated with a greater added value, reinforcing the industry trend where products with a higher added value have surpassed other products, such as logs and woodchips (CORMA 2014). Chilean forestry investments in industrial assets—supplementary works in industrial sites, roads, infrastructure works, ports and, recently, power plants—often exceed in magnitude those of other sectors of the economy, placing the forest sector among the most significant economic-industrial activities of the country along with mining. The pace of investment has decreased in intensity in recent years, mainly because the country has reached a turning point in terms of its capacity to continue expanding planted forests.

4.1.2. Job creation

The forest sector has been an important source of employment for the country. In 2018, direct employment in the sector reached a total of 113,769 jobs, which accounts for approximately 1.5 percent of national employment (INFOR 2019). Employment is significant in the Maule, Ñuble, Biobío, and Araucanía regions, which, on average, account for over 70 percent of forestry employment. Additionally, the forest sector creates approximately 300,000 indirect jobs through production chains with other sectors

of the economy. Outsourcing is a common practice in the forest sector, with numerous thriving service companies in the country that work for leading forestry companies in silviculture, harvesting, sawmilling, industrial processing, and pulp manufacturing (CORMA 2014).

Direct employment is evenly distributed in the forest subsectors. About 31.3 percent of forest industry employment is produced by the primary industry, 26.3 percent by the secondary industry, 22.4 percent by other silvicultural activities, and 20.1 percent by forestry and harvesting. In terms of the distribution of workers in tiers, 84 percent are operators, a little over 15 percent are supervisors and maintenance personnel, and only 0.5 percent are executives (INFOR 2019). Regarding the staffing of private sector companies, a little more than 78 percent of workers belong to contractors, and the remaining 22 percent to their own staff, located mainly in plants or factories.

In recent years, the employment rate of the Chilean forest sector has decreased gradually. After a steady growth from 1995 to 2006, when it reached a record 136,478 workers, with a growth rate of 8.4 percent, forest sector employment decreased between 2006 and 2018. For instance, in the silviculture field the workforce contracted from 41,227 to 22,834 jobs during the last nine years (INFOR 2019). Compared to other industries, forestry directly hires 0.02 jobs on average per million of Chilean pesos produced (national average is 0.04 jobs per million pesos). The decrease in employment levels in forestry can be largely explained by the introduction of technologies and automatization in virtually all subsectors, leading to the replacement of skilled workers by highly trained technicians.

Employment in the industrial sector is male-dominated; women make up only 4.7 percent of the workforce in the main value chain. Close to 64.5 percent of women in the industry work in nursery operations, and over 22 percent as production assistants.

4.1.3. Forest ecosystem services and the benefiting sectors

Scientific studies are revealing very important values of the ecosystem services (ES) provided by forests. There has been a general recognition that the country's forests—and especially its native forests—provide important environmental services that are used in different ways by society and are an important basis of their well-being (NBS 2016). Various productive sectors depend on such services: the mining sector, for example, heavily uses the water supply service; the livestock sector makes use of the water retention capacity of forests; and the tourism sector uses the value of nature as a landscape, recreational, and healthy living space.

In many respects, native forests are providing higher value environmental services than forest plantations. Different sources (Alvares-Garretón 2019) have found that the value of ES is greater in native forests than in forest plantations. For example, annual water runoff is highly sensitive to the relative area of forest plantations and native forests: ratios of forest plantations to native forest areas of 10, 50 and 90 percent would lead to a 3, 18, or 40 percent decrease in mean annual water runoff, respectively. This knowledge is relevant for decision making regarding mitigation strategies pledged in the Chilean NDC. Numerous studies appraise the environmental services provided by native forests (5), providing valuable information on the kind and magnitude of value that could be relevant in decision making concerning conservation and management of native forests in Chile.

Box 5. Native forests: ES valuation examples

- Studies done from the temperate rain forests in southern Chile estimated that timber benefits for secondary forests—expressed as net present stumpage values—were \$3,742 per ha and \$3,093 per hectare for sustainable forest management and unsustainable harvesting, respectively. Timber benefits for old growth forests equaled \$4,546 per ha and \$5,718 per hectare for sustainable forest management and unsustainable harvesting, respectively. Annual benefits from recreation were estimated between \$1.6 and \$6.3 per hectare. The annual value of maintaining soil fertility was estimated at \$26.3 per hectare, and the annual economic value of water supply for human consumption was estimated at \$235 per hectare.

- A study done for Llancahue basin, Los Lagos Region, estimated the contribution of forest ecosystems to water production at a value between \$74,971 and \$170,389 per hectare of native forest. It is estimated that the current protected areas contribute approximately 15 percent of the carbon sink service, compared to the rest of the Chilean ecosystems, and approximately 12 percent to the biodiversity refuge service.
- It is calculated that the value of the contribution of ecosystem services from protected areas in Chile to human well-being fluctuates between \$1,368 million annually and \$2,049 million annually.
- It has been estimated that the total economic value of the goods and services provided by native forests to society totals approximately \$16,000 million per year.
- Recent studies show that according to prioritization criteria, the net current value of afforestation activities with native species, and restoration and forest management of the native forest could reach \$3,955 and \$2,369 per hectare, respectively.

Sources: Nahuelhual et al. (2007), Nunez (2004), Figueroa (2010), Navaro Carcamo et al. (2010); CONAF-UCSSA (2018)

4.2. Domestic demand and supply – products

4.2.1. Industrial use of wood

The Chilean forest industry consumes approximately 48 million m³swb each year, 99 percent of which comes from planted forests. These large volumes of raw material have been mostly achieved as a result of the enactment of DL 701 in 1974, which fostered major investments, not only in the creation of forest heritage, but also in industrialization, transportation, marketing, and exports. Once the planted area increased, so did the availability of timber, and the industry expanded its existing capacity to handle the flows of different qualities of available timber. The largest forestry hubs are located in the Biobío region with 27.5 million m³swb, followed by the Maule region with 6.7 million m³swb, the Araucanía region with 5.5 million m³swb, and the Los Ríos region with 4.9 million m³swb (INFOR 2019). Most of the consumption of logs for industrial use occurs in the pulp industry, which participates with 36.8 percent of the total, followed closely by sawn wood with 34.8 percent. The other items where logs are consumed are chips without bark (17 percent), panels and veneers (10.2 percent), and posts and poles (0.7 percent). The 0.5 percent difference corresponds to the export of logs (INFOR 2019). These five items constitute the primary forest industry, meaning that industry where the first log processing is carried out.

Radiata pine is the predominant species consumed by the industry. In 2018, the consumption of this species reached 31.9 million m³swb with a 66.7 percent share in national consumption and an increase of 4.1 percent compared with the previous year. The second most important species are eucalyptus, mainly *E. globulus* and *E. nitens*, with a consumption of 15.3 million m³swb and a growth of 5.8 percent. Since 2000 the consumption of pieces of radiata pine has grown by 70 percent, while the consumption of eucalyptus has almost quadruplicated. The participation of other exotic species (0.7 percent), where Douglas fir stands out, fails to consolidate a growth trajectory, while the participation of native species (0.5 percent) decreases year by year (INFOR 2019).

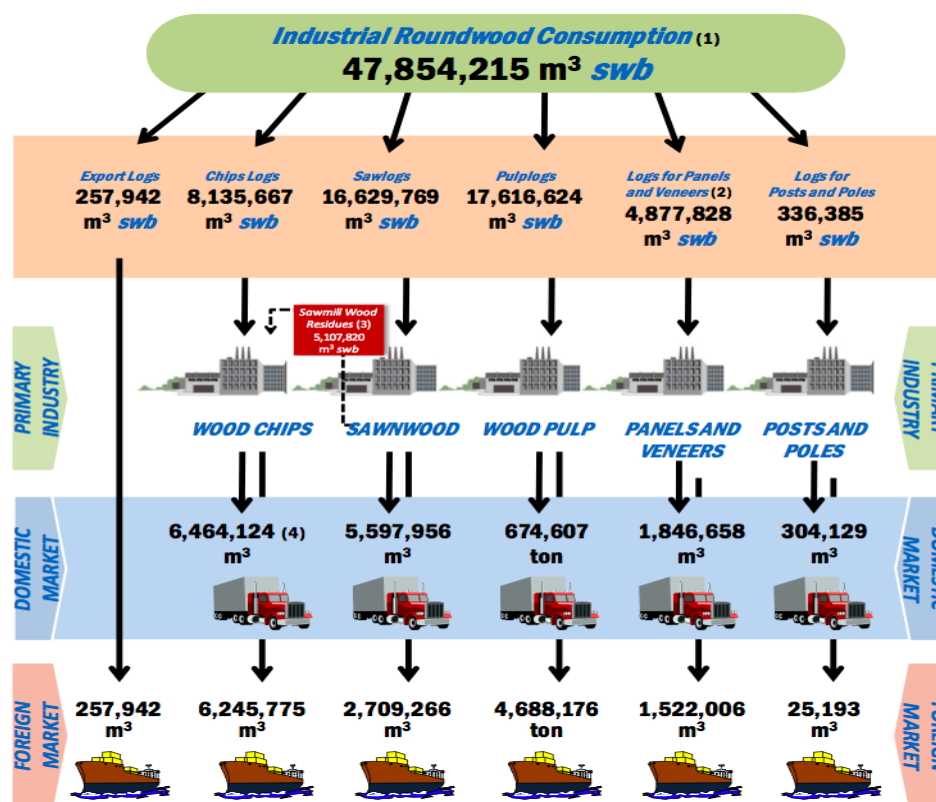
Table 3. Flow of the industrial use of native species wood in Chile

	Industrial roundwood consumption m ³ swb	Production		Destination	
				Domestic market (%)	Foreign market (%)
Natives species – total industrial consumption – 378,158 m ³ swb	212,190	Sawnwood (m ³ swb)	104,507	96	4
	47,968	Panels and Veneers (m ³ swb)	20,480	91	9
	118	Export logs (m ³ swb)			100

Source: (INFOR 2019).

The industrial use of wood from native forests is limited. Total native species volume used in the industry in 2018 equals 260,276 m³swb (212,190 m³swb in sawnwood, panels, and veneers production) (INFOR 2019) (Table 3). A total of 17 native species are constantly used for industrial purposes, primarily lenga, oak, and coigüe. Lenga accounted for 36.3 percent (37,961 m³swb) of the total in 2018, decreasing by 1.6 percent when compared with 2017. Oak participated with 20.5 percent (21,456 m³swb), increasing by 13.5 percent, and coigüe participated with 13.1 percent (13,709 m³swb). These three main species are followed by canelo, tepa, and raulí (INFOR 2019b).

Figure 10. Wood products flow (aggregated data), 2018



Source: INFOR (2019).

Notes: (1) Includes sawlogs and pulplogs. (2) Includes logs for boxes, bins, and matches and other similar products. (3) Refers to wood slabs and wood offcuts. (4) Wood chips for domestic market are divided into: 5,303,602 m³ are used for wood pulp industry, 463,063 m³ for panel manufacturing, 527,898 m³ for fuel, and 169,561 m³ are used for other destinations.

The Chilean forest industry operates as an integrated chain, from the nurseries to the destination markets. This vertical integration means that, broadly speaking, the industry has a low product multiplier effect; that is, the demand for intermediate products from other sectors is relatively small. However, the supply multiplier effect is present, since solid wood products, panels, pulp, and paper are present in the production chain of several industries other than forestry. The industry is progressively advancing toward a circular production system, with a high percentage of use of intermediate products to produce raw material, biomass for energy generation, and particle agglomeration (Gysling Caselli and Soto Aguirre 2016). The industry mostly tends to process its logs in very modern, capital-intensive facilities with high productivity (Box 6).

Box 6. Main primary industries of the Chilean forestry sector

- **The national saw milling industry is the largest in terms of production units, reaching a total of 1,056 operative sawmills in 2017.** Most of these are located in the Maule, Ñuble, Biobío, and Araucanía regions. In the 1940s and 1950s, when sawn timber production ranged around 600,000 m³swb per year, 90 percent of the raw material came from native forests. Today, due to the continuous supply of Radiata pine logs from the plantations, as well as the use of modern and improved technology at industrial facilities, there is a constant growth in the production of sawn timber, which is around 8.5 m³swb million per year. Consequently, native forests have lost importance, representing only a 9 percent share in overall sawn timber production. Until 1974, 90 percent of the sawn timber produced was destined for the domestic market. Now, 30 percent of the production is exported to 43 countries, with China in the lead with 21.6 percent, followed by South Korea, Japan, Mexico, and Saudi Arabia.
- **The pulp market is of great importance for Chile given its position as the world's fourth largest exporter.** Pulp represents more than 45 percent of forest exports, becoming the main product of the Chilean forest industry. The main markets are China, South Korea, the Netherlands, Italy, and Taiwan. The main products are mechanical and chemical pulp, newspaper, absorbent paper (tissue), and cardboard for packaging. Currently, the production of chemical pulp is 5.8 million tons per year, while the mechanical production of pulp is 575,000 tons per year, used entirely by the national industry, while 86.5 percent of the chemical pulp is exported. The production of printing paper, packaging paper, cardboard, and paper tissue is mostly for the domestic market; only 10 percent is exported. The Chilean pulp industry has 10 plants located in the Maule and Los Ríos regions, and two owners: Arauco SA, and Compañía Manufacturera de Papeles y Cartones. The latter is the largest producer of tissue paper in Latin America.
- **The board industry in Chile has undergone significant technological, productive, and commercial changes.** Today, the board industry offers a wide range of products with very specific and appreciated characteristics that have allowed it to create new markets, satisfy diverse needs, and in some cases be substitutes for solid wood. Although Chile's share of the world's production is low, industrial production of wood-based panels has historically been important to the country's economy. Exports of panels and sheets peaked in 2011, exceeding \$1.7 billion; medium density fiber (MDF) plywood and medium density panels (MDP) were the principal exports. The production of oriented strand board (OSB) is destined almost entirely for the domestic market, whereas 58 percent of plywood is exported. The combined production capacity of wood-based panels in Chile is around 4.1 million m³. Two OSB panel production plants and eleven structural plywood plants stand out, three of which are of frontier technology based on high-quality unwinding pieces of radiata pine.
- **The wood chip industry is the third most important in terms of consumption of industrial logs.** It is a relevant product for the paper and cardboard industry, although it is a production process with little added value. Wood chip production in 2017 reached a historical record of 7,566,397 m³, of which 5,804,100 m³ were exported to different markets, mainly to China. According to INFOR data, in 2017 194 chipper units operated in the country, most of them located in the Biobío region. Medium-sized companies dominate the market, but a significant number of small producers supply the largest exporters. By 2020 the conversion of a pulp mill—owned by the Chilean forestry company Arauco in Valdivia—to textile pulp will increase the consumption of eucalyptus chips by up to 1 million dry tons.

Sources: INFOR (1996), INFOR (2010), INFOR (2019).

4.2.2. Forestry exports

With more than 370 products that reach 126 destination countries, the Chilean forest sector is among the largest exporting industries in the country. In 2018, exports of forestry products accounted for 9.1 percent of Chile's exports, ranking third after mining and fishing and aquaculture (BCC 2019). The growth of the Chilean forest industry is reflected in the evolution of the volume of exports, which grew from \$2.37 million free on board at the port of origin (FOB) in 1995 to \$5.44 million FOB in 2015, an increase of 130 percent in 20 years. In 2018, the country set a record for its forestry exports, reaching \$6.84 million, an increase of 27 percent compared to 2015 (INFOR 2019). These figures place Chile among the top 20 leading exporters of forest products in the world. The main export destination is China (32 percent), followed by the United States (16.2 percent), Japan (7.6 percent), and South Korea (6.6 percent). In recent years, several countries from Southeast Asia are importing increasing amounts of Chilean forest products, especially Taiwan, Vietnam, and Malaysia. In Latin America, the main markets are Mexico, Peru, and Colombia.

The Chilean forest sector has not only achieved a strong increase in exports, but also in the degree of diversification. The main subsectors in forest exports are cellulose (chemical pulp) and sawn timber, which account for more than 60 percent of exports. In the case of sawn timber, until 1974 90 percent of the production was sold in the domestic market. However, state-of-the-art sawmills were established in Chile in the 1980s, which considerably increased their production, and made sawn timber an important export

product, reaching 30 percent of the exported volume; 96 percent is Radiata pine. Chile occupies a prominent position in the export of woodchips, a raw material traditionally used for making paper and producing energy as biomass. Nowadays, 5.7 million of the 7.6 million tons of chips produced in the country are exported, which represents 99 percent of the volume of woodchips from *Eucalyptus globulus* and *Eucalyptus nitens* (INFOR 2019). Chile also is a leading exporter of plywood and several types of paper (paperboard, newspaper, corrugated paper, wrapping paper, printing and writing paper), tissue paper product lines (toilet paper, paper towels, paper napkins, and facial paper), and sanitary products (diapers and sanitary pads). Other export products are moldings, planed wood, fiberboard panels, doors, and windows.

4.2.3. Biomass for energy

Forest biomass has significant potential to sustainably contribute to the decarbonization objective that the country established for 2050. According to the Ministry of Energy, in 2018 biomass contributed 2.1 percent (501 MW) of installed generation capacity in the National Electric System, which represents 11 percent (1,284 GWh) of the total injection of nonconventional renewable energy (CNE 2018). According to data from the Chilean Energy Commission, additional capacities of about 25 MW are under different stages of assessment, design, and construction.

In 2017, forest biomass contributed 24 percent to the country's primary energy matrix(CNE 2018). From an estimated²⁷ total of 13.1 million m³ (UACH, 2013) the predominant use of biomass is residential heating and cooking (67 percent). The remaining 33 percent is used as industrial fuel for thermal, electrical, and cogeneration. The same source estimates that 53 percent of the used fuelwood is originated from native forests. Chile is favorably positioned to continue promoting biomass development, due to the availability of forest resources from the sustainable management of native forests and forest plantations. Especially important is the development and use of biofuels in the decarbonization process of the national energy matrix. This goes beyond electricity generation, since the presence of this technology also has considerable power in industrial and residential demand, where the use of cogeneration plays a strategic role.

4.2.4. Nonwood forest products

NWFP have gained increasing importance in Chile's economy, with significant benefits for rural communities. A registry compiled by INFOR (Valdebenito 2013) found 480 NWFPs used and marketed by the rural population in Chile, 432 (90 percent) of which come from native forest species. Among the most relevant are species with medicinal properties and producing essential oils, edible fruits and mushrooms, ornamental species, and species producing fibers used for handicrafts. According to INFOR (2017), the commercialization of NWFPs is destined for the foreign market, but there also is some internal consumption, estimated at \$365 million/year. NWFP exports have maintained significant and sustained growth, reaching \$91.4 million in 2016 (increasing from \$12.7 million in 1990), with shipments to more than 50 countries and involving more than 200,000 rural inhabitants, with a high gender connotation, in nonpermanent jobs. The number of products grew from 12 to 50 from 1990 to 2016, with Europe (mainly Germany, Spain, and France) being the main destination, followed by the United States, Japan, and Taiwan. Brazil is the main buyer in Latin America.

4.3. Social dimension

Chile's indigenous peoples have had a close relationship with forests. In the north, the Aymara, Atacameña, and Diaguita cultures, with a clear influence from the Incas, used cultivation terraces for irrigation purposes, and fire to prepare their land and introduce domestic animals. In the south, the Mapuche—called Araucanians by the Spanish conquistadors—implemented an agricultural method that involved clearing an area of forest and cultivating it for two or three years, leaving it fallow for 15 to 20 years

subsequently, until the soil recovered its vegetation cover. Throughout their history, these peoples have also had a spiritual relationship with the forest and wildlife.²⁸

Presently, the successes of the Chilean forestry sector have not benefited most of the population (Salas et al. 2016). Although the plantation subsector contributes the most forest-based exports, it has not increased the quality of life where most of these plantations have been established (Donoso and Otero 2005). The regions with more forest plantations are the ones with the lowest Human Development Index values in the country (Donoso and Otero 2005). This context triggered a series of conflicts, and opposition to the forest plantation sector in different groups of Chilean society, including (a) small farmers and indigenous communities; (b) NGOs and environmental organizations; and (c) small and medium companies and workers' unions (Reyes and Nelson 2014). For example, the relationship between large forestry companies and the Mapuche has always been tense, with ongoing disputes about land rights and documented incidents of violence and protests (Salas et al. 2016).

4.4. Forests and Climate Change

In the context of Chile's high vulnerability to climate change, forest resources are playing an essential role. Forest resources are an important mitigation tool due to their capacity to capture carbon. They also are an adaptation strategy to limit the effects of climate change. Among other things, they contribute to the regulation of the water regime through rainfall stimulation and precipitation recycling, precipitation interception, and runoff regulation. They also help promote the conservation and protection of soils against erosion and the conservation of biodiversity.

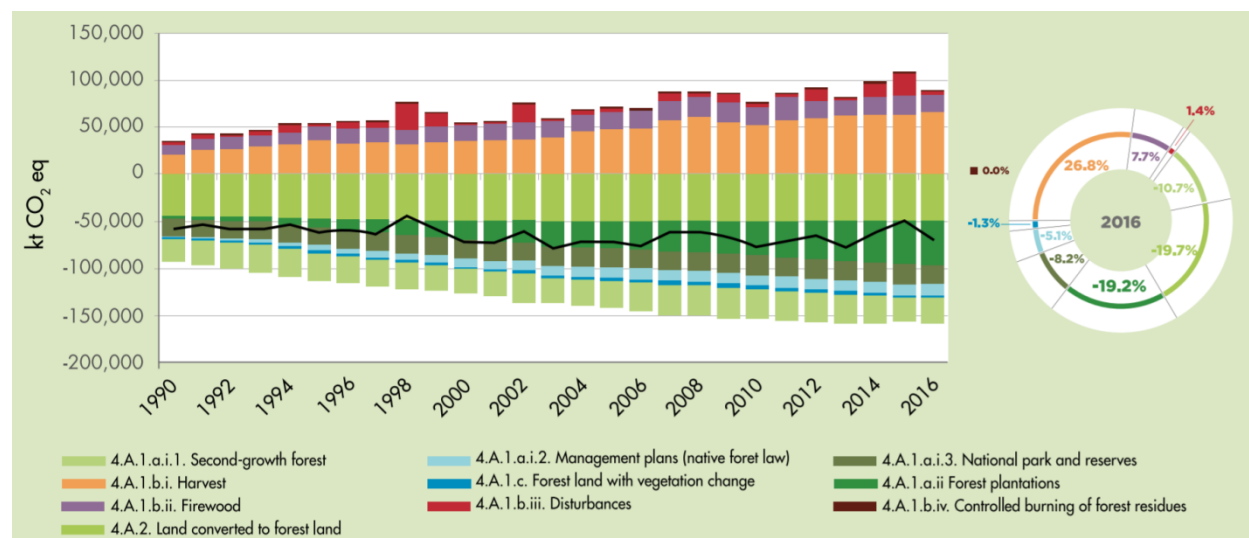
Native forests are the main source of greenhouse gas removal for climate change mitigation in Chile. The land use, land-use change, and forestry (LULUCF) sector helps neutralize a large part (62 percent) of the emissions produced by power generation, industrial processes, agriculture, and anthropogenic waste. The contribution to the reduction in emissions from all types of forests reached 69.65 million tons of CO₂eq. At a component level within this category, those contributing with the greater amount in GHG removal are the native forests—through the increase in biomass in renewables, parks, and national reserves—and forests with management plans (19.7 percent; 8.2 percent, and 5.1 percent, respectively) of the total GHG removal, followed by forest plantations that contribute both to the increase in biomass on forest land, remaining forest land, and on land converted to forest land (with 19.2 percent and 10.2 percent respectively) of total greenhouse gas removal (Figure 10). The most important GHG emissions come from harvested wood products with 26.8 percent followed by fuelwood with 7.7 percent. The contribution of plantations has been gradually decreasing, given that afforestation has not reached 2,000 hectares per year since 2012 (MMA 2018). These estimates show the importance of native forests in ecosystem services such as carbon capture and climate regulation.

The degradation of Chile's native forests has a significant impact on CO₂ emissions. Based on data from the Forest Reference Level (FRL) submitted to the UNFCCC, between 2000 and 2010 forest degradation affected 461,231 hectares, located mainly in six regions of the country (Maule, Biobío, Ñuble, La Araucanía, Los Ríos, and Los Lagos). This degradation generated an average total of 9,149,392 tons of CO₂e emissions per year (MMA 2018). Forest degradation thus produced much higher GHG emissions than those produced from deforestation. These emissions neutralize the absorptive capacity of the native forest sector, hindering its capacity to act as a net carbon sink. The degradation drivers are expected to continue in the future, leading to continued GHG emissions in the forest sector unless measures are taken to address them.

The impacts of climate change on forests in Chile are expected to be widespread and diverse, with some of them—notably the current megadrought and the recent megafires—already emerging. Chile already has been affected by the increased drought (see Annex 3). In the last decade there also has been a significant increase in the area affected by fires in most regions of the country.²⁹ The 2016–17 season, with 570,197 hectares burned, beat all records and was almost 10 times greater than average (7). During the

1998–2008 period, fires affected an annual average of 0.5 percent of the total planted area, while between 2008 and 2018 this figure increased to 1.5 percent average over the period (UTEM 2019).³⁰ For other land uses, these indicators were closer to 0.25 percent in the 1998–2008 period, and increased to 0.4 percent for native forests and grasslands, and 0.6 percent in the case of thickets for the 2008–2018 period. These numbers show that forest plantations have become increasingly prone to fires, compared to other land uses. This can be explained by the greater flammability of pine and eucalyptus trees compared to native trees, and the increasing homogeneity of landscapes dominated by continuous even-aged stands, with a higher forest fuel load compared to other land uses. The lack of firewalls is another factor that explains the vulnerability of the plantations, along with the homogeneous landscape.

Figure 11. Forest land: GHG emissions and removals (kt CO₂ eq) by its main subcomponents, 1990–2016



Source: MMA (2018)

In this context, for the 2019–20 season Chile engaged in the largest investment in its history to manage fires through the National Plan for Preventing and Fighting Forest Fires, with a combined private-public investment of around \$150 million and coordinated efforts among ministries, governments, agencies, security forces, and forestry companies. The program has 2,515 members available for firefighting, distributed in 238 squads between the Atacama and Magallanes regions, with an additional 3,400 members from the private sector.

Box 7. The impact of the 2017 Fire Storm

The European Union Civil Protection Mechanism described the forest megafires experienced by Chile between the months of January and February of 2017 as an “extreme firestorm.” The megafire reached category 6 intensity for the first time in the world with an ultrafast growth of 8,200 ha/hour (114,000 hectares in 14 hours) and exceptional heat intensities of over 60,000 kW/m. Extinguishing the megafire required 3,297 firefighters from CONAF and the Chilean Army, 64 aircraft, 43,000 m³ of water, as well as the construction of 590 kilometers of fire breakers. The Chilean Ministry of Finance estimated a total cost of \$350 million for the control of the forest megafire, including both the expense during the emergency and the reconstruction efforts.

The area affected totaled 518,174 hectares, 236,039 (45 percent) of which were in the Maule region. The affected area of forest plantations was 248,204 hectares, 228,904 ha (92 percent) of which were Radiata pine. The affected area of native forest was 91,745 hectares (18 percent), 17,719 ha of which were dramatically impacted, and 72,064 hectares (78 percent) of the *Schlerophyll* forest type. The impacted area with conservation status species reached 208,717 hectares. The most emblematic affected forest species was *Nothofagus alessandrii* (Ruil), which covered a total area of 350.8 hectares, 198.35 hectares (56 percent) of which were damaged. The total SNASPE affected area, under CONAF administration, was 154 hectares.

Source: UE (2017), CONAF (2017).

Chile has committed to real actions addressing climate change issues. In its NDC, Chile committed to the sustainable management and recovery of 200,000 hectares of native forests, representing GHG captures of around 0.9 to 1.2 MtCO₂eq annually by 2030. Also, it committed to afforest 200,000 hectares, of which at least 100,000 hectares will comprise permanent forest cover, with at least 70,000 hectares of native species. The forestry sector also has the potential to contribute to Chile's clean energy ambition as established in its Energy Policy 2050, since much of the energy used for heating purposes in the country comes from biomass and therefore has impacts in terms of climate change (GHG emissions) and health (pollution).

5. Challenges and Opportunities

The new social and environmental context poses new challenges for Chilean forestry to maintain its achievements and continue to grow in an inclusive and sustainable manner. The effects of climate change—with increasing temperatures and decreasing rainfall—are accelerating the desertification, land degradation, and drought processes, raising the frequency and intensity of forest fires, and therefore affecting the quality of life of hundreds of thousands of people, the future availability of timber, and otherwise impacting the country's ecosystems. At the same time, it is necessary to continue promoting the establishment of planted forests to recover eroded soils in marginal conditions through afforestation and landscape restoration incentives, together with protecting biodiversity and valorizing environmental goods and services from the forest. It is important to continue these efforts to enhance social and environmental performance, increasing the positive impact in pursuit of a more sustainable and inclusive development, addressing social challenges such as the relationship with local communities and native peoples in forest regions, the development of small- and medium-sized owners, and the recognition and promotion of greater female participation. This new scenario also entails the need to strengthen, modernize, and adapt forestry institutions so they align with the current national and global context, allowing for the industry to continue to grow and generate economic, social, and environmental benefits for the country, contributing to the generation of global public goods in line with international commitments and the Sustainable Development Goals, and achieving a worldwide positioning in regard to sustainability and forest development.

5.1. Pressures and threats from outside the forest sector

Although there are surfaces of forest that are affected by land use changes, the competition between forest land and other land uses is favorable to forests. The comparison between areas of land use change among different categories can provide an indication of the underlying competition in land use (Table 4). These data, extracted from the last National Inventory of Greenhouse Gases (MMA 2017), refer to the period 1990–2013 and indicate that the conversion of forest land (both plantations and native forest) to agricultural farmland reached an annual average of 1,303.1 hectares. On the other hand, the change in land use from farmland to forest is 25,037.9 hectares on average per year. The land use change from farmland to forest land is thus almost 20 times greater than the land-use change from forest to farmland. The category of land use change that exerts the greatest pressure on the other categories corresponds to forest land, especially forest plantations (72,022 hectares per year). The expansion of forest plantations is carried out mainly to the detriment of grasslands (39,690.6 hectares), agricultural farmland (24,761.6 hectares) and native forest (6,897.6 hectares) for the analyzed period (1990–2013).

Table 4. Land use conversion matrix (series 1990-2013) (ha/year)

Land use categories	NF	FP	AL	G	W	S	OT	TOTAL (-)
Native forest - NF		6,897.6	397.2	4,978.0	1.8	120.3	614.4	13,009.2
Forest plantation - FP	566.6		905.9	1,818.6	2.4	385.3	120.7	3,799.6
Agricultural land - AL	276.3	24,761.6		2,916.9	5.8	3,740.5	189.4	31,890.4
Grassland - G	5,148.6	39,690.6	8,352.9		213.3	1,647.7	2,221.0	57,274.1
Wetland - W	4.7	238.5	80.3	100.4		42.1	29.2	495.1
Settlements - S	0.0	1.5	4.5	0.0	0.0		17.0	23.0
Other land - OT	27	432.2	160.0	3,162.7	94.3	158.7		4,034.9
TOTAL (+)	6,023.2	72,022.0	9,900.8	12,976.6	317.7	6,094.6	3,191.7	107,442.8

Source: MMA (2017)

The energy sector—especially the use of biomass for heating and cooking—is putting significant pressure on native forests due to the informal character of fuelwood harvesting from native forests. Chile intends to continue promoting the development of forest biomass as an alternative energy source due to the ample availability of forest resources. While the main commercial product generated by native forests is firewood, this activity is characterized by its informality (Gómez-Lobo et al., 2006).

5.2. Challenges and opportunities for native forests

Challenges facing native forest management and valorization

The degradation of large areas of native forest remains a very important challenge for the forest sector, especially since native forest resources are mainly owned by small- and medium-sized landowners and the informal firewood market is not traceable. Native forest degradation changes the structure of native forests in terms of their size and species composition, altering their capacity to provide ecosystem services such as hydrological functions and biodiversity conservation, and to provide development dividends. The causes of native forest degradation have been widely documented and are well known in Chile, including (a) the unsustainable use of forest resources for timber, firewood production, and livestock grazing; (b) expansion of agricultural and livestock activities in forest lands; (c) encroachment of monoculture tree plantations and urban expansion; (d) the effects of climate change, desertification, land degradation and drought; and (e) pests and diseases. These causes are driven by underlying factors that have been identified through extensive analytical and participatory work, which include (a) deficiencies in the public policies regulating, promoting, and controlling the management of vegetation resources; (b) a low level of knowledge and cultural valuation of vegetation resources among the general public; (c) the informality of the firewood market; (d) rural poverty, with the consequent lack of alternative economic opportunities for small forest owners; (e) low profitability and high opportunity costs of native forest lands; (f) fragmented and unregulated land tenure in rural areas; and (g) weaknesses in forest governance (WB 2018). Most of the native forests have historically been subjected to selective harvesting. This unsustainable use of wood is complemented by the envisaged impact of climate change in terms of forest fires, drought, pests, and diseases (CONAF-GEDEFF 2016).

Despite a reported increase in native forest surface, conversion into forest plantations may still be considered a challenge. Public sources show that the surface of native forest is increasing (INFOR, 2008, 2011, 2013, 2015, 2017, 2019; MMA, 2018), mainly on behalf of agricultural land and wetland. However, the native forest conversion into forest plantations is signaled by the National Inventory of Greenhouse Gases (MMA 2017), reporting an annual average of substituted native forest areas of 6,897 ha between 1990 and 2013 (Table 4). According to the same source, the substituted surfaces diminished dramatically by the end of the reporting period, but this issue still needs to be assessed and properly addressed.

Illegal or unregulated wood harvesting is a significant challenge for native forests in Chile. Based on present estimations (UACH 2013), 8–9 million m³ of annually consumed fuelwood is from native forests. Different sources (Lara et al., 2016) indicate that close to 90 percent of the firewood market operates outside

of current regulations, be it tax, labor, municipal permits (commercial patents), health, transportation, and forestry. Only 19.6 percent of the current fuelwood supply originates from sustainably managed native forests (CONAF – UCCSA 2018b). Among the impacts of this informality, the structural degradation of native forests exploited for firewood production stands out, without management plans authorized by CONAF, with various impacts on ecosystems not yet evaluated or understood. In this way, these practices, which have occurred for decades, have led to a significant loss of the ecological and economic value of native forests, reducing their ability to provide goods and services, including carbon capture and storage, and therefore generating a substantial loss of the country's natural capital, leading to significant associated greenhouse gas emissions (CONAF 2016b), among other impacts. This phenomenon, in addition, has encouraged the abandonment of forests, and in some cases, their deforestation and definitive replacement with other productive uses of higher private profitability, further increasing the emissions associated with the misuse of the resource (Donoso et al. 2014). According to CONAF,³¹ between 2013 and 2019 the total surfaces affected by illegal logging in native forests (documented cases) was 11,368 ha, with a total illegally harvested volume of 1.2 million m³.

Besides leading to native forest degradation, the current model of using firewood for heating presents major negative externalities derived from its inefficient use and informal origin. Residential firewood use is highly energy inefficient, thus the demand from households, especially in south and central Chile, is high.³² The informal origin determines the use of wet firewood that, together with the use of improper low tech equipment, intensify the serious pollution problems in cities in central and south Chile.

Measures targeting sustainable native forest management are also affected by irregularities in forest land tenure conditions. Land tenure conditions are fundamental for various action measures, since they facilitate or condition access to certain instruments of promotion and/or incentives to carry out adequate and sustainable management. This is also key in terms of the possibility of establishing transfers of carbon rights in any future results-based payment schemes (CONAF-UCCSA 2017). There are various information gaps that should be resolved to improve the cadastral system of the country's native forest properties. The CONAF – UCCSA (2017) report indicated that rural irregular property fluctuated between 19 percent and 13 percent during the period from 1997 to 2007. Unfortunately, updates to this information are lacking from 2007 to date. Another consequence of the lack of poor forest land tenure is the fact that it is encouraging owners to produce fuelwood for sale, avoiding state regulations (Reyes et al., 2017).

The implementation of SFM for native forests is also challenging due to a perceived reduced value of the native forest stands, high cost of SFM implementation, and low effectiveness of the present incentive system. Sustainable use of native forests is perceived as not being profitable enough for the landowner to be motivated to maintain and use it sustainably, especially when the property size is rather small and the rotation cycles for native species are long.³³ Native forest stands, in their current degraded condition, require investment toward their recovery and a management regime involving many years and complex successive silvicultural interventions to achieve the capitalization of this resource and ensure its existence and long-term profitability (UB 2012). Present forest management systems for *Nothofagus* stands, for example, requires four or five quite intensive and costly silvicultural interventions, mainly in early stand ages, before harvesting, with the purpose of continuously raising the quality of the forest and to ensure high quality wood (CONAF 2014). This inevitably requires owners who are willing to invest in silviculture resources for their forests today, hoping to receive benefits in the rather distant future, a condition that few owners will meet regardless of their social status. This phenomenon, in addition, has encouraged the abandonment of forests, and in some cases, its deforestation and definitive replacement with other productive uses of higher private profitability (Lara et al., 2016). In this context, Law N°20.283 is an important step toward the objective of recovering and properly managing native forests, but it has not had the expected impact. Native forest owners are not interested in applying for this subsidy because the amounts are lower in comparison to other subsidies in the agro-forestry sector (e.g. OC 701 for afforestation), they are not enough to pay the true costs of silviculture, and the process is bureaucratic and uncertain, especially for small and medium landowners (Reyes and Nelson 2016).

Native forest sustainable management also poses difficult challenges for research activities aiming at new silvicultural methods, marketing, and forestry extension strategies for valorizing the native forest. For several decades now, Chile has undergone different native forest management experiences seeking to improve its quality and yield for a second cutting cycle and, therefore, sustainably gaining access to high-quality product markets with enhanced quantity and quality of timber. However, there is no assessment of the different native forest types that guarantees these results and captures the interest of landowners. Developing and validating new silvicultural methods, as well as analyzing the results of those already implemented, thus represents a major challenge in order to secure a managed second-growth forest, avoid land abandonment, and ensure the sustainability of interventions. Similarly, there is a need to improve research in product development, transformation and marketing, to close the gaps between the quality of the timber suitable for production and meeting the market requirements.

Opportunities from SFM of native forests

Besides the obvious environmental benefits, SFM of native forests opens the way to very important socioeconomic opportunities. For example, (a) wood production potential of native forests is significantly underused both in terms of wood for industry and biomass for energy; (b) the NWFP use has not reached its full potential; and (c) PES mechanisms have not been yet properly investigated, designed, and implemented for the benefit of all stakeholders. SFM of native forests is an opportunity for small and medium forest owners to become part of the sustainable economic development of the forest sector. However, complex and sustained measures are needed for this valorization through the sale of (enhanced) products, or through the provision of other environmental services.

Despite being affected by degradation, with rational management and proper promotion of sustainable forest management, the vast natural capital of the native forest has huge potential. It offers owners, the timber industry—and society as a whole—significant benefits of rationally using this important resource. At the same time, it is estimated that, out of 14.6 million hectares of native forests, approximately 6.5 million hectares have potential for bioenergy production or industrial production (CONAF 2013). At present, industrial roundwood from native forests represents only 0.5 percent of the total industrial wood consumption in the country. Compared with other forest industry sectors, the sawmilling sector has an important number of small and medium operators that could benefit from an increase in sustainable roundwood supply from native forests. Their present development and technological level is considered as unsatisfactory and unattractive for investments (CPF 2015). However, sustainable forest management practices have to be augmented by measures destined to support native wood marketing (CONAF-GTZ 2004). The present lack of quality and supply flows for native wood from Chile can be addressed, in time, by long-term implementation of sustainable forest management practices. Another opportunity would be to encourage the use of hardwood in the construction industry, enabling the market conditions for native wood to improve (CPF 2015) in the short and medium term. An improvement in the demand and capacity at the regional level could encourage investments and trigger the credit access. Given the already foreseen supply problems of Radiata pine timber (INFOR 2018) due to the forest fires that in recent years affected the Maule, Biobío, and Araucanía regions, another opportunity would be to industrialize part of the native timber in these regions.

The sustainable biomass production from native forests could be the solution that creates economic opportunities for thousands of owners and, at the same time, contributes to the goal of decarbonizing the country. The consumption of firewood is estimated at 13.1 million m³ of solid wood annually, of which between 8 and 9 million m³ come from native forests. Presently, the native firewood supply is affected by unsustainable practices, but the potential cannot be ignored. The current consumption of firewood in cubic meters represents only 21 percent of the potentially profitable supply from native forests if they were managed sustainably (CONAF 2015). In socioeconomic terms, the residential firewood market segment sells around \$800 million a year, with approximately 4,843 formal companies involved in marketing firewood, and at least 81,337 plots producing firewood from native forests. This market segment generates approximately 91,000 jobs, in addition to those created by the traditional forest industry. Besides increasing

these economic benefits, the sustainable use of native wood for bioenergy—with formal markets allowing the firewood to dry and increasing the energy efficiency of firewood usage—has huge potential to diminish air pollution. Studies analyzing the cobenefits associated with the sustainable use of firewood, according to the goals of the different Chilean management tools, estimate that the economic benefits in terms of health would reach \$476 million, on top of significantly contributing to the income of small landowners (CONAF-UCSSA 2018b). However, the production chain challenge for the players involved—particularly micro-, small-, and medium-sized forest enterprises—of minimizing the negative impacts, both in forests and cities, is undoubtedly very significant and complex (CONAF 2015).

Due to Chile's high degree of endemism, NWFPs provide a significant opportunity for the valorization of the native forest for commercial purposes. NWFPs from the native forest raised their share from 7 percent in 1990 to 75 percent in 2015 when compared to NWFPs from plantations. The growing market for these products, and its significance for social and economic local activity, support its further development as a way of valorizing the native forest, while always considering sustainability under a systematic and comprehensive management approach.

Native forests provide a wide range of environmental services, which—if properly valorized—could provide additional incentives to landowners for the sustainable management of this resource. Among the main environmental goods and services obtained from Chilean native forests are carbon dioxide sequestration, firewood supply, habitat for biodiversity, tourism and recreation, erosion control, supply and regulation of hydrological flows (water), nutrient regulation, biological control, and NWFPs. The main problem has been that most of the benefits of the native forest have only been valorized from the private point of view, considering only the marketing value of the products obtained from its cutting. The environmental services from native forests are public assets, and lack of a market price for these assets prevent them from being considered when making decisions about the forest. Recognizing that native forests are, directly or indirectly, a significant provider of ecosystem services to society creates an opportunity for the preservation and recovery of the native forest.

Payments for environmental services (PES) schemes are getting increasing attention in Chile. PES constitutes a new conservation paradigm that explicitly recognizes the need to build bridges between the interests of the landowners and the users of the environmental services they receive for free in the form of positive externalities. As natural habitats shrink, ecosystem services, previously offered free of charge by nature, are increasingly threatened. This growing shortage turns them into potential marketing subjects such as economic goods and services. Studies carried out in Chile show that the profitability of native forests with the current economic incentives proposed under the Native Forest and Forest Development law are not sufficient to restore and/or recover native forests, since the single payment per hectare fails to reverse the negative returns forest owners currently face (Troppa and Martínez 2017). This gap between social and private profitability makes it impossible for private agents to perceive the social benefits generated by native forest. This translates into a need for explicit recognition of the value of the native forest. Adding an economic compensation that is proportional to the production of environmental services could significantly change this scenario, even making the native forest, in many cases, the most profitable private land use alternative. The central idea behind PES is that native forest owners are paid directly by external beneficiaries of the ecosystem services, as per an agreement and terms and conditions, for adopting practices that ensure the conservation and restoration of ecosystems. Chile has extensive information on how to create and operate PES schemes, and various studies have shown different ways to implement them (Cabrera 2010). Moreover, there are notable pilot attempts to design and implement PES. For example, the UNDP pilot project implemented by CONAF in the Los Ríos region is aimed at restoring native forests for the provision of water in the framework of working with rural drinking water committees. Studies have identified the following as ecosystem services of the native forest with the greatest potential for a possible implementation of PES in Chile: (a) water of drinking-water quality; (b) water for crop irrigation (regulation of the water regime); and (c) scenic beauty in areas with tourism potential (CONAF-UCCSA 2019).

5.3. Challenges and opportunities for forest plantations

The economic success of the Chilean forestry sector relies heavily on forest plantations, but the continuous flow of benefits coming from this sector is vulnerable to significant challenges. The afforestation rate has diminished due to the expiration of the DL701 incentives scheme and limited availability and quality of land suitable for forestry. Existing measures need to address issues like the decrease in forest plantation areas due to environmental, productivity and cost-related reasons, the environmental impact of current management practices, and the potential wood deficit in the coming years.

The end of the DL 701 afforestation incentives in 2012, coupled with a reduced availability and ownership fragmentation of productive land for afforestation purposes, is creating new challenges for Chile to continue its forest expansion. The vast majority of forest plantations in Chile were established under the umbrella of state incentives, mainly under DL 701. The expiration of the DL 701 afforestation incentive system decreased dramatically the annual rate of afforestation. At the same time, new forest plantations are limited by the availability of land with varying degrees of erosion that is suitable for afforestation. Although the total area of eroded soils exceeds half of the national territory (CIREN 2010), only some of it is suitable for forestry.³⁴ However, it is estimated that in Chile there are still 2.63 million hectares³⁵ nationwide with varying degrees of erosion suitable for afforestation (Grosse and Rosselot 2016). Current available lands are usually of a lower quality than the already planted ones. Present constraints include high erosion and limited water availability. Land also is often fragmented in the hands of many small- and medium-sized owners, in some cases with irregular property titles and without any financial capacity and/or in a vulnerable position. Another important challenge for the forest landowners is the ability to adapt and implement—through technology transfer—the best silvicultural practices used in the country today so that their forests would yield the same timber performance as those of large companies.

The Chilean forest sector faces the challenge of maintaining the existing planted forest area and preventing it from shrinking. Amid the complex environmental scenario of recent years, due mainly to climate change, there has been a decrease in rainfall, as well as long drought periods. This has affected ecosystems in general, with direct effects on vegetation, including native and planted forests. Consequently, there has been a decrease in growth and productivity, higher vulnerability to pests, and forest fires of great magnitude and intensity. Reforestation activities are challenged by the need to reforest the planted forests affected by forest fires in 2016–17. Under these conditions, managing and protecting lands preferably suitable for forestry is key for the forest sector to continue being a source of social, economic, and environmental wealth for the country. The forest sector faces the challenge of finding solutions to encourage current landowners to keep their forest land, and not change the land-use in favor of more profitable alternatives, given the high opportunity cost they face. To address this challenge, a legal change might be needed.

The environmental impact of forest plantation management practices needs to be addressed. In spite of the fact that Chilean forest companies managing forest plantations have become more concerned about the environmental issues (Salas et al. 2016), plantations continue to be managed with traditional harvesting schemes (e.g., large clear-cuts on steep slopes and intensive widespread use of chemicals to control competing vegetation), whereas environmental standards are mostly implemented in the matrix surrounding industrial plantations (e.g., creation of conservation areas) but not within plantations. Forest plantation managers need to continue to adopt measures to ensure water supply from planted watersheds near local communities, landscape quality (i.e., aesthetic and connectivity), and good maintenance of public roads.

5.4. Challenges and opportunities for the forest industry

The Chilean forestry industry foresees a plantation timber deficit in the coming years. The new standing timber availability projected for 2040 (INFOR 2018) shows a decrease in the total volume supply of approximately 8 percent compared to previous estimates (INFOR 2013), from 46,971,637 m³swb to

43,216,564 m³swb. These projections show a historical stagnation in the growth of the forest due to climate reasons, with a decline in the consumption of raw material and its production since 2018. Only in the year 2041 would there again be available raw material similar to the consumption recorded in 2017. It is estimated that this situation will affect all forest production and create a shortage of pulpwood supply for the pulp industry that could lead to using lower quality sawable products, as well as the procurement of woodchips, all of which will cause a higher demand for different products in the domestic market (INFOR 2013).

There are significant differences in productivity and management effectiveness between large and small forest plantation owners. For example, in the case of Radiata pine, large companies record a yield increase of 10 percent, while small and medium-sized owners get on average less than half of that (INFOR 2018). Considering only the genetic improvement—without adding elements such as initial fertilization, herbicide treatment, or soil preparation—there is a potential gap in volume at the end of the rotation period for small- and medium-sized owners. This would not only represent an additional volume contribution for industrial supply, but also a source of financial and social development for these landowners.

5.5. Social aspects

The Chilean forest sector is not exempt from criticism and faces several issues regarding its relationship with local communities, native peoples, and broad segments of society. The fast growth and expansion of the sector has not always kept pace with the expectations and demands to make this a more inclusive and sustainable industry. Besides the already mentioned environmental issues, there are challenges pending in the social sphere, including (a) perceived inequitable distribution of forest resource use benefits, and insufficient contribution to social inclusion; (b) conflicts with native communities; and (c) gender balance in forestry-related activities.

The forest sector is affected by the relationship between plantations and poverty, and a broader social gap in predominantly forested regions and counties. Most of the human settlements linked to the forest territory have an insufficient level of economic and social development, an ambiguous relationship with the environment, and very low participation in local decisions. Furthermore, its inhabitants do not feel respected in their rights as individuals and in their cultural heritage. The practices of coexistence and respect for the rights of people could certainly be improved to achieve harmonious levels of inclusiveness, economic growth, and social and cultural development (CFP 2015). FPC acknowledged the issues in the process of preparing the Chilean Forest Policy 2015–35. One of the strategic objectives refers to *the conditions and instruments necessary for forest development to reduce social and technological gaps, improve the conditions and quality of life of forest workers and their families, and respect the tradition and culture of the peasant and indigenous communities that inhabit or are inserted in forest ecosystems* (CFP 2015).

The forest sector's relationship with native people in Chile also has room for improvement. CPF has concluded that the “Good Faith Dialogue” (“El Dialogo de Buena Fe”), as defined in OIT Convention 169 (OIT 2014), between communities of indigenous and peasant peoples and public or private entities is not practiced in a habitual, generalized, or institutionalized way. Furthermore, the concept of good faith dialogue is insufficiently known by public and private sector agents. There are conflicts between the forest industry and native peoples—particularly of Mapuche—that have not been solved yet. The conflict is based on the presence of forestry companies on lands that are claimed by the Mapuche as their own and the environmental and cultural impact that planting vast monoculture areas poses on the lands adjacent to the communities. However, there is some notable progress toward a management model with a greater cultural relevance when operating in the lands of native peoples. In 2018 CONAF developed the Management Plan for Vegetation Resources in Indigenous Lands (PGRVTI), which seeks to improve the quality of life of the native peoples of Chile through the sustainable management and use of the forest with an intercultural approach. The plan includes a national diagnosis of indigenous lands and territories, the location of the

communities, the forest and vegetation formations, and the agro-climatic information, in addition to other data that enables the actions of the ENCCRV in these territories. Likewise, this plan also includes an analysis on the promotion actions, initiatives, and tools currently managed by CONAF in regions with indigenous communities (CONAF 2018). The plan also incorporates two intercultural planning and management models resulting from the joint work of forestry professionals and indigenous leaders and specialists, and based on the worldview and cultural practices of the Andean (MAIA) and Mapuche (MOFIM) peoples. A brief description of the principles and characteristics of both tools are described in Box 5.

Box 5. The MAIA and MOFIM intercultural models in the context of the Management Plan for Vegetation Resources in Indigenous Lands

Andean Intercultural Environmental Model (MAIA): MAIA is a conceptual and practical work model that gathers the overall view of the Andean peoples (Aymara, Quechua, Atacameña, Diaguita, and Colla cultures) of northern Chile, from the Arica and Parinacota Region—on the border with Peru and Bolivia—to the Atacama Region on the border with Argentina. The objectives of the MAIA project focus on a cultural dimension: improving biodiversity; protecting and promoting cultural heritage, recovering Andean ancestral knowledge of nature, and other productive initiatives (increasing forest-agriculture-livestock production, helping to produce income, goods and services for families).

Mapuche Intercultural Forest Model (MOFIM): MOFIM is a methodological tool for forest-agriculture-livestock management in the territory of the Mapuche people. It aims at providing an intercultural approach to the actions developed with the participating communities; for example, recovering or developing environmental, cultural, religious, medicinal, productive, ceremonial practices, for individual and collective use. A MOFIM project involves an investment and work process of at least three years.

Source: CONAF (2018).

The forest sector has not traditionally spent much attention on the development of a modern labor force. A significant proportion of offices and jobs in the forest sector have low levels of formality and social recognition, triggering socioeconomic gaps between workers in the sector (CFP 2015). Despite its important role in Chile's socioeconomic context, the forestry sector presents high heterogeneity in terms of working conditions in aspects like (a) continuous technical-professional education and training, and (b) recognition of their employment status. A significant number of forest sector workers face precarious working conditions. The level of unionization reaches 10 percent of the workforce, and are characteristically weak and atomized labor organizations that do not negotiate their levels of economic remuneration and social security conditions. The accident rate, declared by employers and which mainly represents the industrial subsector, is 5 percent (CFP 2015).

The Chilean forest sector has traditionally been dominated by men, although 28 percent of small forest owners are women. In the forestry sector, merely 5 percent of the workforce is female, with most working in forest nursery operations. Consequently, in 2014, CONAF created the Gender Equality Unit, an office that could be a starting point for the generation of gender-disaggregated data and statistics that would allow an analysis and a Gender Action Plan for the forest industry. Some steps have been done: CONAF launched a project to foster inclusion and the participation of rural women in the context of climate change at the COP25 in Madrid. Framed within the National Landscape Scale Restoration Plan, the "Women and forests in a context of climate change" program promotes the participation of rural women in degraded restoration projects (CONAF 2019).

5.6. Climate change

The climate change context is particularly important for Chile, posing significant challenges for the forest sector, but also creating important opportunities in terms of climate change mitigation and

adaptation. Such opportunities include (a) addressing forest resources degradation and thus decreasing CO₂ emissions and increasing the adaptation capacity of forests; (b) improving residential firewood consumption patterns; (c) managing the risk of increasingly larger forest fires and increasing water stress; and (d) promoting long-use forest products to increase the CO₂ sink.

Reducing native forest degradation will automatically and positively impact CO₂ emissions. The continuation of native forest degradation, with already described causes and consequences, will lead to continued and increased CO₂ emissions in the forest sector. Moreover, native forest degradation affects the general equilibrium of these valuable ecosystems, thus diminishing their natural resilience to climate change. Measures designed to promote the sustainable management of native forests would provide important benefits for climate change.

Besides having a major contribution to native forest degradation, the unsustainable firewood supply in Chile adversely affects CO₂ emissions.³⁶ The present energy use of forest biomass, although it is addressing in many cases a socioeconomic issue, is not sustainable from a climate change mitigation perspective. Measures to increase the sustainability of firewood production and the energy efficiency of firewood could make a significant contribution to the GHG balance.

Managing and addressing the risk of increasingly larger forest fires will be one of the biggest challenges for the forest sector as regards climate change, as this also represents a significant source of GHG emissions. The weather conditions for the occurrence of forest fires—warmer temperatures, drier air, and higher winds—will increase in frequency, according to the projections of these variables for the climate change scenarios in Chile. Drought is severely affecting Chilean territory, with impacts not only on soils, biodiversity and silvo-agricultural production (See Annex 3), but also favoring the increased incidence of forest fires. Actions to manage and address the risk of increasingly larger fires include (a) raising public awareness in order to reduce ignitions (almost all fires of known cause in Chile are caused accidentally or intentionally by humans); (b) generating more heterogeneous landscapes that reduce the risk of fires spreading and are more resilient to them; and (c) applying fire prevention techniques and technologies, such as integrated fire management, preventive forestry (pruning, load reduction, maintaining firebreaks and firewalls), and advanced fire risk detection and monitoring systems; and (d) promoting better preparation and cross-institutional coordination for effectively fighting fires when they occur. The NPPFF would undertake these needed actions.

The net contribution of forestry to climate change mitigation could be considerably increased by two factors, which have not yet been included in Chile's GHG inventory. The first one is accounting for the carbon accumulated in harvested forest products. Today, all the carbon contained in the harvest is considered emitted, even though there is a significant percentage (ranging from 15 to 20 percent in the case of Chile) of this volume of timber that is intended for products that can have a lifespan of decades and even hundreds of years. The other significant factor is the accumulation of carbon in the soil, which is also not accounted for in the GHG inventory. The same is true for the carbon contained in the root biomass, which is considered emitted at the time of the harvest.

5.7. Crosscutting governance aspects

Despite its proven effectiveness in implementing forest policies and regulating and monitoring the forest sector, CONAF is facing limitations in performing forest-related public services. Created as a state administration body funded by Constitutional Organic Law and ruled by private corporation entity bylaws that define its functions, CONAF is caught in this administrative dualism that determines legal limitations in performing public services to the full extent of its authority. This situation has produced many problems. For instance, CONAF officers cannot enter private properties to monitor logging without an explicit authorization of their owners, which reduces the effectiveness of forest monitoring and law enforcement. These institutional weaknesses facilitate illegal logging that negatively affects native forest conservation (Reyes and Nelson 2014). It was argued that this institutional weakness has had negative

effects on ecosystems, and that CONAF was not strong enough to enforce existing legislation (OECD-ECLAC 2005). There have been several efforts to solve this problem through developing a public agency, first starting in 1984 (Reyes and Nelson 2014) and continuing after that, with limited success. The scope was to create a new institutional framework with public authority, which will allow the government to face the new environmental, social, and productive challenges the country demands. The last legislative initiative started in 2011 with drafting a bill seeking to create the National Forest Service (SERNAFOR) as a decentralized public service, and a legal entity with its own capital, under the supervision of the president through the Ministry of Agriculture.

The dualism of CONAF is affecting its ability to face new challenges in the area of ecosystem conservation. Government studies have shown that one of the most significant conservation problems is the gap between what is protected by the SNASPE and what needs to be protected to preserve ecosystems at the national level (MMA 2016). Considering that biodiversity extends both inside and outside these areas, the establishment of an ecological infrastructure is pertinent, which may include buffer zones, biological corridors, or other support areas (MMA 2015). The identified challenges were partially addressed by the modification of the Environment Framework Law. The current system that regulates protected areas is divided into five ministries, which is why the creation of a new institution aims at unifying all these areas and the protection of biodiversity under a single ministry. In its 2016 “Environmental Performance Review of Chile,” OECD establishes that the existing division of roles in the country hinders the consistent and integrated management of protected areas. OECD also estimates that despite current efforts, Chile will probably not be able to apply operational management in all protected areas until 2050. In July 2019, the Senate approved the first legislative procedure for the Biodiversity and Protected Areas Service (SBAP). Still, the operationalization of this new framework has been delayed. While there is a certain level of agreement among the scientific community, the world of academia, and civil organizations regarding the importance of having the SBAP, there is still no unanimous opinion on questions of administrative management, responsibilities, funding, and in the transfer of protected areas from CONAF to another public entity.

A more or less similar situation is experienced by the main forestry research institution in the country, the Forestry Institute (INFOR). Being a private entity, it cannot concentrate its efforts in long-term research, especially focusing on native forests. There is no guaranteed funding, so INFOR concentrates its research almost exclusively on short-term projects focusing on forest plantations and industry technology-oriented topics. Only a small part is focused on natural forests, although ecological restoration in degraded forests and recovery of areas replaced by fast-growing plantations in the past were important targets/challenges for researchers, companies, public service agencies, and landowners (Reyes and Nelson 2014). INFOR researchers lack independent funding for their own projects, e.g., nonproduction-oriented research, such as ecology and wildlife. Furthermore, INFOR does not have experimental forests where they could carry out long-term research (Donoso and Otero 2005).

Several studies have confirmed the need for a new development law to continue restoring the degraded land in the country, focused on small and medium forest owners, and contributing directly to the country’s NDC commitments. Recovering degraded soils, granting exclusive support to small and medium-sized forest owners, and paying for environmental services are among the basic points included in the Afforestation and Recovery of Burned Forests bill that is currently under discussion. The main purpose of this bill is promoting rehabilitation of erosion-prone land affected by fires through afforestation, reforestation, or just vegetation covering by granting incentives to small and medium-sized owners. There is a broad consensus for the new legal body to support only small- and medium-sized forest owners, excluding large companies since, economically, they would not require government assistance. This would also help better allocate public resources to smallholders, who own the most eroded soils in the country. The new regulations are expected to promote an owner’s association in order to facilitate their connection with small and medium forest enterprises. An additional 15 percent bonus will be granted to partnership projects, in addition to payments for technical assistance and specific incentives for the establishment of

native species. The draft bill includes (a) the reforestation of planted forests and native forests that have been affected by natural disasters or forest fires; (b) afforestation of bare soils; (c) the creation of planted forests through afforestation in lands preferably suitable for forestry; and (d) the provision of environmental services. The latter considers an annual payment for maintaining the permanent vegetative coverage for the provision of environmental services. This implies a 20-year conservation commitment between the landowner and the state. The bill aims to recover 500,000 hectares of degraded land—without vegetation—in 20 years (25,000 hectares per year) with an annual budget of \$37.5 million (Rebolledo 2019).

Different assessments have indicated that Law N° 20.283 has had limited success in achieving its objectives. The assessments made by different entities on the low effectiveness to date point to several issues, including (a) the inflexibility of the law and the scarce incentive to the owners from the amounts paid for subsidized activities (it is estimated that 74 percent of the subsidized activities receive less than the estimated cost for their execution, covering only 5 percent of the total costs for sustainable forest management in comparison to traditional forms of management); (b) the excessive administrative procedures associated with the awarding and the permits needed to execute and prove the activities (between two to four years, 84 percent of which is spent on administrative processes); and (c) the lack of financing for technical assistance. Despite the evidence regarding the value of the native forest ES, there is some concern that the present legislation (especially LBN) (Lara et al. 2016) doesn't include enough provisions for enhancing the value of ES.

ENCCRV elaboration support studies have identified regulations relative to the agriculture sector that needs some adjustments in order to be compatible with the sustainable management of native forest resources (CONAF-MINAGRI 2016). The exemption from reforestation—in Law No. 19.561 of 1998—in regard to the agricultural recovery of previously deforested land is seen as an incentive to replace the forest. According to CONAF, the fact that the legislation does not maintain the classification as “native forest” after losses by forest fires is a decisive factor that accelerates the legal substitution of native forest. This happens in Aysén for livestock, with avocados in the sclerophile forest (center-south of the country), and with berries in the central valley's forest. The elimination of the exemption, or its limitation, could reduce forest loss due to this cause. Moreover, Law No. 18.450 of 1985, which approves regulations for the promotion of private investment in irrigation and drainage works, provides financial support, through competition, to irrigation works to improve the efficiency and productivity of agricultural activity. By considering forest conservation variables on the farms they apply, an incentive could be generated to reduce deforestation and forest degradation. Another example is the system of incentives for agro-environmental sustainability of agricultural soils in Law No. 20.412 of 2010, which establishes an incentive system for agro-environmental sustainability of agricultural soils. The incentives in component 5 of the law stimulate the removal, cleaning, or confinement of stumps, dead trunks, bushes without fodder value or other physical or chemical impediments, in soils suitable for agricultural purposes. Without proper changes, the continuation of Law no. 20.412 is seriously affecting natural vegetation, such as scrubland or xerophytic formations.

6. Intervention Areas and Activities

6.1. Current World Bank involvement in the forestry sector

The World Bank has played a key role in recent advances in Chile related to climate change mitigation and adaptation in the forest and agriculture sectors. In the last decade, the WB intervention in forestry-related areas has been based on a programmatic approach initiated in the Country Strategic Partnership (WB 2011). It has continued with the proposed operations considered in the WB Group Country Partnership Framework for Chile (currently under development), particularly Focus Area 3 (Improving Water, Land and Climate Change Management), which seeks to strengthen climate change mitigation and

adaptation capacities (objective 7) (WB 2018). Moreover, the Systematic Country Diagnosis (WB 2017) identified native forest degradation as one of the major challenges to environmental sustainability in the country. The WB intervention package in Chile is directly supporting several focus areas under the Forest Action Plan (Sustainable Forestry and Forest Smart Interventions) as well as cross-cutting themes (climate change and resilience, rights and participation, institutions and governance). It also is aligned with the WB Group Climate Change Action Plan's top-level priorities on supporting transformational policies and institutions by translating Chile's NDC climate policies and investment plans into actions, as well as on scaling up climate action by mobilizing REDD+ financing to support large-scale, multisectoral programs in the climate-smart land use, water and food security high-impact area (WB 2018).

The main projects that have been (or are) implemented in Chile with WB support are listed in Annex 8. WB intervention combines technical assistance, investments, and results-based finance, including two FCPF Readiness Grants to support preparation of the ENCCRV (P124908; \$8.8 million); an NDC Partnership Support Facility grant to help identify investment opportunities for the ENCCRV (TF0A4793; \$250,000); a GEF operation to support investments in Sustainable Land Management (P085621; \$23 million); and a project-scale carbon finance transaction pilot under the BioCarbon Fund (P111918; \$3.87 million). The results that have been achieved through WB intervention have supported the identification of the key drivers (especially through the process of ENCCRV elaboration) and of a clear strategic way forward. Consequently, WB has recently mobilized trust-fund resources from the Forest Carbon Partnership Facility [FCPF] to support ENCCRV implementation and address the main identified issues.

Sustainable Land Management Project (MST) (2013, in progress). The World Bank, through funds provided by GEF, supports CONAF in the implementation of this project. Its funds are administered by AGCI and implemented by CONAF. The project objective is to contribute to the formulation of a national framework of sustainable land management—applied to forest, agricultural, and livestock lands—to fight against degradation, reverse desertification, reinforce the incorporation of biodiversity in public policies in the field, and protect carbon assets. The project is implemented within the framework of the ENCCRV, which is led by CONAF as executing agency, in close collaboration with the other services of the Ministry of Agriculture (SAG, INDAP and ODEPA and the Ministry of the Environment through a National Committee). Although the project is national in scope, activities are carried out in five pilot areas in the same number of regions: Arica and Parinacota, Coquimbo, O'Higgins, Araucanía, and Aysén. The project supported the adoption of ENCCRV as the National Framework for Sustainable Land Management (SLM) in 2017. By the end of 2019, 20,764 hectares of land were under SLM practices; 315 farm-level plans were prepared and under implementation for a total of 1,728 beneficiaries, including 750 women. In addition, 1,183 forest users have been trained, of which 615 are women and 500 belong to indigenous peoples' communities. The project supported the completion of the SLM Monitoring and Evaluation System, which is already delivering inputs in Chile's reports to UNFCCC.

Technical assistance to reduce emissions from deforestation and forest degradation (REDD +) (2014, in progress). Through the FCPF, the World Bank has provided nonreimbursable technical assistance services (\$8.8 million) to CONAF. The funds have been administered by AGCI, and the operations have been implemented by CONAF. The use of the funds have allowed the development of ENCCRV, with the objective of supporting the recovery and protection of native forests and other natural formations—as well as promoting afforestation in the establishment of vegetative deformations in feasible soils—as mitigation and adaptation measures to the effects of climate change. This support contributes to the fulfillment of the international commitments assumed by Chile before the UNFCCC. It also helps advance the goals and purposes of the United Nations Convention to Combat Desertification (UNCCD) and the Convention on Biological Diversity (CBD).

Chile REDD+ Emissions Reductions Program (2019, in progress). The objective of the program is to make payments to the Republic of Chile for measured, reported, and verified emissions reductions (ER)

from reduced deforestation and forest degradation, the conservation and enhancement of forest carbon stocks (REDD+) in selected regions of southern Chile, and to distribute ER payments in accordance with an agreed benefit sharing plan. Beneficiaries of Chile's ER Program are expected to be mostly small forest owners (including indigenous communities) in vulnerable rural areas. Beneficiaries will also receive nonmonetary benefits through the implementation of subprojects related to the ER program measures. The program plans to support all 26 actions in ENCCRV (Annex 6). Through the FCPF, the World Bank seeks to support Chile in the development of a pilot payment mechanism for results associated with the reduction and verified capture of greenhouse gases during the implementation phase of the National Strategy for Climate Change and Vegetation Resources (ENCCRV). This initiative is carried out through an Emission Reduction Payment Agreement (ERPA). ERPA funds will be used to continue supporting the implementation of ENCCRV—in accordance with a benefit distribution system with the FCPF Carbon Fund—to trade emissions for 5.2 million tons of carbon dioxide (CO₂), which will have a total sales value of up to \$26 million. ERPA was signed by the government of Chile and the FCPF, through the WB, in late 2019.

6.2. Other relevant interventions

Chile REDD+ 2014–2016 (GCF, \$63.9 Million). During these years, Chile has reduced a total volume of 14.53 tons CO₂eq in emissions from reducing deforestation, forest degradation, enhancement of forest stocks, and conservation. UNFCCC has assessed these results as being fully compliant with its REDD+ stipulations, thus the GCF and GoC have signed the implementation agreements. The payment will be reinvested to deepen the implementation of ENCCRV.

The project has two components: (1) implementation and investments, and (2) enabling conditions for ENCCRV implementation. The implementation and investments component includes: (a) an afforestation and revegetation program (7,688 ha); (b) support for an ecological restoration program and program of reforestation (4,271 ha); (c) a preventive forestry program with an emphasis on rural-urban interface (3,844 ha); (d) a forest management program/arrangements and comprehensive management of the native forest; and (e) support for a wood energy program (9,738 ha). The second component includes: (a) an environmental education and dissemination program; (b) support for forest and environmental enforcement; (c) a program for the technological transfer of management and alternative uses for silvoagricultural waste; (d) an adaptation program for the management of vegetation resources in the context of climate change, desertification, land degradation, and drought; and (e) technical assistance to support continuity in the technical area (FAO 2019b).

6.3. Intervention areas and activities

Chile's Forest Policy is turning its focus from large-scale forest plantations to a more comprehensive approach focusing mainly on native forests and small-medium forest owners, attempting to address simultaneously complex environmental, social, and economic issues. Several intervention areas have been identified based on their high potential to transform the forest sector in Chile into an environmental, social, and economically sustainable sector, and enhance its linkages with other sectors.

The interventions are closely interconnected and therefore they need to be carefully designed and implemented as their effectiveness depends significantly on their synergistic effect. The identified intervention areas have been classified based on priority, estimated time for implementation, and available financing.

Many of the identified intervention areas are already included in programmatic documents and initiatives elaborated at a governmental level, most notably the Chile Forest Policy and ENCCRV. During the last years, Chile has undertaken a significant research and programmatic effort, specifically the development of Chile Forest Policy and ENCCRV, that resulted in a quite accurately defined and

consensually determined list of objectives and subsequent actions. Consequently, the country is presently seeking resources for implementation. Although some of the needed resources have been assured through the support from FCPF (through WB) and GCF, there are still important financing gaps (e.g. the total implementation budget for ENCCRV is estimated at \$433 million).

6.3.1. Short-term interventions

Short-term interventions focus on post-fire restoration and on building an institutional and regulatory framework for forest management improvements. Besides measures destined to address the effects of forest fires, short-term intervention areas also include institutional and legislative initiatives addressing small and medium forest owners and sustainable use and management of native forests.

Most of the identified short-term interventions are included already in Chile's forest/climate change programmatic framework (Table 5) and, at least partially, financing is available from ERPA. Still, due to the nature of these sources (payments against measured, reported, and verified emissions reductions), the implementation of these interventions must be subject to prioritization and, in some cases, as described below, may need to address certain gaps.

Table 5. Short-term intervention areas and activities and gaps that needed to be addressed

Intervention area	Proposed activities	Programmatic framework	Identified gaps
Post-fire recovery	Reforestation of forest plantations affected by fires Ecological reconstruction of fire-affected native forests	ENCCRV (MT. 4 – <i>Reforestation and revegetation program</i> and IF.2 – <i>Ecosystem restoration in areas affected by forest fires</i>)	Financing (potentially, some needs can be covered through ERPA)
Institutions	Implementation of SERNAFOR: Public entity, with enhanced monitoring and law enforcement power	Chile Forest Policy 2015–35	Financing (potentially, some needs can be covered through ERPA) TA/knowledge
Regulatory framework	Design and Implementation of a Forest Development law	ENCCRV (MT.1 - <i>Inclusion of climate change, land desertification, and degradation and drought-related issues in new Law of Forest Development</i>)	Financing (potentially, some needs can be covered through ERPA) TA/knowledge
	Improve LBN (Modify the bonus amounts to make it more attractive to forest owners and make the process less bureaucratic)	ENCCRV (MT.2 - <i>Modification and strengthening of the LBN</i> and IF.5 - <i>Inclusion of elements of preventive management and post-fire restoration in LBN</i>)	Financing) TA/knowledge
Regulatory tools	Clarify ownership issues for small and medium forest landowners	ENCCRV (MT.3 - <i>Adjustments for the inclusion of owners with poor legal land tenure</i>)	Financing (potentially, some needs can be covered through ERPA) TA/Knowledge Sharing
	Legal tools for encouraging integrated forestry-related supply chains, especially for products originated from native forests	Chile Forest Policy 2015-2035 ENCCRV (US.2 - <i>Integrated system of regulation and tax exemption for the promotion of productive value chains</i>)	Financing TA/knowledge
	Create a framework to encourage the sustainable use of forest-originated biomass in the country's energy matrix.	Chile Forest Policy 2015-2035 ENCCRV (US.3 - <i>Strengthening the dendroenergy program and the country's energy matrix</i>)	Financing TA/knowledge
	Regulate the trasability of fuelwood originated from native forests		Financing Analysis needed TA/knowledge

Climate change	Improve the estimation of GHG emissions (including soil carbon sequestration) and analyze the impact of fires	ENCCRV (IF.1 - <i>Estimation of greenhouse gas emissions and analysis of fire severity</i>)	Financing (potentially, some needs can be covered through ERPA)
	Keep a high-quality firefighting system	NPPFF	Financing (potentially, some needs can be covered through ERPA)

Source: Authors' elaboration.

Post-fire forest recovery. Both native forests and forest plantations have been severely impacted by recent forest fires, and their recovery requires significant financial and logistical efforts, especially for small and medium forest owners. There are measures already included in ENCCRV that support reforestation activities (action measure MT.4) and ecological reconstruction (IF.2). Those measures also are supported by ERPA interventions. Exotic species reforestation should be complemented with the increasing use of native species, based on careful design of sustainable plantation models. Ecological reconstruction is also a complex action that should be aimed at restoring forests that are close to the natural type.

SERNAFOR will allow the state to enhance its monitoring and enforcing capacity in the forest sector. The new institution can benefit from CONAF's previous experience in managing the public incentive systems aimed at supporting forest owners. SERNAFOR should also gain new prerogatives enabling more effective law enforcement and monitoring, especially concerning the efforts to diminish native forest degradation. SERNAFOR should be able to manage the coordination and implementation of forestry policy instruments generally. Due to its complex nature and prerogatives, SERNAFOR establishment and operations can benefit from technical assistance and transfer of knowledge relative to institutional change and impact assessments.

The present turning point for Chilean forest policy requires a new forest development law. The planned new forest development law is under discussion, but there are several points that have gained general recognition. For example, the new law should (a) create mechanisms for supporting post-fire recovery; (b) address the issues of soil degradation and restoration; (c) focus on small and medium land/forest owners, including through promoting their association; and (d) introduce mechanisms enabling native forests substitution with exotic species plantations. The new law also can create the necessary framework for ES recognition and PES implementation, having a direct contribution to the NDC goals. It is expected to include climate change, desertification, land degradation, and drought related-issues.

LBN needs to be improved to better address the needs of native forest owners. There are detailed studies that identified the main causes of the limited effectiveness of the present LBN. These findings should be the basis of the LBN reform. Moreover, the reformed LBN should also incorporate aspects related to preventive management and post-fire restoration. The LBN has created important expectations and the envisaged solutions haven't yet reached the necessary consensus among stakeholders. To speed up the LBN reform, the GoC may be supported through technical assistance.

Forest policy focusing on small and medium forest owners will not be achievable without clear ownership. Poor legal land tenure is often a barrier in law enforcement and monitoring, as well as imposing difficulties for small and medium land/forest owners in accessing any kind of incentives system.

Increased demand for native wood can mobilize the economic potential of sustainably managing native forests. The costs and long rotation cycles of SFM for native forests cannot be covered only from public incentives, especially for small and medium forest owners. They should be accompanied by an increased demand for wood and biomass originated from sustainably managed native forests. Thus financial (and other) policies should be designed and implemented, for example in areas like: (a) establishment of integrated supply chains related to products originated from native forests; (b) use of native species wood in construction activities; and (c) the sustainable use of energy biomass according to the dendroenergy program. Governmental incentives in this area may also encourage private financing agencies to promote business loans for small-medium forest owners of forest enterprises.

There is a common opinion that the biomass energy potential of native forests should be used, but the continuation of unsustainable fuelwood supplies from native forests has made a major contribution to native forest degradation. First, deeper analysis is needed to better understand the supply and demand for fuelwood, as the results of previous studies are often contradictory. Besides analysis, a fuelwood traceability mechanism should be considered to gather empirical data on fuelwood origins. Second, regulatory and enforcement efforts (including incentives-based mechanisms) are needed for channeling the fuelwood supply from sustainably managed native forests.

GHG emissions accounting requires continuous attention and improvement. There is a solid base for GHG monitoring within the responsible authorities. However, there are aspects that can be improved; for example, the estimations for the accumulation of carbon in the soil or the carbon that is stored in long-term use wood-based products.

GoC elaborated NPPFFF, a complex interinstitutional establishment with high capabilities to detect and react to forest fires. This system has to be maintained and improved continuously with special attention to keeping it operational at any time.

6.3.2. Long-term interventions

Long-term interventions include actions that require a longer period of implementation, although many of them are of high priority. These interventions have been grouped in five areas: (1) native forests management; (2) institutions and regulations; (3) increased productivity and management quality of forest plantations; (4) equity and social inclusion in the forestry sector; and (5) awareness and education (Table 6). Most of the identified actions need to be initiated as soon as possible, benefiting from the institutional and regulatory measures listed as short-term interventions. For instance, the activities in the native forest management intervention area are essentially linked with upgrading the LBN and enabling the sustainable use of wood originated from native forests. Similarly, the forest plantation related long-term interventions are conditioned by the provisions of the new forest development law.

Table 6. Long-term intervention areas, policy framework, implementation and identified gaps that need to be addressed

Intervention areas	Activities	Priority	Policy framework	Implementation tools/envisaged solutions	Identified gaps
Native forests management	Expand the elaboration and adoption of FMPs for native forests; incentivize the small and medium native forest owners to apply for subsidies for SFM	High	Chile Forest Policy 2015–35	The upgraded LBN and the enabling economic environment for native industrial wood are the envisaged tools.	Analytical Financing (potentially, some needs can be covered through ERPA)
	Strengthen the extension services for native forest management	High	ENCCRV (US.1 - <i>Institutional forest management program focused on public and private land</i>)	Can be based enabled by the institutional reform (SERNAFOR) or based on incentives included in reformed LBN	Financing (potentially, some needs can be covered through ERPA) TA / Knowledge Sharing.
	Ecological reconstruction actions based on FMPs, including plantations with native species	High	ENCCRV measures (MT.5 - <i>Strengthening ecological restoration program in prioritized communes / areas</i>)	Can be based on incentives in LBN.	Financing (potentially, some needs can be covered through ERPA)
	Develop and validate new silvicultural methods to address the sustainable management of native forests (including economic terms).	High		Carefully designed long-term research programs, including experimental pilots	Financing
	Better regulations and monitoring of wood harvesting activity (including fuelwood)	High	ENCCRV (MT.7 - <i>Strengthening of forest and environmental control programs</i>)	Can be based on law enforcing prerogatives of SERNAFOR	Financing (potentially, some needs can be covered through ERPA) TA/knowledge needed
	Native forests phytosanitary protection	Moderate	ENCCRV (PF.1 - <i>Strengthening of the Phytosanitary Protection Program for native vegetation resources</i>)	Can be based on support measures in LBN, monitoring and low enforcing prerogatives of SERNAFOR. Long term research programs, including the climate change adaptation issues	Financing
	Improve native forest management under criteria of protection, conservation, preservation, and reconnection of fragments; watershed managements.	Medium	Chile forest policy 2015–35	Proper identification of forests with conservation values, elaboration of conservation baselines	Financing Analytical

	NWFP utilization	Medium	Chile Forest Policy 2015–35	Development of sustainable models for NWFP use. Regional associations of producers	
	Design and implement PES	High	ENCCRV (NN.7 - <i>Pilot the incorporation of PES schemes in existing forest incentive programs</i>)	The measure in ENCCRV is focused by ERPA (FCPF)	Financing (potentially, some needs can be covered through ERPA) Analytical TA/knowledge
Institutions and regulations	Reform the institutional frame for INFOR; include more public-related prerogatives.	Moderate	CFP 2015–35	The enhanced institutional framework should channel better funding for long-term projects oriented toward sustainable management of native forests, climate change, ecology, and wildlife	Financing
	Operationalize the Biodiversity and Protected Areas Service (SBAP)	Moderate	National Biodiversity Strategy 2016	In July 2019, the Senate approved the first legislative procedure for the Biodiversity and Protected Areas Service (SBAP). The operationalization of this new framework is delayed	Financing Analytical TA/knowledge
	Resolve the existing technological gaps in the forestry sector, especially those between large wood companies and MSMEs	High	Chile Forest Policy 2015–35	Transfer of knowledge, institutional coordination to facilitate rational management of available capacities and resources	Financing Analytical TA/knowledge
Increased productivity and management. Quality of forest plantations	Expand the adoption and implementation of high-quality silvicultural practices for small and medium plantation owners	High	Chile Forest Policy 2015–35	The new forest development law is the envisaged implementation tool	Financing Analytical TA/knowledge
	Continue afforestation of APF by supporting small and medium landowners	Medium	Chile Forest Policy 2015–35 ENCCRV (RS.1 - <i>Focusing on restoration and inspection program to promote the sustainability of forest management</i>)	Promote sustainable plantation models.	Financing
	Improve legislation to diminish the environmental impact of forest plantations	Medium		Assess the adverse environmental impact of large forest plantation management, and address it.	Financing Analytical TA/knowledge
	Enhance forest plantation productivity through innovation and research	Medium		This measure is largely in the hands of large plantation owners, but the technology transfer to small and medium owners should also be considered	Financing Analytical

	Silvicultural and landscape measures to help prevent fires and stop them from spreading	High	NPPFFF	Promote a more heterogeneous landscape, silvicultural interventions (pruning, firebreaks and firewalls) etc.	Financing
Equity and social inclusion in the forestry sector	Improve social, economic, and environmental conditions for settlements linked to forests	High	Chile Forest Policy 2015–35	The relationships with communities and indigenous people needs to be based on equitable sharing of forestry development benefits.	Financing Analytical TA/knowledge
	Good practices to achieve coexistence and respect for the rights of people and their cultural heritage	High	Chile Forest Policy 2015–35		Financing Analytical TA/knowledge
	Improve working conditions of forestry-sector employees	High	Chile Forest Policy 2015–35		Financing
Awareness and education	Design and implement environmental education and awareness programs	High	Chile Forest Policy 2015–35 ENCCRV (MT.6 - <i>Environmental education and dissemination program</i>)	Continuous awareness and educational programs based on detailed awareness assessments	Financing (potentially, some needs can be covered through ERPA)

Source: Authors' elaboration.

Annex 1.

Chile Forest Cover Map

Country total:

75,695,000 hectares

Total forest cover:

17,930,343 hectares

Planted forests

17.4%

Area: **3,114,223 ha**

Consisting of mainly two species: Radiata pine and Eucalyptus globulus

Native forests

81.6%

Area: **14,636,995 ha**

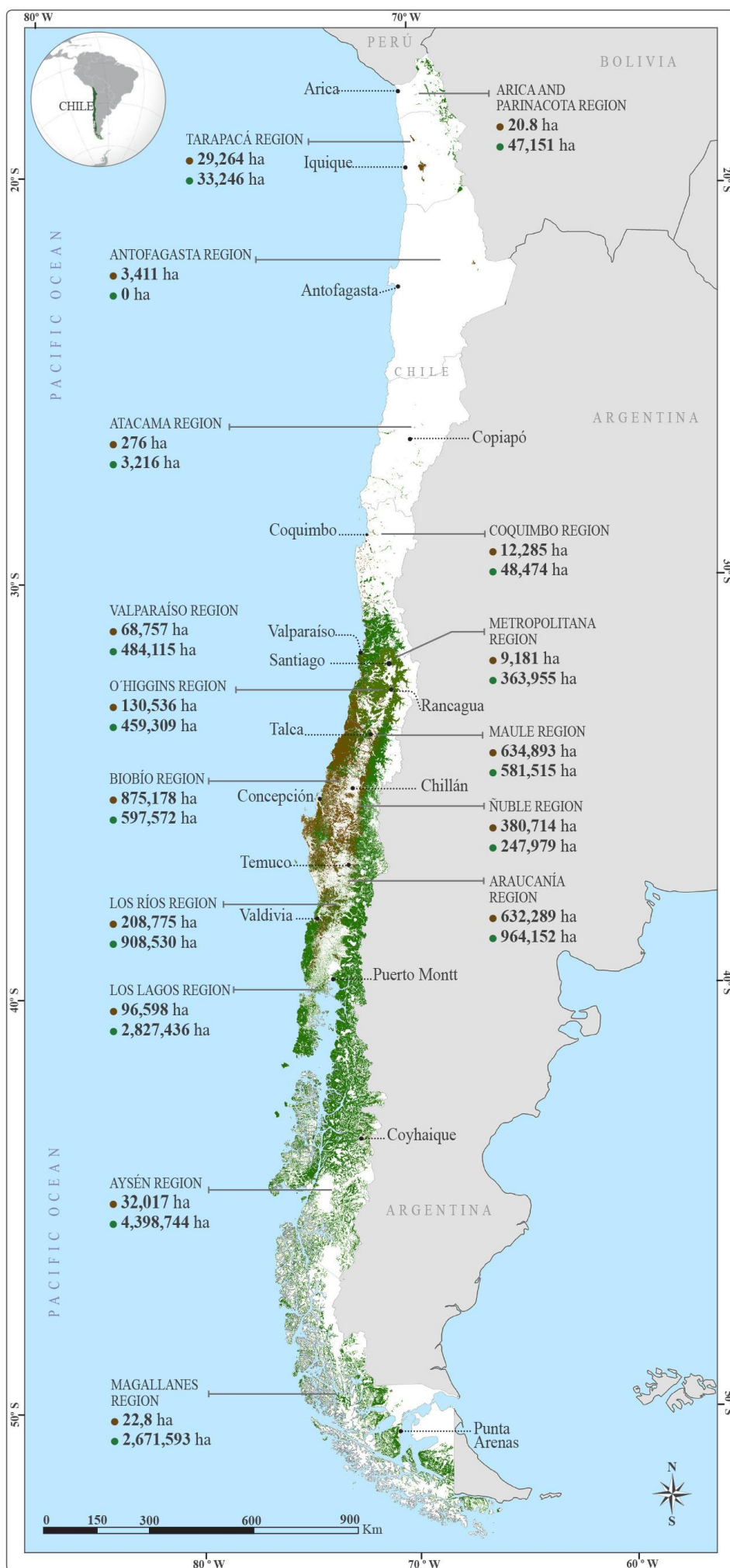
Classified in 12 forest types according to the main species

Mixed Forests

1%

Area: **179,125 ha**

Consisting of a mix of native and exotic species, planted or naturally regenerated



Annex 2. Forest coverage by region

Region	Forest plantations (ha)	Native forests (ha)	Mixed forests (ha)	Total (ha)
Arica y Parinacota	20.8	47,151.3	-	47,172.1
Tarapacá	29,264.2	33,246.4	-	62,510.6
Antofagasta	3,411.2	-	-	3,411.2
Atacama	-	-	-	-
Coquimbo	12,285.1	48,474.9	886.4	61,646.4
Valparaíso	68,757.9	484,115.7	724.6	553,398.1
Metropolitana	9,181.0	363,955.3	218.0	373,354.3
O'Higgins	130,536.4	459,309.1	545.7	590,391.1
Del Maule	634,892.5	581,515.3	28,674.8	1,245,083.6
Biobío	1,255,890.0	845,552.3	68,687.4	2,170,129.7
La Araucanía	632,289.0	964,152.9	47,639.5	1,644,081.3
Los Ríos	208,775.2	908,530.7	17,866.0	1,135,171.9
Los Lagos	96,598.8	2,827,436.4	12,799.3	2,936,834.5
Aysén	32,017.3	4,398,744.8	1,083.0	4,431,845.1
Magallanes	22.8	2,671,593.9	-	2,671,616.7
Total	3,113,943.2	14,633,788.8	179,124.6	17,926,846.6

Source: INFOR (2019).

Annex 3. Types of native forest in Chile

Forest Type	Surface (ha)	Share (%)	Latitudinal range	Description
<i>Esclerófilo</i>	1,628,216.5	11.1	32°–38°	This forest type includes several forest communities within the Mediterranean climate of Chile. The common characteristic of these communities is the dominance of sclerophyllous species.
<i>Palma Chilena</i>	15,085.0	0.1	32°20'–34°30'	It is dominated by <i>Jubaea chilensis</i> . It grows only within the Mediterranean climate but in western slopes and humid valleys. The main tree species associated with this forest type are those of the <i>Sclerophyllous</i> forest type, which have a greater or lower density according to the density of the palms.
<i>Roble - Hualo</i>	230,870.5	1.6	32°50'–36°50'	This forest type also grows within the Mediterranean region, but in its most humid areas. <i>Nothofagus obliqua</i> and/or <i>Nothofagus glauca</i> are the species that give the name to the forest type. The lowest elevations where this forest type grows in both Cordilleras have been dramatically transformed into plantations of exotic species.
<i>Roble - Raulí - Coigüe</i>	1,654,880.1	11.3	36°30'–40°30'	This forest type grows in the submediterranean and temperate oceanic climates. It is comprised of secondary or pure forests of the species <i>N. obliqua</i> , <i>N. dombeyi</i> , and/or <i>N. nervosa</i> . It is a forest type of anthropogenic origin, since the secondary forests that characterize it did not exist before human disturbances. It is a forest type of a high economic relevance, since the species are highly valued and the forests quite easy to manage.
<i>Coigüe - Raulí - Tepa</i>	845,921.5	5.8	37°–40°30'	Where <i>N. nervosa</i> and/or <i>N. dombeyi</i> have more than 50% of the individuals in an area or stand, then the forest belongs to the Coihue-Raulí-Tepa type. <i>Laurentia philippiana</i> is always a main component species of this forests, but <i>Saxegothea conspicua</i> and <i>Dasyphyllum diacanthoides</i> are also generally present.
<i>Araucaria</i>	252,216.9	1.7	37°40'–40°48'	<i>Araucaria araucana</i> is commonly associated with <i>N. dombeyi</i> , <i>N. pumilio</i> , <i>N. antartica</i> , and also with <i>N. obliqua</i> at the lower elevations of the forest type. However, most typically <i>A. araucana</i> is mixed with <i>N. pumilio</i> and/or <i>N. dombeyi</i> .
<i>Ciprés de la Cordillera</i>	73,005.6	0.5	34°45'–44°	In Chile this forest type is comprised of pure forests of this coniferous species or mixed forests with evergreen or deciduous <i>Nothofagus</i> species. Stands dominated by <i>Austrocedrus chilensis</i> are inserted within other forest types (Roble-Hualo, Roble-Raulí-Coihue, Coihue-Raulí-Tepa, lenga, or Siempreverde), depending on the latitude.
<i>Alerce</i>	216,129.5	1.5	39°50'–43°30'	<i>Fitzroya cupressoides</i> is a magnificent tree not only because of its dimensions (it can reach up to 5 m in diameter and more than 50 m in height), but also for being the second longest living species, with a record of at least 3,600 yrs (Lara and Villalba, 1993).
<i>Siempreverde</i>	3,504,793.4	23.9	38°30'–47°	One main characteristic of this forest type is that it is only comprised of evergreen species, most broadleaved trees.
<i>Lenga</i>	3,633,340.2	24.8	36°50'–56°	<i>N. pumilio</i> and <i>N. antartica</i> are the two Chilean <i>Nothofagus</i> species with the longest distribution along Chile, although the species are present almost exclusively in the Andean Cordillera.
<i>Ciprés de las Guaitecas</i>	579,966.3	3.9	40°–54°	This forest type grows in both Cordilleras and the central depression, but in its northern distribution it is usually present as small discrete stands in the so-called “Mallines” that correspond to concave areas where small stream water is temporally stored.

<i>Coigüe de Magallanes</i>	1,999,353.8	13.6	47°–55°30'	This forest type grows where the South American continent has its southern end, in the islands, archipelago, and coastal areas. The forest type is defined by the existence of more than 50% of <i>N. betuloides</i> trees in a forest stand.
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Source: Gardner et al. (2006); Donoso and Donoso (2007), INFOR (2019).

Annex 4. Land degradation and drought in Chile

In Chile, desertification, land degradation, and drought (DLDD) are factors that directly affect the vulnerability of the country to the impacts of climate change. The Chilean territory is severely affected by DLDD and needs to urgently implement measures to reduce its effects on the quality of life of its inhabitants. Desertification has been listed as one of the most severe socioenvironmental problems in Chile. The arid and semi-arid lands affected by these processes account for more than 60 percent of the national territory, and they generally suffer the highest impact on soils, biodiversity, and silvo-agricultural productivity. The rural population living in these areas are directly affected, which translate into high rates of poverty, lack of opportunities, and strong migration rates (Frau et al. 2010). According to the latest update of the national DLDD risk map in 2016, an estimated 57.5 million hectares, which represent 76 percent of the country, are affected in one of the DLDD categories (severe, moderate, or mild). The affected population nationwide amounts to 11.6 million inhabitants, representing 65 percent of the country's inhabitants, who are distributed in 295 counties nationwide (CONAF – UCSSA 2016). In addition to this, scientists forecast a widespread warming throughout Chile, with rates of increase that vary regionally from 1° to 3.5 °C, and the drying of much of the national territory due to the greater water deficit (precipitation). A drier and warmer climate deepens the stress on natural vegetation, agricultural and forest plantations, and facilitates the occurrence of large-scale forest fires, extending the fire season to most of the year in the south-central part of Chile (UTEM 2019).

Chile features the highest water stress risk level in Latin America (WRI 2019). Since 2010 the south-central part of Chile has experienced an intense and long-lasting drought, known as megadrought. This event has been the geographically most extensive, prolonged and warmest drought since 1900 (CR 2015). The megadrought continues, with 2019 being one of the driest years in the last six decades. The most affected territories are located between the Coquimbo and La Araucanía regions, with rainfall deficits of about 90 to 30 percent having serious impacts on water availability for various productive activities, the forests, and other ecosystems (Garreaud, et al. 2017). Extensive areas of the country have been declared in a state of agricultural emergency, a water scarcity zone and a catastrophe zone due to extreme drought by the Ministry of Agriculture, Ministry of Public Works and the Ministry of the Interior, respectively. Nationally, it is estimated that approximately 72 percent of the territory in the country has some degree of drought in its different categories (mild, moderate, severe). These figures correspond to approximately 55 million hectares. As for the population affected by a degree of drought risk, it reaches approximately 16 million people, that is to say, 90 percent of the country's inhabitants, with the majority of these people located in the Metropolitan region, home to 6.7 million individuals. According to the Center for Climate Science and Resilience at the University of Chile, about a quarter of the rainfall deficit during the megadrought can be attributed to anthropogenic climate change. This factor will remain in the future, increasing the occurrence of droughts like the current one, as well as desertification in central and southern Chile (CR 2015).

Annex 5. Legal framework of the forest sector in Chile

The list below describes current sectoral regulations, applicable in the regulation, evaluation, and inspection activities carried out by CONAF analysts and examiners, as well as for the management carried out by extension agents, consultants and other users who develop activities around the native forest or forest plantations:

- Decreto Supremo N° 4363, de 1931, del Ministerio de Tierras y Colonización, Ley de Bosques
- Decreto Ley N° 2565, de 1979, del Ministerio de Agricultura, Sustituye Decreto Ley N° 701, de 1974, que somete los Terrenos Forestales a las disposiciones que señala
- Decreto Supremo N° 193, de 1998, del Ministerio de Agricultura, Reglamento General del D.L. N° 701
- Decreto Supremo N° 259, de 1980, del Ministerio de Agricultura, Reglamento Técnico del D.L. N° 701
- Decreto Supremo N° 192, de 1998, del Ministerio de Agricultura, Reglamento para el pago de las Bonificaciones Forestales
- Decreto Supremo N° 66, de 1992, del Ministerio de Agricultura, Fija tarifas por actuaciones e inspecciones que deba realizar la Corporación Nacional Forestal
- Decreto Supremo N° 25, de 2011, del Ministerio de Agricultura, Reglamento de Operadores Forestales del D.L. N° 701
- Decreto Supremo N° 1341, de 1998, del Ministerio de Hacienda, Reglamento que establece Normas Contables aplicables a los contribuyentes que realizan actividades forestales de conformidad al D.L. N° 701
- Ley N° 20.283, Ley sobre Recuperación del Bosque Nativo y Fomento Forestal
- Decreto Supremo N° 93, de 2008, del Ministerio de Agricultura, Reglamento General de la Ley sobre Recuperación del Bosque Nativo y Fomento Forestal
- Decreto Supremo N° 82, de 2010, del Ministerio de Agricultura, Reglamento de Suelos, Aguas y Humedales
- Decreto Supremo N° 95, de 2008, del Ministerio de Agricultura, Reglamento del Fondo de Conservación, Recuperación y Manejo Sustentable del Bosque Nativo
- Decreto Supremo N° 96, de 2008, del Ministerio de Agricultura, Reglamenta los recursos destinados a la investigación del Bosque Nativo
- Decreto Supremo N° 80, de 2008, del Ministerio de Agricultura, Reglamento del Consejo Consultivo del Bosque Nativo
- Decreto Supremo N° 531, de 1967, del Ministerio de Relaciones Exteriores, Convención para la Protección de la Flora, Fauna y las Bellezas Escénicas Naturales de América
- Decreto Supremo N° 490, de 1976, del Ministerio de Agricultura, Declara Monumento Natural a la especie forestal Alerce
- Decreto Supremo N° 43, de 1990, del Ministerio de Agricultura, Declara Monumento Natural a la Araucaria Araucana
- Decreto Supremo N° 13, de 1995, del Ministerio de Agricultura, Declara Monumento Natural las especies forestales Queule, Pitao, Belloto del Sur, Belloto del Norte y Ruil
- Decreto Ley N° 873, de 1975, del Ministerio de Relaciones Exteriores, Convención sobre el Comercio Internacional de Especies Amenazadas de Fauna y Flora Silvestres
- Decreto Supremo N° 83, de 2010, del Ministerio de Agricultura, Clasificación de Suelos Agropecuarios y Forestales en todo el País.

Annex 6. Chile Forest Policy 2015–35: Results, objectives, and targets for general objective 2 (productivity and economic growth)

Impact objectives	Results objectives	Targets
2.1. Increase the quantity, quality and productivity of plantations, incorporating small and medium owners and producers in the sector into the country's forest development process.	2.1.1. Increase afforestation and subject plantations of exotic and native species to high standard and quality management, incorporating small and medium forest and industrial owners and producers into the country's forest development process.	<p>2020: At least 50,000 ha are forested on land of small and medium owners. At least 100,000 ha of the current plantations held by small and medium-sized owners are in a high-quality and high-quality management process.</p> <p>2025: At least 200,000 ha have been forested on land of small and medium owners, and 100 percent of them are under high quality and high quality management. At least 200,000 ha of the current plantations held by small and medium-sized owners are in the process of high quality and high standard management.</p>
	2.1.2. Promote and support small and medium forest and industrial owners and producers for the continuous increase in the quality and productivity of plantations through state promotion, technological transfer, associativity, and productive chains.	<p>2020: The operation of at least one associative entity has begun in each of the regions of the central-southern zone of the country, whose central focus is the increase in productivity, innovation, and application of appropriate technologies in forest management, guiding them to capture value to maximize economic returns; and in forest raw material processing plants, to improve the quality of their products and obtain competitive and profitable prices in the market.</p> <p>2025: Associative entities of small forest and industrial producers operating under the regime in order to increase productivity, innovation and application of appropriate technologies in the management of forests, orienting them to capture value to maximize economic returns; and forest raw material processing plants, to improve the quality of their products and obtain competitive and profitable prices in the market.</p>
2.2. Promote the sustainable productive function of the native forest, orienting it toward the production of high-value timber goods, considering silvicultural management and the limits imposed by the functions of the forest related to the protection of nature, conservation of biodiversity, and the needs of the local communities.	<p>2020: 100,000 ha of native forests have been incorporated into sustainable forest management with the production of high-value goods.</p> <p>2025: 300,000 ha of native forests have been incorporated into sustainable forest management with the production of high-value goods.</p> <p>2035: 1 million ha of native forests have been incorporated into sustainable forest management with the production of high-value goods, with strong state support in matters of development, training, and technical assistance.</p>	
2.3. Consolidate the significant contribution of the forestry sector to energy security and independence and decarbonization of the country's primary energy matrix, increasing the production and use of biomass certified in origin and quality.	<p>2020: The forestry sector, through biomass, makes an effective contribution of 26 percent to the primary energy matrix, with 10 percent of products certified in origin and quality.</p> <p>2025: The forestry sector, through biomass, makes an effective contribution of 28 percent to the primary energy matrix, with 20 percent of the products certified in origin and quality.</p> <p>2035: The forestry sector, through biomass, makes an effective contribution of 30 percent to the primary energy matrix, with 50 percent of the products certified in origin and quality.</p>	
2.4. Significantly expand—in extension, quality, and sustainability—the generation of	<p>2020: Sustainable models for the use of the main nonwood forest products have been developed. The main nonwood forest products destined for export generate income of \$100 million.</p>	

nonwood forest products associated with forest resources.	<p>Regional associations of producers have been created that have information and develop models for the use of these products, increasing penetration in international markets of high valuation and demand, with products registered commercially, with designations of origin and that conform to international regulations.</p> <p>2025: Information and sustainable models are available for harvesting and processing of the main nonwood forest products. The main nonwood forest products destined for export generate income of \$150 million.</p> <p>2035: Exports of nonwood forest products triple current levels, reaching amounts close to \$240 million / year, adding value by increasing the quantity and quality of products, relying on sustainable management models, in harvesting, harvesting and processing, optimized and applied by associative entities.</p>
2.5. Make wood one of the main components of construction materials in the country, substantially increasing their use in housing, industry, and public infrastructure, based on a standardized product certified by the lumber industry.	<p>2020: 20 percent of the materials in homes, industry, and public infrastructure use wood intensively.</p> <p>2025: 30 percent of the materials in homes, industry, and public infrastructure use wood intensively.</p> <p>2035: Double the proportion of wood in housing construction, industry, and public infrastructure.</p>
2.6. Resolve the existing technological gaps in the forestry sector, and coordinate the pertinent public and private entities, distributing roles and responsibilities for an optimal use of the resources destined to diminish these gaps.	<p>2020: The Ministry of Agriculture, through the public forestry institutional framework, with the advice of the Forest Policy Council, has identified the technological gaps, especially those verified between the most developed industrial subsector and the SME in wood, which must be resolved within the framework of the nesting sector development strategy, and assumes the task of coordinating public and private technological entities, to facilitate rational management of available capacities and resources.</p> <p>2025: The research and technological development policy of the forestry sector is operating in a regime, with the pertinent institutionality of the Ministry of Agriculture and with the formal and active participation of the other organisms that act in this field, such as universities, research centers of the productive sector, and nongovernmental organizations related to the forestry sector.</p> <p>2035: The Ministry of Agriculture, through the public forestry institutional framework, with the advice of the Forest Policy Council, has identified the technological gaps, especially those verified between the most developed industrial subsector and the SME in wood, which must be resolved within the framework of the nesting sector development strategy, and assumes the task of coordinating public and private technological entities, to facilitate rational management of available capacities and resources</p>

Source: CFP (2015).

Annex 7. 2017–25 Chilean Strategy for Climate Change and Vegetation Resources (ENCCRV)

General Purpose

Reducing the social, environmental, and economic vulnerability created by climate change, desertification, land degradation, and drought on the plant resources and human communities that depend on them, in order to increase the resilience of ecosystems and contribute to mitigate climate change, promoting the reduction and capture of greenhouse gas emissions in Chile.

Specific Objectives

01: Contributing to complying with the commitments assumed by Chile in terms of plant resources, before the UNFCCC, UNCCD, CBD, and other national and international organizations.

02: Influencing technical, political, and financial decisions that would allow better positioning the role of plant resources to mitigate and adapt to climate change, combat desertification, land degradation and drought, as the main priorities in industry development policies.

03: Managing mechanisms for the assessment and valorization of environmental services provided by native plant resources, including pay-for-performance systems in conformity with benefit sharing, and environmental and social safeguards.

Adaptation Goal:

Reducing the vulnerability associated with the land degradation risk by way of the management of plant resources, through the direct intervention of at least 264,000 hectares between 2017 and 2025. The contribution to the vulnerability reduction will be assessed in terms of indicators associated with biodiversity, provision of ecosystem services —such as water supply and flow regulation, and water quality—and soil productivity.

Mitigation Goal:

Reducing the GHG emissions associated with degradation and deforestation by 20 percent by 2025, based on emissions from the 2001–13 period, as well as increasing the capacity of plant resources as a carbon sink.

Drivers	Strategic actions	ENCCRV action measures	Goals
All drivers	Crosscutting measures (MT)	MT.1. Inclusion of climate change, desertification, land degradation, and drought related-issues in new law of forest development	Law published
		MT.2. Modification and strengthening of the Law No. 20.283 on Recovery of the Native Forest and Forest Development and its regulations	Law published
		MT.3. Adjustments for the inclusion of owners with poor legal land tenure	Modified regulations – 800 owners
		MT.4.* Reforestation and revegetation program in prioritized communes/areas	140,000 ha
		MT.5.* Strengthening ecological restoration program in prioritized communes / areas	20,000 ha
		MT.6.* Environmental education and dissemination program	8,000 people
		MT.7.* Strengthening of forest and environmental control programs	200 communes
		MT.8. Strengthening and updating of management plans for SNASPE areas in the context of the ENCCRV	50% SNASPE
Forest fires	Preventive silviculture and post-fire restoration (IF)	IF.1. Estimation of greenhouse gas emissions and analysis of fire severity	100% of analyzed forest fires.
		IF.2.* Ecosystem restoration program in areas affected by forest fires	10,000 ha
		IF.3.* Preventive forestry program in urban-rural interface	8,000 ha
		IF.4. Strengthening of the “Prepared Communities against forest fires” Program	40 communes
		IF.5. Inclusion of elements of preventive management and post-fire restoration in Law No. 20.283 and its regulations	Law published

		IF.6.* Technological transfer program on alternatives for the management and use of forestry and agricultural waste 2017	100% communes with programmes
Unsustainable use of vegetation resources	Promotion of sustainable forest management models (US)	US.1.* Institutional forest management program focused on public and private land	70,000 ha 100 extension workers
		US.2. Integrated system of regulation and tax exemption for the promotion of productive value chains	Regulations promulgated
		US.3.* Strengthening the dendroenergy program and the country's energy matrix	16,000 ha
Expansion of agricultural and livestock activities	Promotion of sustainable agricultural land management (RH)	RH.1. Modification of the Law No. 19.561 that exempts reforestation from agricultural land recovery	Modifications published
		RH.2. Incorporation of forest conservation variables in the Law No. 18,450	Modifications published
		RH.3. Limit the application of Law No. 20.412 in lands suitable for forestry activities (APF)	Modifications published
Unsustainable Cattle grazing	Promotion of integrated silvopastoral models (MG)	MG.1. Damping strips for livestock activity	800 ha
		MG.2. Strengthening and expansion of livestock management councils	16 new councils
		MG.3. Agricultural and livestock research program	8 projects
Climate Change effects	Promotion of adaptive management models (GA)	GA.1.* Adaptation program for the management of vegetative resources in the context of climate change, desertification, land degradation and drought	80 communes
Pests and Diseases	Promotion of native plant protection measures (PF)	PF1. Strengthening of the Phytosanitary Protection Program for native vegetation resources	300,000 ha protected, 240,000 ha with prevention, 240 people trained
Expansion of monoculture plantations	Promotion of sustainable plantation models (RS)	RS.1. Focusing restoration and inspection program to promote the sustainability of forest management	40 selected areas
Low economic value of native forests	Payment for Environmental Services	NN.1. Pilot the incorporation of PES schemes in existing forest incentive programs (MT.1; MT.2; US.1)	

Source: WB (2019), FAO (2019a).

Note: *Actions supported by GCF (FAO 2019a); FCPF plans to support all activities (WB 2019).

Emission Reductions Payment Agreements (ERPA)		
Fund:	Green Climate Fund (GCF)	Forest Carbon Partnership Facility (FCPF)
Implementing Partners:	UNFCCC, FAO	World Bank, AGCID
Period:	2014–16	2018–25
Amount:	USD 63.6 million	\$26 million
Volume:	12.7 million tCO ₂ e	5.2 million tCO ₂ e
Regions:	Maule, Ñuble, Biobío, La Araucanía, Los Lagos, and Los Ríos	
Activities:	Conservation, afforestation, restoration, sustainable management and preventive forestry with native species, environmental training and education, among others	
Beneficiaries:	Mainly small forest owners according to benefit sharing system	

Source: WB (2019), FAO (2019a).

Annex 8. Principles of Chilean Sustainable Forest Management Certification System (CERTFOR)

The minimum requirements that a forest company should meet in order to obtain the CERTFOR-PEFC certificate are:

1. Planning and long-term objectives

The use of forest resources must be planned and managed according to the concept of SFM in order to provide a sustained flow of goods and services in successive rotations.

2. Forest conservation and high-value areas

Land-use change, such as the substitution of native forests, should be avoided, and high conservation value (HCV) areas should be preserved.

3. Maintenance of forest resources

Forest resources must be managed in order to maintain their health, vitality, and productivity, and to protect them from fires and other harmful agents.

4. Biodiversity, soil, and water

Biodiversity conservation, maintaining soil productivity, and minimizing adverse impacts on the quality and quantity of water, particularly considering the needs of downstream communities, should be promoted.

5. Local communities

The security of local communities should be safeguarded, and their traditions and customs, as well as their rights and resources, should be respected, promoting their development through good relationships.

6. Indigenous peoples

Declared agreements, documented commitments and legally established rights should be respected, as well as the traditional knowledge of indigenous peoples.

7. Labor relations

Forest workers' rights must be respected, and adequately and equitably compensated, safeguarding their occupational health and safety.

8. Laws, treaties, and agreements

Chilean laws and international agreements and treaties ratified by Chile must be respected, and nonbinding agreements of which the country is a signatory must be considered.

9. Monitoring and assessment

Those responsible for the forest management unit should perform an annual monitoring of forest resources and their management system.

Annex 9. World Bank involvement (forestry sector directly or indirectly related projects since 2010)

Project	Amount (USD)	Implementation period	Description
P155973: Strengthening Chile's national agriculture and forestry innovation system	400,000	2009–14	WB has worked with the government of Chile to develop a long-term strategy for agricultural innovation to accelerate growth in the agrifood sector. The approach of the final analytical product was to create the recommended innovation coordination unit within MINAGRI to implement the actions agreed in the early two analytical activities.
P111918: CL Securitization and Carbon Sinks Project	3,870,000	2010–18	The project resulted in 2,917.6 ha planted, contracts signed for conservation of around 300 ha, 12 small- and medium-scale landholders receiving annual economic benefits through the project on an annual basis.
P085621: Sustainable Land Management Project	5,800,000	2013–ongoing	WB is supporting the government in developing a Sustainable Land Management Framework to address issues related to desertification, land degradation, and drought that the country is facing by strengthening the coordination among the Ministry of Agriculture's extension services and piloting its use in 30,000 hectares of degraded land in five regions of the country.
P130378: Market Instruments for climate change mitigation in Chile	4,980,000	2014–19	The project supported the development of a monitoring, reporting, and verification framework and registry established within the energy sector. The project informed the GoC about climate change mitigation alternative instruments, such as mitigation compensation mechanisms.
P152820: CL Technical Assistance for Geothermal Development in Chile	3,500,000	2016–ongoing	Assist the government of Chile to improve geothermal energy market conditions by removing key barriers, leading to sustainable investments in this sector.
P124908: Chile FCPF Readiness Preparation Grant	8,800,000	2014–ongoing	Chile's National Forestry Corporation conducted a series of diagnostic studies that helped elaborate the National Strategy for Climate Change and Vegetation Resources (ENCCRV, for its Spanish acronym), putting native forests at the center of the sector's mitigation and adaptation efforts.
P171055*: Chile Country Forest Note and High-Level Forest Event	250,000	2019–ongoing	The objective is to disseminate the success story of the Chilean forest sector and highlight the role of forests in mitigating climate change at UNFCCC COP25, and to identify the key challenges and opportunities for the management of Chile's forests in the future.
P160277*: Chile REDD+ Emissions Reductions Program	26,000,000	2019–ongoing	Provide results-based payments to Chile for the GHG emission reductions achieved through the implementation of the ENCCRV.

Source: www.worldbank.org

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Notes

¹ South American and Oceania surface.

² <https://tradingeconomics.com/chile/unemployment-rate>

³ <https://www.nordeatrade.com/en/explore-new-market/chile/economical-context>

⁴ (a) small island countries; (b) countries with low-lying coastal areas; (c) countries with arid and semi-arid areas, forested areas and areas liable to forest decay; (d) countries with areas prone to natural disasters; (e) countries with areas liable to drought and desertification; (f) countries with areas of high urban atmospheric pollution; (g) countries with areas with fragile ecosystems, including mountainous ecosystems; (h) countries whose economies are highly dependent on income generated from the production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and (i) land-locked and transit countries.

⁵ It includes adult plantations, young plantations, freshly harvested areas (which may be reforested) and exotic wild forests. There is no discount for roads, log yards or other that are within the unit or polygon of the plantation (INFOR 2019).

⁶ Corresponds to a mixture of two situations: (a) native forest (adult or secondary forest) and planted species and (b) native forest (adult or secondary forest) with exotic naturalized species.

⁷ Forest area decreased in the world at a rate of 5 million hectares per year. In percentage terms forests worldwide have decreased from 31.6 percent in 1990 to 30.6 percent in 2015, and in Latin America and the Caribbean from 51.3 percent to 46.4 percent in the same period.

⁸ According to Chilean legislation, native forest is the forest that is composed of native species, originating from natural regeneration, or canopy plantation that may have the accidental presence of exotic species.

⁹ Any tract of natural forest with a minimum extent so as to integrate a core area where edge effects are minimal, and which maintains a complex vertical structure dominated by large (old) shade-tolerant trees with emergent pioneers, with a species composition that has not been significantly modified (by recurrent human impact or other large disturbance at least during the past two centuries) (Armesto et al. 2009).

¹⁰ The data of this chart differ from the rest of numbers reflected through out the note, given that it corresponds to information obtained between 2005 and 2013, study titled “Elaboración del Panel sobre la base de datos de “Población y Asentamientos Humanos en el ámbito de las Comunidades Agrícolas”; JUNDEP/INE/INDAP, Santiago, Chile).

¹¹ Growth rates of 30–40 and 40–50 m³/ha/year for *E. globulus* and *E. nitens*, respectively (Geldres and Schlatter 2004; Munoz et al. 2005)

¹² These projections were obtained by using a model of mathematical programming that maximizes the physical offer of standing wood for the three main species as a whole: *Pinus radiata*, *Eucalyptus globulus* and *Eucalyptus nitens*, fulfilling restrictions of crop age and handling schemes that guarantee the physical sustainability of the offer through time.

¹³ Large companies - planted land exceeding 30,000 ha; medium-sized companies - planted land exceeding 5,000 ha and smaller than or equal to 30,000 ha; medium-sized owners - planted land exceeding 200 ha and smaller than or equal to 5,000 ha (for the Coquimbo and Aysén regions the lower limit is bigger than 400 ha); small-sized owners - planted land under 200 ha (for the Coquimbo and Aysén regions should be under 400 ha).

¹⁴ With ammendments and updates.

¹⁵ DL 701 was completed by a series of subsequent regulations (<https://www.conaf.cl/nuestros-bosques/plantaciones-forestales/dl-701-y-sus-reglamentos/>)

¹⁶ Details regarding the process can be found on CONAF web page. For instance, the updated list of forest consultants is available at <https://www.conaf.cl/nuestros-bosques/bosques-en-chile/listado-de-consultores-forestales-conaf/>.

¹⁷ This implies that the forest sector uses lands with a low opportunity cost, which is an important advantage since it allows for the development of areas that would otherwise be unproductive (Cabaña 2011).

¹⁸ According to CONAF studies, from 1970 to 1974, almost 170,000 hectares were planted, both by the public and private sector, 111,000 hectares by the state and just over 58,000 by individuals. In 1981, on the other hand, 91,628 out of 91,729 hectares were planted by private parties, and only 101 hectares by the public sector.

¹⁹ It refers to the potential of the country's private native forests, excluding the State-Protected Wildlife Areas (under SNASPE).

²⁰ Three large companies own 64 percent of plantations, 100 percent of pulp mills, 81 percent of paper and cardboard plants, 75 percent of wood-panel factories, 37 percent of chip production, 26 percent of sawmills, and 36 percent of nurseries. These three companies also have been the main beneficiaries from the afforestation subsidies (Reyes and Nelson 2014)

²¹ Direct measures include those that directly generate GHG emissions through specific investments in activities on the ground (e.g. re/afforestation, forest management, etc.). Enabling measures include those with an indirect effect on GHG emissions through policy or regulatory reforms (WB 2018).

²² Selectively harvesting the better and larger trees, without considering silvicultural protection or regeneration aspects (rates on biological increase) for the residual forest (Donoso 1999).

²³ Almost 25 percent of registered species are endemic, while about 46 percent of native vascular are endemic.

²⁴ The first site protected by the state, called the Malleco Forest Reserve, was created with the purpose of safeguarding a forested area in southern Chile and regulating logging activity

²⁵ It is worth mentioning that the Aysén and Magallanes regions in the southern end of the country concentrate over 80 percent of the total area under protection, leaving less than 20 percent for the rest of the national territory

²⁶ Since 1981, 14 Ramsar sites have been established covering an area over 362,020 hectares. Ten areas recognized as Biosphere Reserves by UNESCO cover 10,937,253 hectares. There are five World Heritage Sites under the UNESCO World Cultural and Natural Heritage Convention, with the Rapa Nui National Park standing out for its world-renowned natural, cultural, and archaeological value.

²⁷ CDT estimates the annual national consumption of firewood at 7.0 million cubic meters (CDT, 2016) and Universidad Austral de Chile estimated a consumption of 13.1 million cubic meters of solid (UACH, 2013). Certainly, these differences generate a series of inconsistencies in national statistics, because the study by Universidad Austral de Chile has been the CONAF National Wood Energy Strategy estimates base, among other important national initiatives. The UACH (2013) statistic is in agreement with the FAO data included in the INGEL, which estimated the volume of consumption of native firewood at around 8 million m³ solid. The ENCCRV, for its part, uses this value, indicating that it reaches between 8-9 million m³ of solid per year and proposing actions and strategies according to this information. With data from CDT (2015), it is estimated that the consumption of native firewood would only reach 4 million m³.

²⁸ The indigenous peoples of the Andes followed the Inca system of beliefs and rituals related to the *Pachamama*, considered as the mother of earth and space. The Mapuche ask permission to the *Ngen* (spirits of nature) to enter the forest in order to collect fruits or extract medicinal herbs. Certain trees also have a spiritual significance, such as the *Araucaria* and the *Canelo*, which is considered a sacred plant due to its healing effects.

²⁹ The occurrence of fires reveals only a slight upward trend between 1984 and 2018, averaging between 6,000 and 7,000 forest fires per year. However, during the last 10 years the average number of affected hectares has increased significantly affecting just over 107,000 hectares per year, in comparison to an annual average of 65,000 hectares during the entire 1984–2018 period. Similarly, the average for the last five years increased dramatically, reaching almost 165,000 hectares.

³⁰ For other land uses, these indicators were closer to 0.25 percent in the 1998–2008 period, and increased to 0.4 percent for native forests and grasslands, and 0.6 percent in the case of thickets for the 2008–2018 period.

³¹ Data provided by CONAF officials during the elaboration of CFN in May 2020.

³² In the case of a city such as Valdivia, it can average 63,000 MJ/household/year, which is two to four times higher than that of cities in developed countries at the same latitude.

³³ Lenga rotation cycle is around 120 years, Roble-Raulí rotation cycle is no less than 40 years (Grosse and Quiroz 1999).

³⁴ Forestry suitability of the soils in Chile is almost 46 percent of the national territory (CIREN 2010).

³⁵ Additionally, there is an area of 518,000 hectares that was affected by forest fires in the 2016–17 season, of which just over 274,000 hectares are planted forests and another 67,000 hectares are native forests, mostly concentrated in the O'Higgins, Maule, and Biobío regions, raising the national total of land suitable for reforestation to 3.17 million hectares.

³⁶ Extraction and use of firewood as fuel following sustainable forest management criteria can be considered carbon neutral (IPCC).