# CHILE'S FORESTS

A pillar for inclusive and sustainable development





WORLD BANK GROUP









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# ACRONYMS

**AGCID:** Chilean Agency for International Development Cooperation

AIFBN: Association of Forest Engineers for the Native Forest

APF: Preferably Suitable for Forestry

ASP: Wildlife Protected Areas

**BRIDEF:** Metropolitan Anti-Corruption Investigation Brigade

CBD: Convention on Biological Biodiversity

**CERTFOR:** Chilean Sustainable Forest Management Certification System

**CIREN:** Natural Resources Information Center

CLP: Chilean Peso

**CMPC:** Paper and Cardboard Manufacturing Company

**CMSBN:** Conservation and Sustainable Management of Native Forests

**CNE:** Chilean Energy Commission ECLAC: Economic Commission for Latin America and the Caribbean

CO2: Carbon dioxide

**CO<sub>2eq</sub>:** Carbon dioxide equivalent

**CONAF:** National Forestry Corporation

**CONAMA:** Chilean Environmental Commission

COP: Conference of the Parties

**COREF:** Reforestation Corporation

**CORFO:** Chilean Economic Development Agency

**CORMA:** Chilean Timber Industry Association

DGA: General Directorate of Water

DIPRES: Chilean Budget Office

**DL 701:** Decree Law No. 701 on Forest Development

**DLDD:** Desertification, Land Degradation and Drought

**ENCCRV:** Chilean Strategy for Climate Change and Vegetation Resources

**EPG:** Assessment of Government Programs

**ERPA:** Emissions Reduction Purchase Agreement

**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

FOB: Free On Board

FPM: Fine Particulate Matter (PM 2.5)

FRA: Forest Resources Assessment

FSC: Forest Stewardship Council

FTA: Free Trade Agreement

GCF: Green Climate Fund

**GEDEFF:** Department of Forest Development and Promotion

GEF: Global Environment Facility

GHG: Greenhouse Gases

GTZ: German Cooperation Agency

GWh: Gigawatt hours

ha: Hectares

HDF: High Density Fiberboard

INDAP: Agricultural Development Institute

INE: National Statistics Institute

**INFOR:** Forestry Institute

INGEI: Chilean Greenhouse Gas Inventory

INIA: Agricultural Research Institute

**IPCC:** Intergovernmental Panel on Climate Change

**IUCN:** International Union for Conservation of Nature

**IUFRO:** International Union of Forest Research Organizations

LBN: Native Forest Law

LDN: Land Degradation Neutrality

**LULUCF:** Land use, land-use change and forestry

M<sup>3</sup>sub: Solid cubic meter under bark

masl: meters above sea level

**MAIA:** Andean Intercultural Environmental Model

MDF: Medium Density Fiberboard

MDP: Medium Density Particleboard

MINAGRI: Ministry of Agriculture

MMA: Ministry of the Environment

**MOFIN:** Mapuche Intercultural Forestry Model

MW: Mega Watt

NCRE: Non-Conventional Renewable Energy

NDC: Nationally Determined Contribution

NTFP: Non-timber forest products

**OECD:** Organization for Economic Cooperation and Development

**OSB:** Oriented Strand Board

**PANCC:** Chilean Climate Change Action Plan

**PANCD:** Chilean Action Program Against Desertification

PCI: Private Conservation Initiatives

**PEFC:** Program for the Endorsement of Forest Certification

**PGRVTI:** Management Plan for Vegetation Resources in Indigenous Lands

PES: Payment for Environmental Services

**REDD+:** Reducing Emissions from Deforestation and Forest Degradation

**SAG:** Agricultural and Livestock Service

**SBAP:** Biodiversity and Protected Areas Service

SDG: Sustainable Development Goals

SERNAFOR: National Forest Service

SFO: Small Forest Owner

**SIMEF:** Integrated System of Monitoring and Evaluation of Forest Ecosystems

SIT: Territorial Information System

**SNASPE:** National System of State Protected Areas

UACH: Austral University of Chile

UCCSA: Climate Change and Environmental Services Unit

**UF:** Development Unit (Unit of account used in Chile and set according to inflation)

**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

VAT: Value Added Tax

# **EXECUTIVE SUMMARY**

Thanks to a long-term reforestation policy that has allowed the country to recover its forests and develop a strong forestry industry in less than four decades, Chile is currently positioned as a leading global player in the forestry sector. From an environment perspective, it is one of the few countries in the world that has managed to reverse deforestation and increase its forest area, ranking third in the list of countries with the largest increase in forest area worldwide between 2010-2015; and among the twelve countries worldwide that increased their forest cover by more than 10% in the last 25 years, in contrast with the global trend of forest cover loss. Today, forests cover 17.9 million hectares of land throughout the country, of which approximately 82% consist of native forests (14.6 million hectares), 17% of planted forests (3.1 million hectares), and 1% of mixed forests (179,125 hectares). In the case of planted forests, the majority (almost 95% of the total area) is used to grow pine and eucalyptus species.

The economic success of the Chilean forest industry is also remarkable. While prior to the 1970s the sector had a secondary role in the national economy, today, the forest industry constitutes one of the pillars of the Chilean economy, representing 2.1% of national Gross Domestic Product (GDP). The forest sector is particularly relevant in the south-central parts of the country, where its contribution to the GDP of some regions, such as Biobío and Los Ríos, exceeds 15%. The forest industry is also an important source of employment. In 2018, employment in the forestry sector reached 113,769 jobs, which accounts for approximately 1.5% of the national employment rate. The Biobío region features the highest rate of forestry jobs (37.8%) in Chile.

This remarkable economic growth has been driven by a significant increase in forestry exports over time, reaching in 2018 a historical record of more than USD 6.8 billion, representing 9.1% of Chilean total exports and placing the forestry sector as the third biggest exporting industry after mining, and fishing & aquaculture. This increase in commercial activity has allowed Chile to position itself among the top 20 major exporters of forest products in the world, and to become a leading producer of pulp, plywood panels, woodchips and timber. The national forest industry has also managed to diversify its production to over 370 forest products, 99% of which are manufactured using timber from planted forests. The adherence to a number of sustainable forest management standards has also played an important role in consolidating the sustainability of the Chilean forest sector. On average, approximately 70% of its planted forests are certified, placing Chile well above the world average. According to the Forest Stewardship Council (FSC) records, Chile ranks 11th worldwide in terms of certified forest area, second only to Brazil in Latin America.

These achievements have been largely accomplished do to the existence of a solid and reliable institutional framework that has managed to establish a partnership between the public and private sectors dating back to 1931, with the enactment of the Forestry Law which established the first set of incentives for the development of the forestry sector. These incentives were later reinforced in 1974 with the enactment of Decree Law 701, which allowed leveraging a significant amount of financing from the private sector, resulting in a significant increase in the afforestation rate across the country.

During this period and until 2013, afforestation rates across the country averaged 100,000 hectares per year, with an estimated total investment of around US\$ 69 billion between the private and public sectors to date. These investments were allocated not only for the establishment of the country's existing vast planted forest estate, 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 part of the country, mainly in the Maule, Ñuble, Biobío, Araucanía and Los Ríos regions.

Chile has also made important achievements in the conservation of its biodiversity and natural heritage, with endemic rates of its flora and fauna close to 25%, and 46% for vascular plants. Since the creation of the first Protected Area in 1907, Chile today has increased the extent of its Protected Areas to over 18 million hectares, conserved under the National System of State Wildlife Protected Areas (SNASPE), representing 21.2% of the national territory and four percentage points higher than the target set under the Convention on Biological Diversity. This figure would be even higher if the 1.2 million hectares of land protected under private conservation initiatives were added. Through the SNASPE, 29% of the country's native forests are currently conserved. The country's temperate Valdivian rainforests hold special importance for the conservation of global biodiversity as they are considered one of 35 biodiversity hotspots in the world.

The Chilean forest sector has also achieved important results in terms of innovation and knowledge. Genetic improvement programs have been essential to improve the productivity of fast-growing species such as pine and eucalyptus. Forest resources also have strong 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 National Cadastre of Vegetation Resources, administered by CONAF, and the Continuous Inventory of Forest Ecosystems of Chile administered by INFOR, which is also responsible for maintaining statistical data and economic accounts for the sector.

The forest sector also makes an important contribution to the country's energy security through the generation of Non-Conventional Renewable Energy based on forest biomass. In 2017, biomass contributed 2.1% to the installed capacity of electricity generation of the National Electric System and 24% to the primary energy matrix, surpassing coal and taking the second place in the country's energy balance.

In today's new social and environmental context —both nationally and globally the forest sector also faces new challenges. The most pressing ones relate to the need to continue reforesting the country's degraded lands; mitigating and adapting to the effects of climate change; valuing the goods and services of native forests and integrating them into sustainable development; social validation based on participatory processes with local communities, indigenous people and vulnerable groups, and incorporating a gender perspective; and establishing an institutional framework commensurate to the strategic importance of the forestry sector for the country. These conditions are also essential for Chile to achieve its ambitious international goals set under its Nationally Determined Contribution (NDC) to the United Nations Framework Convention on Climate Change (UNFCCC) and pursuant to the Sustainable Development Goals.

# Chapter 1 COUNTRY CONTEXT

The development of the Chilean forest sector has had remarkable results and can serve as a model for many countries seeking to achieve successful forest management experiences. To better understand the country's lessons learned and the context in which they were developed, this chapter briefly outlines the main enabling conditions that allowed the Chilean forest sector to flourish, organized in four dimensions under a historical perspective.



# **1.1** NATURAL AND HUMAN ORIGINS

The singular Chilean geography has directly contributed to its being a highly forested country, while the variety of its indigenous peoples gave it a unique cultural identity.

The origins and development of the Chilean forest are unique in the world. When South America separated definitively from Antarctica and Australia, a glacial period created the cold Humboldt Current that now bathes the coasts of Chile along the Pacific Ocean. Later, the formation of the Andes mountain range and the Atacama Desert isolated the Chilean forests from other forest ecosystems in the continent. This prolonged isolation is reflected in the high degree of endemism of Chile's ecosystems, as it is estimated that over 45%<sup>1</sup> of its vascular plant species are only found in this region of the planet. Another characteristic of the Chilean landscape is its volcanism, generated by the subduction of tectonic plates, which places Chile in the Pacific Fire Belt. 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% volcanic ash from past eruptions.

Due to its length and location, the Chilean continental territory features a great diversity of climates, plants and types of native forests. Dominated by the dryness of the Atacama Desert, the highlands of Northern Chile have species that are unique in the world, like the Queñoa (Polylepis tarapacana), a tree that is able to grow at more than 4,000 meters above sea level. In this deep desert area, forests grow around oases and feature species such as the Tamarugo (Prosopis tamarugo), which thrives in low humidity and highly saline soils. In central Chile grows a Mediterranean type of vegetation called Sclerophyllous, which is found in very few parts of the world, and that has been deeply damaged by human intervention. The transition forests between the Mediterranean and the temperate climate vegetation, feature a large diversity of tree species of which the Nothofagus genus is the most representative of Chile. From the Araucanía region towards the south, a temperate climate allows for the predominance of evergreen vegetation types, two of which have been declared Natural Monuments: the Araucaria or Pehuén (Araucaria araucana), and the Alerce (Fitzroya cupressoides). These trees can grow more than 50 meters high and live over 1,000 years in the case of the Araucaria, and 3,600 years for the Alerce. In the forests of southern Chile, climbing shrubs are an integral part of forest ecosystems. Many of them are quite singular, either because of their ability to mimic (Boquila trifoliocan) or because of their symbolic nature, as is the case of the Copihue (Lapageria rosea), the Chilean national flower. In the southern end of the country, the Chilean Patagonia features species such as Lenga, Ciprés de la Guaitecas and Coigüe de Magallanes, which spread throughout the western slope of the Andes



<sup>&</sup>lt;sup>1</sup> Rodríguez, Roberto et al. Catalogue of Chile's vascular plants. Gayana Botánica Nº 75, 2018.



Queñoa. Chilean Highland, Tarapaca Region

Copihue (Lapageria Rosea) declared national flower





Araucarias and Nothofagus. Conguillío National Park, Araucania Region

down to Tierra del Fuego Island, where these forest species lose dominance in the transition area towards the Magellanic Steppe. This desert only hosts some hard types of grass such as the coirón, mosses, lichens, and a Subantarctic forest which can be found at both sides of the border with Argentina.

# **CHILE'S NATIVE FOREST TYPES**

According to Chilean law, native forests are those composed of native species, formed through natural generation, natural regeneration or planted understory (below neighboring tree crowns) which may include accidentally-introduced non-native species. According to this definition, 12 forest types have been identified, with the Lenga type being the most abundant, followed by the Evergreen, Magellan Coihue, and Roble-Raulí-Coihue forest types. For the Araucaria and Alerce forest types there is a legal provision that prevents these species from being cut. As of 2018 the forest cover area exceeds 14.6 million hectares. The Los Ríos, Los Lagos, Aysén and Magallanes regions account for 75% of the native forest area. Conversely, there is no forest presence in the Antofagasta and Atacama regions.

The following infographic presents the 12 native forest types of Chile. It is important to mention that most of them are named after the predominant species, except for the Sclerophyll and Evergreen types, which comprise a variety of species. Currently, there is an ongoing proposal to include a thirteenth type pertaining to Queñoa (in the Arica and Parinacota Region) and Tamarugo (Tarapacá Region) forests.



Sclerophyll

Distributed in the Mediterranean climate zone between the Coquimbo and Maule Regions, it comprises several species such as Quillay, Peumo, Espino, Maiten and Algarrobo.



Chilean Palm

Primarily found in the Valparaíso Region, with a lesser presence between the Coquimbo and Maule Regions.



Roble - Haulo

Distributed in the Mediterranean climate zone both along the Coastal and the Andes mountain ranges, from the Metropolitan Region to the Biobio Region.

METROPOLITANA

REGION



Roble - Raulí -Coigue

Distributed between the Maule and Los Lagos Regions, mainly along the Andes mountain range.



Coigüe - Raulí - Tepa

Distributed at mid-altitude along both the Andes and Coastal mountain ranges, between the Maule and Los Lagos regions.



Araucaria

Distributed from the Biobio Region along both the Andes and Coastal mountain ranges, and in the Araucanía and Los Ríos Regions along the Andes mountains, growing at altitudes between 800 and 1,700 masl.



The gray area depicts the regions where the 12 native forest types indicated below are found.







#### **Forests in Northern Chile**

The Queñoa and Tamarugo forests are the two native species in northern Chile. In the Arica and Parinacota Region there are about 47 thousand hectares of Queñoa forests, and in the Tarapacá Region about 7 thousand hectares mainly of Tamarugo species.



# Cypress of the Mountain:

Distributed along the Andes mountain range, between the Valparaíso and the Los Lagos Regions, and along the Coastal mountain range in the Los Ríos Region, between 250 and 1,800 masl.



Alerce

Distributed in a discontinuous pattern along both the Andes and Coastal mountain ranges, between the Los Rios and Los Lagos Regions.

> AYSÉN REGION



Evergreen

Distributed along both the Andes and Coastal mountain ranges, between the Araucanía and the Aysén Regions. Composed by species such as Arrayán, Ulmo, Tepa, Olivillo, Mañío, Luma, Meli, and Canelo.



Lenga Distributed along the Andes mountain range, from Maule to the Magallanes Region.



Cypress of the Gauitecas

Ranging between the Los Ríos and Magallanes Regions.



Coigüe of Magallanes

Ranging between the Los Ríos and Magallanes Regions.

CHILE PACIFIC OCEAN

Source: CONAF. Decree Nº193/1998; Decree Nº259/1980

Punta Arenas

# **CHILE'S MAIN NATIVE SPECIES**

Queñoa (Polylepis tarapacana)



**Distribution:** It grows at an altitude of 3,800 to 5,000 masl, in the Chilean highlands, from the Arica and Parinacota Region down to the Antofagasta Region.

Key Characteristics: Crooked trunk. Reddish scaling bark. Leaves: Perennial, trifoliate 7 by 3 mm.

#### **Tamarugo** (*Prosopis tamarugo*)



**Distribution:** It grows at an average altitude of 1,100 masl, in the Tarapacá (Pampa del Tamarugal) and Antofagasta Regions (Los Flamengos Natural Reserve).

Key Characteristics: Dark brown rough trunk, with irregular fissures. Leaves: Deciduous, alternating from 2.5 to 4.5 cm.



#### Espino (Acacia caven)

Distribution: It grows far from the sea, at an altitude up to 1,500 masl, in the Mediterranean climate area between the Coquimbo and O'Higgins Regions.

# Forest type: Sclerophyll

#### Key Characteristics: Dark brown rugged trunk, with irregular fissures. Leaves: Hard and waxy, partially deciduous, 2 to 4.5 cm. Very fragrant golden yellow flowers.

#### Palma Chilena (Jubaea chilensis)



 Distribution: It grows primarily along the Chilean Coastal mountain range, between the Valparaíso and O'Higgins Regions.

Key Characteristics: Thick trunk with gray, smooth bark, featuring a regular pattern formed by fallen leaves. Leaves: large 2–3 m long feather-shaped pinnate. It produces a fruit called "coquito nuts" that it is edible, and commonly used to make "palm syrup."

Forest type: Chilean Palm.

## Coigüe (Nothofagus dombeyi)



**Distribution:** It grows from sea level to high mountain altitudes, in much of the southern part of the country between the Maule and Los Lagos Regions.

Key Characteristics: Straight, branch-free trunk, with gray bark featuring vertical fissures. Leaves: Perennial, lanceolate, serrated 2 to 4 cm long.

Forest types: Coihue-Rauli-Tepa and Roble-Rauli-Coigue

Araucaria (Araucaria araucana)



#### Natural monument

- **Distribution:** It grows at an altitude between 800 masl up to 1,100 masl (ideal altitude), especially in the Nahuelbuta and in the Andes mountain ranges in the Araucanía Region.
- Key Characteristics: Straight and cylindrical trunk that can reach 3 to 4 m in diameter in individuals that are thousands of years old. Very thick, gray bark with hexagonal fissures. Leaves: extremely hard and resinous, with a 3 to 4 cm long thorn at the end.

Forest type: Araucaria

#### Alerce (Fitzroya cupressoides)

50m

#### Natural monument

- Distribution: It grows discontinuously at an altitude above 600 masl along the Coastal and Andes mountain ranges in the Los Ríos and Los Lagos Regions.
- Key Characteristics: Very thick trunk that can reach 3 to 4 m in diameter in individuals that are thousands of years old. Reddish bark with longitudinal fissures. Leaves: small and thin that resemble scales. Irregular branches forming a pyramidal crown.

Forest type: Alerce



#### Lenga (Nothafagus pumilio)

Distribution: It grows at an altitude of up to 2,000 masl along the Andes mountain range, between the Nuble and Magallanes Regions.

Forest type: Lenga

Key Characteristics: Lenga trees growing in the north feature a twisted and stumpy trunk, while those growing in the south are cylindrical and straight. Leaves: deciduous, rounded and serrated 2 to 4 cm long. Foliage is green in spring and summer, and turns to its typical yellow and red in the fall.

Ciprés de las Guaitecas (Pilgerodendrom uvifera)

Canelo (Drimys winteri)





# 40m T 🔘 provincial data

**Distribution:** It grows at an altitude of no more than 1,000 masl, in the archipelagos of the Aysen and Magallanes Regions.

Key Characteristics: Trunk can reach up to 1 m in diameter. Very hard and thin bark. Leaves: small scale arranged in decussate pairs, and small, flattened shoots.

Forest type: Cypress of the Guaitecas.

Source: CONAF. National Strategy on Climate Change and Vegetation Resources 2017–2025. CONAF, 2016

# Indigenous influence areas and their relationship with native and planted forests

Plantations

Native Forest

**Rapanui** Easter Island Valparaíso Region Arica and Parinacota, and Tarapacá Regions **Quechuas** Antofagasta Region

🏂 Aymara

#### Atacameños Antofagasta Region

 Image: Collas

 Atacama Region

#### **Diaguitas** Atacama and Coquimbo Regions

# Mapuche

According to their geographical location and cultural patterns they are known as Pehuenche, Lafkenche or Huilliche. Biobío, Araucanía, Los Ríos and Los Lagos Regions

**Kawéskar** Puerto Edén and Puerto Natales, Aysén and Magallanes Regions

0

# Yagán Navarine

Navarino Island and Punta Arenas, Magallanes Region

Source: CONAF. Management Plan for Vegetation Resources on Indigenous Peoples Lands. CONAF, 2018





# Indigenous Peoples Population in Chile

Indigenous Peoples	population	0/0
Aymara	156,754	7.17%
Quechua	33,868	1.55%
Atacameño	30,369	1.39%
Colla	20,744	0.95%
Diaguita	88,474	4.05%
Rapanui	9,399	0.43%
Mapuche	1,745,147	79.84%
Kawéskar	3,448	0.16%
Yagán	1,600	0.07%
Otros	95,989	4.39%
TOTAL	2,185,792	12.8%

Source: INE, 2017 Census. INE, 2018



Chemamull (from Mapudungun language: che = person, mamüll = wood). Tirúa area, Biobío Region

Lafkenche woman in Carahue, Araucanía Region

Aymara woman, Arica and Parinacota Region **Chile has a great ethnic and cultural heritage.** The first human settlement recorded in the Chilean territory dates from 14,800 years ago —one of the oldest in America— and was located in Monte Verde, in the south of the country, close to what now is the city of Puerto Montt, in the Los Lagos Region. The first known peoples were a group of fishermen who inhabited the coasts of the Atacama Desert, known as Chinchorros, 7,000 years ago. At present, there are nine officially recognized native peoples in Chile, including the Rapanui people who live on Easter Island, or Rapa Nui. Based on data from the 2017 census, 2,185,792 Chileans belong to native groups, which accounts for 12.8% of the total population, with 79.84% of them identifying as Mapuche, 7.17% as Aymara, and 4.05% as Diaguita. The rest of the indigenous peoples are less than 2%.

**Chile's indigenous peoples maintained a close relationship with forest resources throughout their different stages of development.** 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 which involved clearing an area of forest and cultivating it for two or three years, followed by a fallow period of 15 to 20 years until the soil recovered its vegetation cover (known as shifting agriculture).

Throughout their history, these peoples have also had a spiritual relationship with the forest and wildlife. 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 plow the land, 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.

# **1.2** DEGRADATION OF SOIL AND FOREST RESOURCES

The Spanish Conquest and the subsequent colonization process of Chile's forest lands brought about a severe degradation of the country's soil and forest resources.

During the Spanish colonization and the early stages of the Chilean Republic, forests were thought to be inexhaustible. While there is no accurate record of how much forest area was lost during this period, estimates indicate that at the beginning of the Chilean Independence there were about 24 million hectares of forest, which were reduced to just over 10 million hectares during the first hundred years of the Republic.<sup>2</sup> This decline began with the gradual expansion of settlements and population growth across the country, which not only created a high demand for wood for heating, cooking and construction, but also drove the clearing of forest lands for productive purposes, mainly agriculture and livestock farming.

By the time Chile emerged as an independent Republic in 1810, the condition of its forests and soils had changed dramatically. A turning point occurred by the end of the 17th century, when grain cultivation was promoted in the south-central part of Chile, using fire to clear lands covered by trees. Since the mid-1860s, Chile became a major wheat exporter meeting the demand of Australia and California during the so-called Gold Rush; authorities justified forest fires saying that this was helping create the "Barn of America"<sup>3</sup>. Mining in the north and coal production in central Chile increased these impacts.

With the purpose of promoting economic development in the southern territories of the country, in the mid-19th century the Chilean government promoted a colonization process between what are now the Los Ríos and Los Lagos Regions. Settlers, mostly of German origin, cleared large areas of evergreen forests, including ancient Alerce trees, as the government granted property titles once the lands were "cleared". A similar situation occurred in the Aysén Region (Chilean Patagonia), where as a result of the handover of land to settlers and the promotion of sheep farming (in high demand by the British textile industry), vast areas of native vegetation were intentionally burned in massive wildfires that lasted for years, leading to the loss of native forests.

# **1.3** EARLY ENVIRONMENTAL AWARENESS

In response to the vast extent of soil and forest degradation, the Chilean society developed an early awareness of the importance of forest conservation, which resulted in the enactment of the first forest and environmental legislation and related institutions.

Along with the colonization process in southern Chile, by the end of the 1800s, a number of conservation theories and actions emerged which sought to counteract the deforestation process. Leading intellectuals, scientists and politicians raised their voices against the tragedy inflicted upon the Chilean forests. They claimed that if uncontrolled agricultural policies continued, the country's very survival was at stake. One of the first intellectuals to express his concerns was a French naturalist based in Chile, Claudio Gay, who talked about "the danger of the lack of an effective policy and legislation to protect the country's



Photograph taken in 1896. Settlers on top of a burnt Alerce stump. Jerman Wiederhold's collection

<sup>2</sup> Prado, José Antonio. *Forest Plantations.* Beyond trees. CIFAG, 2015.

<sup>3</sup> Cabaña, Carlos; Benavides, Michele; and Pizarro, Nancy. CONAF: *Its history and role in the forestry and environmental development of the country 1972-2012*. CONAF, 2013



First Pine plantations in Chile

<sup>4</sup> Elizalde, Rafael. *Chile's survival.* SAG, 1970.

<sup>5</sup> Camus, Pablo. Federico Albert: the architect of Chile's forest management. Geography Review of the Big North Nº 30, 2003. natural resources". Chilean politician, writer, historian and naturalist Benjamín Vicuña Mackenna urged for the establishment of a Forestry Code, stating that without it "Chile would become a desert in less than a century".<sup>4</sup> Other prominent intellectuals also referred to the state of the country's forests, but it was German professor and scientist Federico Albert who became the first architect of the protection of forest resources in Chile, by proposing the revegetation with fast-growing species as a solution, and advocating for the creation of the first research and forest development institutions in the country. Albert also claimed that the colonization of the provinces south of the Biobío river, and the privatization of public lands, resulted in the destruction of the nation's forests.<sup>5</sup>

Between the mid 19th and the early 20th century, a series of regulations to protect soil and forest resources were enacted. In this context, in 1849, the first forest protection law for the Chiloé and Llanquihue forests became a reality. Later, in 1871, the "forest logging" act was passed, and in 1879 the "Public Forest Reserves" decree law was approved, which in 1907 allowed for the establishment of the oldest Wildlife Protected Area in Chile, the Malleco Fiscal Reserve; and in 1926 the creation of the Vicente Pérez Rosales National Park, considered as the first National Park in Chile, and second in South America. In 1925 and in order to reverse massive tree logging, a decree was enacted that became known as the Forest Law which regulated native forest harvesting. This law was amended in 1931 to foster large-scale reforestation through tree plantations by means of tax incentives. Under this law, which is regarded as the cornerstone of Chilean forestry legislation, the development of Radiata pine plantations began.

In response to deforestation and soil degradation, throughout its history the Chilean government has created a series of institutions with the aim of promoting an integrated development of the Chilean forestry sector. The first effort to establish a forestry institution in the country was attained in 1873 with the enactment of the General Logging Regulation that stipulated the position of Forest Inspector General and the first Forest Guard Corps. Later, in 1906 the "Water and Forest Division" was created, which was institutionally consolidated in 1911 as the "General Inspectorate of Water, Forests, Fishing and Hunting". Forest planning began to take shape in the beginning of the 1930s, together with the amendment of the Forest Law in 1931. Subsequently, the government promoted a series of reforestation programs, which resulted in the creation of the Reforestation Corporation (COREF), predecessor of the current National Forestry Corporation (CONAF), created in 1972 with the objective of implementing Chile's forest policy, promoting the development of the sector, fighting forest fires, and managing Wildlife Protected Areas. Along with these initiatives aimed at developing a strong forestry sector, Chile also started investing in training forestry professionals. As a consequence, in 1945 the Victoria Technical Forestry School was established and, in 1952, the University of Chile introduced the first Forest Engineering program. In 1954, along with the founding of the Austral University of Chile, the first School of Forest Engineering in the country was established. The country's forest research capacity was further enhanced through the creation of the Forestry Institute (INFOR) in 1961, an entity affiliated with the Ministry of Agriculture with the aim of laying the foundations for a solid productive forestry sector.

# **1.4 PROPERTY RIGHTS**

The evolution of property rights and land tenure in particular during the time of the Spanish colonization and until the present day, is key to understanding the Chilean forestry model.

In Chile, land ownership is mostly private, with state-owned lands limited to those with no productive use, high mountains, ice zones and Wildlife Protected Areas. This is one of the main reasons why Chilean forest plantations have developed mostly on privately owned lands, unlike other countries where forest lands sustaining the national timber industry are owned by the State, which grants and restricts their use through concessions. Chilean property law is regulated and guaranteed mainly by the Civil Code and the Republic's Political Constitution, which represents a fundamental guarantee and grants legal security, which, in the case of the forest sector, was reinforced in 1974 with the enactment of Decree Law 701 on Forest Development, which not only regulates forestry activities, but also reassures private land owners that their forested lands will not be expropriated.

Private property in Chile was first established during the Spanish colonization of the American continent. Prior to the Spanish conquest, there was no unified idea of property in Chile. The main forms of property in indigenous cultures were of a collective nature. As a reward for the military and financial services provided during the conquest, the Spanish Crown granted property rights

to the conquerors, which in some cases included large areas of land that traditionally belonged to the Mapuche people. This phenomenon continued during the Republican era and was complemented towards the end of the 19th century with the establishment of settlers -both Chileans and foreigners- between what are now the regions of La Araucanía, Los Ríos and Los Lagos. This system resulted in the consolidation of most of the rural property, as well as the deforestation of millions of hectares of native forest, the privatization of forest plantations, and the historical claim of land restitution from Mapuche organizations.

Today, 100% of Chilean forest plantations are privately-owned. The



Woman small owner of a forest plantation







boom of the timber industry based on the exploitation of private native forest began during the first half of the 20th century. During the same period, both private companies and the State began establishing forest plantations. Later, in the 1970s, the military government privatized most of the publicly-owned companies and assets, including forest industries and plantations, while incorporating new lands to the country's forest estate through afforestation incentives. This public subsidy policy that remained in force until 2012 allowed for the creation of a private forest cover of almost 3.1 million hectares by 2018. At present, approximately 55.4% 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-sized forestry companies (10.1% of the area), 683 medium-sized owners (10.6% of the area), and 22,830 small-sized owners (23.9% of the area) of forest plantations in the country.<sup>67</sup>

Native forests have a high number of small-sized forest owners, including native peoples, agricultural communities, and female owners. It is estimated that of the total of 81,337 native forest holdings,<sup>8</sup> 91% (74,010 holdings) belong to small-scale forest owners who manage 9.3% of the native forest area. The holdings of medium-scale and large property owners amount to 7,239 holdings (8.9% of the total), who manage 59.4% of the native forest cover.<sup>9</sup> Finally, there are 105 State-managed Wildlife Protected Areas (0.1% of total forest holdings), which control 31.4% of native forest lands. It is worth mentioning that approximately 28% of smallscale native forest holdings are owned by women, who manage 20% of the native forest area, while 20% of small-scale native forest holdings are managed by land owners that belong to an indigenous community, totaling 11% of the native forest area. Finally, 0.1% of small-scale native forest lands.



<sup>6</sup> INFOR. *Statistical Yearbook 2019* (Statistical Bulletin N° 168). INFOR, 2019. Large companies: Planted area exceeding 30,000 ha. Medium-sized companies: Planted area exceeding 5,000 ha and smaller than or equal to 30,000 ha. Medium-sized owners: Planted area 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 area under 200 ha (for the Coquimbo and Aysén regions should be under 400 ha).

<sup>7</sup> INFOR. *Wood availability Pinus Radiata and Eucalyptus Plantations 2017-2047* (Technical Report N° 220). INFOR, 2018.

<sup>8</sup> A forestry holding can be made up by more than one plot of land, with an average of 1.7 plots per holding.

<sup>9</sup> CONAF. Final Report from the Evaluation of Government Programs: Native Forest Law Program. DIPRES, 2013.

# **KEY MILESTONES IN CHILE'S FOREST SECTOR DEVELOPMENT**

# **1.5 million BC** Forest formation

From the mid-Tertiary to the end of the Quaternary period (i.e. the last 1.5 million years), Chile's forests were isolated from other forest ecosystems, which explains the high rate of endemism of its biodiversity and longevity of some of its species, such as the Araucaria and Alerce, which can live for over 2,000 years.



## 10.000 AC

# The presence of Indigenous Peoples

Chile's Indigenous Peoples used fire and practiced agriculture and cattle ranching, which—considering the million inhabitants that already populated the territory—resulted in a limited clearance of forest areas.

# - 1549

### **First Spanish legislation**

The first law is created to authorize timber harvesting for construction and civil works. Logging in the colonial period was carried out under the perception that forest resources were inexhaustible.

# 1536

#### The conquest of Chile



On an expedition organized from Peru, Spanish conquistador Diego de Almagro crossed the An-

des mountain range and reached what is known today as the city of Copiapó. Five years later (1541), Pedro de Valdivia arrived at the Mapocho river valley and founded the city of Santiago. The conquistadors clashed against Mapuche populations in a long conflict that lasted for centuries and caused the largest number of spanish casualties in the New World.

# 1810

### Beginnings of slash and burn

Chile's incorporation in international trade during the first years of the Republic intensified the use of forest resources. In addition to the demand for traditional agricultural products, wheat markets openedup. Authorities justified forest fires for land clearing under the argument this was helping to create the "Breadbasket of America".

## 1832 Darwin in Chile



The British naturalist Charles Darwin traveled the country, from

Tierra del Fuego to Copiapó, making botanical, zoological and anthropological observations on the central and southern forests in Chile.

 WIND
 <th

# 1850-1920

# The colonization of the southern territories



During the mid-19th century Chile sought to consolidate its territorial, cultural, political and economic integration in the southern territories. The colonization process caused a massive destruction of native forests located in the La Araucanía, Los Ríos, Los Lagos and Aysén Regions.

# 1838–1855 Environmental



awareness grows
Naturalist Claudio Gay publishes an

open letter addressed to the Ministry of the Interior explaining "the danger of the lack of an effective policy and legislation to protect the country's natural resources." At the same time, Benjamín Vicuña Mackenna urges for the establishment of a Forestry Code, stating that without it "Chile would become a desert in less than a century."

# 1872

# Enactment of the first law for the protection of native forests

The first law on native forest protection and logging is approved. This law was aimed at protecting water basins and soils in general.

# 1888

# Radiata pine is introduced in Chile

Arturo Junge, a businessman from Concepción, imports the first Radiata pine seeds.

# 1889

# Federico Albert, the father of conservation in Chile

Hired by the government of President Balmaceda, German scientist and pro-



fessor Federico Albert lays down the foundations for the development of laws aimed at the conservation of natural resources and the creation of protected areas.

# 1931

## **Enactment of the Forest Law**

The Decree Law No4,363, known as the Forest Law, is enacted regulating forestry and logging activities. It is considered to be the first comprehensive body of law on forests in Chile.



# 1907-1926

# The first Protected Areas are created

In 1879 the "Public Forest Reserves" Decree Law was enacted, which in 1907 allowed for the establishment of the oldest Protected Wildlife Area in Chile, the Malleco Public Reserve. In 1926 the Vicente Pérez Rosales National Park is created, currently one of the most visited in Chile.



# **1938**

## The first book on sustainable silviculture is published



The German forest engineer Konrad Peters publishes his Experimental Study on Silviculture in Chile, considered the first study on forest plantation management. Peters was responsible for afforesting and managing the first pine and eucalyptus industrial plantations, paving the way that enabled the growth of the forest sector the country enjoys today.



The Chilean Economic Development Agency (CORFO), a State institution devoted to promoting the economic and industrial development of Chile, is created. The agency was key during the first stages of development of Chile's forest industry.

# - 1952 CORMA is created

On April 15, 1952, the Chilean Wood Industries Association (CORMA) is created, the largest trade association in the Chilean forest sector.

# 1945-1954

The first forestry education institutions are established



In 1945 the Victoria Forest Technical School was established which trained the first forest technicians in the country. In 1952, the University of Chile introduced the Forest Engineering program, and in 1954 the School of Forest Engineering is created at the Austral University of Chile in Valdivia.

# **1943–1956** International Missions

Headed by American forest engineer Irving Haig, the first Foreign Forestry Mission arrived in Chile in 1944. In 1956 the forestry mission directed by Dr. H. Igler issued a report which recommended expanding the capacity of pine saw mills and pulp and paper industries.



## 1959–1971 The first pulp mills begin operating

In 1959 Laja becomes the first pulp mill built in Chile. In 1968 CORFO, along with other public and private investors, create the Celulosa Constitución company. In 1971 the Arauco S.A. company is formed and the construction of the Arauco Pulp Mill is approved.

# 1961 - 1965

## The Forestry Institute (Instituto Forestal - INFOR) is created

Through an agreement between the UN's FAO and CORFO, INFOR is established in 1961. Its legal foundation took place in 1965 with the purpose of developing scientific and technological know-how for the advancement of forestry in the country.

# 1970

# Beginning of the establishment of forestry institutions

On May 13, 1970 the Reforestation Corporation (COREF) is created. It held afforestation agreements between the public sector and private landowners, which resulted in 200,000 ha of Pine plantations.

THE FOUNDATIONS OF FOREST DEVELOPMENT

INDUSTRIAL AND INSTITUTIONAL PERIOD

# **1979 - 2004**

#### Industrial expansion continues

In 1979, the CMPC opened its second pulp mill. In 1993, the Bucalemu sawmill was installed —the first of its kind to generate electricity—. In 2004, Celco's Valdivia pulp mill started its operations and became the first soluble cellulose mill in Chile. It gained notoriety for causing environmental damage to the Rio Cruces Nature Sanctuary wetlands.

# 1974

#### Decree Law 701 is approved

The Forest Development Decree Law 701 is enacted, including a series of incentives for afforestation by the private sector. The subsidy system expired in 2012

# 1973

### The National Forest Corporation (CONAF) is created



By modifying the COREF statutes, the National Forest Corporation (CONAF) is created with the purpose of managing forest policy, promoting the development of the sector, combating forest fires and managing the State Wildlife Protected Areas.

# 1984

## The National System of State Wildlife Protected Areas (SNASPE) is created

Administered by CONAF, the SNASPE comprises the following categories: National Parks, National Reserves, and Natural Monuments. Chile has 105 Wildlife Protected Areas, which in total cover approximately 18.6 million hectares, representing 21.13% of the national territory.

# 1992 - 2010

### Law and Ministry of the Environment

On April 27, 1992, the Law of the Environment was enacted, representing a breakthrough for Chile as an exporter of raw materials. In 2010, the Ministry of the Environment was created, along with the establishment of the Environmental Assessment Service and the Superintendency of the Environment.

# 1998

### DL 701 is modified

The enactment of Law 19,561 adopted new procedures in order to increase the participation smallholders in forest sector development and the establishment of planted forests in lands preferably suitable for forestry



# Chile's forest sector prepares to face the challenges of climate change

Chile chaired the COP25 of the UNFCCC and became one of the first countries to update its NDC (Nationally Determined Contribution) targets for the sector to reach 200,000 ha of afforestation and another 200,000 ha of native forest management over the next 10 years, and to access results-based payments for REDD+ with the support of the Green Climate Fund and the World Bank.

# 2008

# Enactment of the Native Forest law

The Native Forest Law No20.283 was enacted with the aim of protecting, restoring and improving the country's native forest resources, in order to ensure their sustainability.

# - 2004

## The CERTFOR certification system earns international recognition

The Pan-European Forest Certification (PEFC) validates the CERTFOR national certification system. To date, almost 70% of forest plantations are certified.



CURRENT PERIOD: SUSTAINABILITY NEW CHALLENGES

# Chapter 2

# THE CONSOLIDATION OF CHILE'S FOREST SECTOR

Since the beginning of the 20th century, Chile embarked on a long journey to develop a forestry model adapted to its national circumstances, achieving considerable progress in the last four decades by significantly increasing its forest cover and developing a highly competitive industry with global reach, making forestry among the country's main economic activities. This chapter looks at the economic, environmental and social dimensions of Chile's forest sector based on national and international datasets in order to identify the key achievements and contributions of Chile's forests to the country's sustainable development, while serving as a model for other countries seeking to increase the contribution of their natural capital to their development process.



# **2.1** STATE OF CHILE' FOREST RESOURCES AND THEIR CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

This section takes stock of the progress made by the Chilean forestry model through 10 key dimensions related to its current economic, social and environmental development.



# State of Chile's forests

Native Forest. Los Lagos Region

Chile has 17.9 million hectares of forest land, covering 23% of the country's continental area. Of this forest cover, approximately 82% corresponds to native forests (14.6 million hectares), 17% to planted forests (3.1 million hectares)<sup>10</sup>, and 1% to mixed forests (179,125 hectares).<sup>11</sup> More than 90% of forest resources are located between the Maule and the Magallanes regions in the south-central part of the country. The types of native forests with the highest representation are the Lenga with 3.6 million hectares (25.2%); the evergreen with 3.5 million hectares

<sup>10</sup> Corresponds to the Plantations Land-Use category in the National Cadaster of Vegetation Resources.

<sup>11</sup> INFOR. Statistical Yearbook 2019 (Statistical Bulletin Nº 168). INFOR, 2019. (24.3%); the Oak-Raulí-Coihue with 1.6 million hectares (11.4%); and the Sclerophyll with 1.4 million hectares (9.6%). From a structural point of view, a large part corresponds to mature forests (41.9%) and secondary forests (31.6%). In terms of planted forests, Radiata pine forest plantations cover most of the area (56%), followed by Eucalyptus plantations (38%), mostly of Eucalyptus globulus and Eucalyptus nitens species. Between 2007 to 2012, the area planted with Radiata pine at the national level stabilized at around 1.47 million hectares. However, since 2013 there has been a decline in the area planted, mainly as a result of the 2017 summer megafires.

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. The latest Global Forest Resources Assessment (FRA) of the Food and Agriculture Organization (FAO) of the United Nations reports a net increase in Chile's forest cover from 15,263,000 hectares in 1990 to 17,735,000 in 2015. Between 2010 and 2015, Chile was among the top three countries in the world with the highest increase in forest cover, with an increase of 301,000 hectares and a growth rate of 1.8%, surpassed only by China and Australia. In addition, Chile is among the twelve countries that increased their forest area by more than 10% in the last 25 years, in contrast with the global trend of forest cover loss of 5 million hectares per year. In percentage terms forest cover worldwide has decreased from 31.6% in 1990 to 30.6% in 2015, and in Latin America and the Caribbean from 51.3% to 46.4% during the same period. This remarkable increase in Chile's forest cover is by no doubt due to the expansion of its planted forests, which have at the same time contributed to reducing pressure over native forest resources, along with more stringent regulations and an increasing availability of wood from forest plantations to meet market demand.







Area of at least 5,000 square meters populated with plant formations where trees are predominant, with a minimum width of 40 meters, a tree canopy cover above 10% in arid and semi-arid conditions and 25% in more favorable circumstances.

# **CHILE FOREST COVER MAP**

Source: CONAF. Cadaster and Assessment of Chile's Native Vegetation Resources, 2019.







Reforestation. Biobío Region

# Afforestation and reforestation

As a result of a joint effort between public and private actors aimed at restoring the country's degraded lands, Chile managed to maintain a high rate of afforestation and reforestation for many years. From the 16th century up to the middle of the 20th century, the expansion of agriculture coupled with unregulated timber harvesting depleted the country's forests and degraded productive lands in much of the national territory. Land degradation reached a point where the State was urged to regulate harvesting activities on native forests and to implement a long-term afforestation policy, which resulted in the General Logging Regulation of 1837, the Forest Law of 1931, and the adoption of the Forest Development Decree Law No. 701 of 1974, which established a series of private sector incentives in support of large-scale afforestation. The total amount of public investment to date is estimated at approximately USD 560 million.<sup>12</sup> Over a long period of time and until 2013, the area afforested (new forests planted on lands with different land cover) and reforested (new forests on lands recently covered by forests) combined surpassed an average of 100,000 hectares per year.<sup>13</sup>



<sup>12</sup> Own elaboration. Methodological Note: Public investment was estimated based on INFOR's statistics and other studies that include data on public investment since 1966 (Aninat, Claro y Méndez. Economic análisis of the costs and ebenefits related to the Forest Development Decree DL 701. Associated Economic Consultants, 1982).

<sup>13</sup> INFOR. Statistical Yearbook 2014 (Statistical Bulletin Nº 144). INFOR, 2014.





Degraded land. Biobío Region

Thanks to these efforts, the Chilean forest sector today is one of the pillars of the country's economy, based on a renewable natural resource of 3.1 million hectares of planted trees. These plantations —mostly of pine and euca-lyptus species— support 95% of the country's forest industry, and cover 99% of the domestic demand for timber.<sup>14</sup> In recent years, the afforestation rate is facing a significant decline as a result of the termination, since 2012, of the incentives established in DL No. 701, and also due to the limited availability of new lands suitable for planting in a cost-efficient manner. It is estimated that in Chile there are still 2.630.210 hectares<sup>15</sup> of degraded lands, many of them with low productivity and in the hands of small landowners, which could potentially be forested.

<sup>14</sup> INFOR. Statistical Yearbook 2019
 (Statistical Bulletin Nº 168). INFOR, 2019.

<sup>15</sup> Grosse, Hans and Rosselot, Fernando. The potential of new forest plantations in Chile. Forest Science and Research Magazine N° 22, 2016.





Forest products at the Lirquen port dock. Biobío Region

# Economy and added value

Representing 2.1% of the country's GDP, Chile's forest sector is one of the pillars of the national economy.<sup>16</sup> While in the 1970s the significance of the forest sector in the national economy was secondary, today it represents one of the most important economic activities in the country, contributing with 2-3% to GDP from year to year. Another indicator of the growing importance of the forest sector to the economy is reflected in its contribution to added value, both at the national and particularly at the regional level, with the highest percentage of investments from the sector being concentrated in the Biobío, Maule and Araucanía regions. According to figures from the Chilean Wood Industries Association (COR-MA), more than 80% of these investments are made in the pulp, wood panel, and veneer production subsectors, which have a greater added value to the economy compared to other products such as logs and woodchips. Among the different subsectors, the pulp and paper industry contributes the most to national GDP, accounting for 40% of the forest sector's contribution. The sawn timber industry is second in importance contributing with 31%, while silviculture accounts for 23%, and the furniture industry for 6%.



<sup>16</sup> INFOR. Statistical Yearbook 2019 (Statistical Bulletin Nº 168). INFOR, 2019.


Through these investments, forestry has added much more value to the national economy compared to the average of the industrial sector. Based on data of the year 1970, while the national industry grew at a rate of 1,799%, the forest industry grew at 5,332%, i.e. 2.86 times more than the industry average.<sup>17</sup> This figure is a clear indication of the value-added dynamics of the forest sector, compared to the evolution of the national industry as a whole. Chilean forestry investments in industrial assets, and associated works in industrial sites, roads, infrastructure works, ports and, more 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 growing plantations. Planted forests have not significantly increased their area for a decade, and their harvesting volume availability is growing slowly at present. This trend indicates that it is unlikely that the planted areas for industrial purposes will grow significantly in the near future. Therefore, the sector will likely have to satisfy new demand for raw material through increased productivity, whether through improvements in established methods and genetic improvement of pines and eucalyptus, increased silvicultural management prior to harvest (pine), and the creation of markets for by-products demanded by an increasingly specialized industry.

<sup>&</sup>lt;sup>17</sup> Environmental Management and Economic Program, Industrial Engineering Department, University of Chile (PROGEA). *Economic and social contribution of the forest sector in Chile*. CORMA, 2014





Nursery workers

Pruning and thinning

# Job creation

The forest sector has been an important source of employment for the country. According to INFOR figures, in 2018 the direct employment in the sector reached a total of 113,769 jobs, which accounts for approximately 1.5% of the national employment rate. It is worth mentioning that since forestry is mostly concentrated in the south-central part of the country, employment is much more significant in the Maule, Ñuble, Biobío and Araucanía regions, which together represent over 70% of total employment in forestry.

The forest sector also generates a significant number of indirect employment through its value chains and links with other sectors of the economy, accounting for approximately 300,000 jobs in total. The ratio between the number of direct and indirect jobs is an indicator of a sector's contribution to indirect employment. In the case of the forest sector, this equals 1.47, which means that for every direct job almost one and a half additional jobs are indirectly generated. This is mainly due to the fact that outsourcing is a common practice in the forestry industry, with hundreds of service-providing companies operating in the country under contract for leading forestry companies in activities such as silviculture, harvesting, sawmilling, industrial processing and pulp manufacturing.<sup>18</sup>

**Direct employment is evenly distributed among the forestry subsectors.** 31.3% of direct forest sector jobs are produced by the primary industry, 26.3% by the secondary industry, 22.4% by other forestry activities, and 20.1% by silviculture



<sup>18</sup> Environmental Management and Economic Program, Industrial Engineering Department, University of Chile (PROGEA). *Economic and social contribution of the forest sector in Chile*. CORMA, 2014.



Pulp mill industrial worker

Women employed in forestry 4.7% of total forest jobs and harvesting. In terms of the types of employment, 84% of jobs are in forest operations, a little over 15% are in supervision and maintenance, and only 0.5% are executive positions. With regard to staffing in private sector companies, a little over 78% of the workers are subcontractors, with the remaining 22% being direct employees, assigned mainly in industrial plants or factories.

In recent years the employment rate of the Chilean forest sector has been gradually decreasing. Employment in the sector grew substantially from 1995 to 2006, when it reached a record 136,478 jobs, with a growth rate of 8.4% during that period. Between 2006 and 2018 the sector started experiencing a downward trend in the number of people employed. An example of this reduction can be seen in the silviculture subsector where in the last nine years, the total workforce was reduced from 41,227 to 22,834 jobs, a decrease of 44.7%.<sup>19</sup> Compared to other industries, forestry on average directly employs 0.02 jobs per million of Chilean pesos produced. This figure represents half of the national average of 0.04 jobs per million pesos. The drop in employment levels in forestry can be largely explained by the introduction of technologies and automation in virtually all subsectors. In the field of timber extraction and harvesting, mechanization has been introduced with the use of high-tech machinery; a similar situation occurs in the milling industry, where sawmills are equipped with cutting-edge log sorters. On the other hand, plywood and pulp and paper facilities are equipped with robotic systems and remote operations control centers. All this technological deployment has meant the replacement of lower-skilled workers by highly trained technicians.



Employment in the forest sector is male-dominated, with women making up only 4.7% of the workforce in the main value chains. The majority of women in the forest industry work in nursery operations, representing 64.5% of the total women workforce in the sector, followed by production assistants which represent 22%.

<sup>19</sup> INFOR. *Statistical Yearbook 2019* (Statistical BulletinNº 168). INFOR, 2019.

# **Forestry exports**

With more than 370 products reaching 126 countries, the Chilean forest sector is among the largest export industries in the country. In 2018, forest product exports accounted for 9.1% of Chile's total exports, ranking third after mining, and fisheries and aquaculture.<sup>20</sup> The growth of the Chilean forest industry over time is directly related to the gradual growth in the volume of exports, which grew from 2,369 million dollars FOB (Free on Board at the port of origin) in 1995 to 5,439 million dollars FOB in 2015, an increase of 130% in twenty years. More recently, in 2018, the country reached a historical record in its forestry exports with a total of USD 6,838 million, representing an increase of 27% compared to 2015.

# Chilean Exports by Sector, 2005–2018 Million US\$ 50,000 40,000 30,000 20,000 10,000 0 2005 2010 2015 Industry Forestry Fisheries Mining Agriculture Source: INFOR. Statistical Yearbook 2019 (Statistical Bulletin Nº 168). INFOR, 2019; Central Bank of Chile. Statistics, external sector (consulted in

December, 2019 at: https://www.bcentral.cl/areas/estadisticas)

These figures place Chile among the top 20 leading exporters of forest products in the world, with a main focus on Asian markets. The main export destination is China (32%), followed by the United States (16.2%), Japan (7.6%), and South Korea (6.6%). 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 forest export subsectors are cellulose (chemical pulp) and sawn timber, which account for more than 60% of all forest exports. In the case of sawn timber, until 1974, 90% of the production was sold in the domestic market. However, state-ofthe-art sawmills were established in Chile in the 1980s, which considerably increased their production and made sawn timber an important export commodity, reaching 30% of the exported volume, with 96% originating from Radiata pine plantations. Chile also occupies a prominent position in the export of woodchips, a raw material traditionally used for making paper and producing biomass for energy. Nowadays, 5.7 million of the 7.6 million tons of chips produced in the country are exported, with 99% originating from Eucalyptus globulus and Eucalyptus nitens plantations. Chile is also 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 include moldings, planed wood, fiberboard panels, doors and windows.



<sup>20</sup> Central Bank of Chile. *External Sector Statistics. Foreign trade of goods.* (Accessed December 2019: https://www. bcentral.cl/areas/estadisticas).

# FOREST SECTOR EXPORTS

### Main destination markets for Chilean forestry exports from 2000-2018

In USD millions FOB



USD 75.452 billion

Total Chilean exports

USD **6.838** billion (2018)

Source: INFOR. *Statistical Yearbook 2019* (Statistical Bulletin Nº 168). INFOR, 2019.



Pulp mill. Biobío Region

# **The Forest Industry**

The Chilean forest industry operates as an integrated value chain, beginning from the nurseries and all the way to the destination markets. This vertical integration means that in general, the industry has a low product multiplier effect, which means that the demand for intermediate products from other sectors is relatively low. However, the supply multiplier effect is high, since solid wood products, panels, pulp and paper are present in the production process of several industries other than forestry. Therefore, the production process of the forest industry uses few inputs from other sectors, while forestry products become inputs to several other industries. The industry is progressively advancing towards a circular production system, with a high percentage of use of intermediate products for the production of raw material, biomass for energy generation and particle agglomeration.<sup>21</sup> At the same time, the majority of forestry industry processing takes place in very modern, capital-intensive facilities with high productivity.

The Chilean forest industry consumes approximately 48 million cubic meters solid under bark (m<sup>3</sup>sub) each year, 99% of which comes from planted forests. These large volumes of raw material have been made available mostly as a result of the enactment of the Forest Development Decree–Law of 1974 (DL No. 701), which promoted major investments, not only in the creation of a large forest estate, but also in the associated industrialization, transportation, marketing, and export sectors. Along with the increase in the planted forest area and the respective growth in the availability of timber supply, so did the industry grow its installed capacity to handle the flows of different qualities of timber that were made available. Today, the



<sup>21</sup> Gysling, Janina and Soto, Daniel. *Primary Forest Industry in Chile, 2006–2015 period.* INFOR, 2016.





Forest company control room. Nuble Region

forest sector is highly diversified. The largest development poles of the forest sector are located in the Biobío region with 27.5 million  $m^3$ sub, followed by the Maule region, with 6.7 million  $m^3$ sub, the Araucanía region with 5.5 million  $m^3$ sub, and the Los Ríos region with 4.9 million  $m^3$ sub.



Wood-based panel mill. Ñuble Region

### Main primary industries of Chile's forest sector





### SAWN TIMBER:

The national saw mill industry is the largest in terms of production units, reaching a total of 1,056 sawmills operating in 2017, most of which are located in the Maule, Ñuble, Biobío and Araucanía regions, and mainly consist of Radiata pine plantations. It is worth mentioning that in the 1940s and 1950s, when sawn timber production ranged around  $600,000 \text{ m}^3$  per year, 90% of the raw material came from native forests. Today, due to the continuous supply of Radiata pine logs from forest plantations, as well as the use of modern and improved technology in industrial facilities, there is a constant growth in the production of sawn timber, which is around  $8.5 \text{ m}^3$  million per year. Consequently, native forests have lost their relative importance, representing only a 9% share in the



overall sawn timber production. Until 1974, 90% of the sawn timber produced was destined to the domestic market. Today, 30% of the production is exported to 43 countries, with China representing 21.6% of the total, followed by South Korea, Japan, Mexico, and Saudi Arabia.

### **PULP AND PAPER:**

The pulp market is very important for Chile, given its position as the world's fourth largest exporter. Pulp represents more than 45% of the country's forest exports, becoming the main product for the Chilean forest industry. Major markets for Chilean pulp include China, South Korea, the Netherlands, Italy, and Taiwan. The main products are chemical and mechanical pulp, newsprint, tissue paper, and packaging board. Currently, the annual production of chemical pulp is 5.8 million metric tons per year, while mechanical pulp production averages 575,000 tons per year. The latter is used entirely by the domestic papermaking industry, while 86.5% of the chemical pulp is exported. The production of printing paper, wrapping paper and packaging board, and tissue paper goes to the domestic



market, and only 10% is exported. The Chilean pulp industry has 10 facilities located between the Maule and Los Ríos regions, and only two owners: Arauco S.A., and the Paper and Cardboard Manufacturing Company (Compañía Manufacturera de Papeles y Cartones, CMPC), which is the largest producer of tissue paper in Latin America.



### WOOD-BASED PANELS:

The wood-based panel industry has undergone significant technological, productive, and commercial changes. Today, this industry offers a wide range of products with very specific and valued characteristics, which have allowed it to create new markets, meet diverse needs, and, in some cases, substitute solid wood products. Although Chile's share in terms of world production is low, industrial production of wood-based panels has historically been important for the country's economy. Exports of wood panels and veneer reached a peak in 2011 with over USD 1,700 million in total, of which medium density fiberboard (MDF) and medium density particleboard (MDP) accounted for the largest amounts exported. The production of oriented strand boards (OSB) is almost entirely destined



to the domestic market, unlike plywood where 58% is exported. The combined production capacity of wood-based panels in Chile is around 4.1 million cubic meters, with two OSB production plants, and eleven structural plywood plants (three of which are of cutting-edge technology) that use high quality Radiata pine peeler logs.



### WOODCHIPS:

With in the Chilean forest sector, the woodchip industry ranks third in terms of industrial log consumption. It constitutes an important input for the paper and cardboard industry and is relevant for the efficient use of forest resources, despite being a raw material with little added value. The production of woodchips in 2017 reached a historical high of 7,566,397 m<sup>3</sup>, of which 5,804,100 m<sup>3</sup> were exported to different markets, mainly China. Based on INFOR data, in 2017, 194 wood-chipping units were operating in the country, most of them located in the Biobío Region. While medium-sized companies dominate the supply market, there is a significant share of small producers that supply the largest exporters. It is estimated that by 2020 the conversion of the Chilean forestry



company Arauco facility in Valdivia from pulp mill to textile pulp will increase the consumption of eucalyptus chips by up to one million dry tons.

Graph sources: INFOR. Chilean Forest Statistics 1996 (Statistical Bulletin N° 50). INFOR 1996; INFOR. Statistical Yearbook 2010 (Statistical Bulletin N° 128). INFOR, 2010; INFOR. Statistical Yearbook 2019 (Statistical Bulletin N° 168). INFOR, 2019





Small forest owners

Eucalyptus plantation

# Sustainable forest management

Chile has made significant progress in meeting different certification standards for sustainable forest management. These certifications are awarded after meeting a variety of principles and criteria, which include adherence to sustainable forest management requirements, compliance with relevant laws, and respecting the rights of native peoples and local communities, as well as labor rights of workers.

Following the need for forestry companies to have a certification supporting their operations under these standards, in 2002 the Chilean Sustainable Forest Management Certification System (CERTFOR) was established. It was created and funded by major public and private institutions such as CORFO, the Chile Foundation (Fundación Chile) and INFOR and, since 2004, this system has been internationally endorsed by the Programme for the Endorsement of Forest Certification (PEFC). The CERTFOR system opened the doors for the forestry industry to pursue certification under the Forest Stewardship Council (FSC) system, which is recognized and validated internationally. Both seals also grant chain of custody (CoC) certification, which allows producers and retailers to label their products so that final consumers can identify products that support responsible forest management. Forest management certifications are valid for five years and are subject to annual reviews. In 2018, the FSC carried out the first certification of Ecosystem Services in the country. Approximately 70% of industrial forest plantations in Chile are certified under the FSC, and 60% under the CERTFOR-PEFC systems. In 2018, Radiata pine and Eucalyptus plantations covered a total of 2,135,701 hectares of land. FSC records indicate a total of 1,547,224 hectares certified in Chile, which means that 72.4% of the Chilean forest plantations comply with FSC standards. On the other hand, CERTFOR-PEFC records indicate a total of 1,314,242 hectares of forest plantations certified throughout the country, which represents 61.5% of the total. It is worth noting that only 30% of the productive forests in the world are certified. According to FSC records, Chile ranks 11th worldwide in terms of extent of certified forest area, being surpassed only by Brazil among Latin American countries.



### Principles of the CERTFOR-PEFC Certification System:

The minimum requirements that a forest company should meet in order to obtain the CERTFOR-PEFC Sustainable Forest Management Certificate are:

#### 1. Planning and long-term objectives

The use of forest resources must be planned and managed according to the concept of Sustainable Forest Management (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 non-binding 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.



Nahuelbuta National Park

# **Biodiversity conservation**

Chile has a long tradition of protecting its environmental values through the establishment of parks, sanctuaries, reserves and other protected categories. The first relevant milestone in this regard dates back to 1907, when 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. From that moment until the 1960s, several organizations took part in the creation of the country's protected areas. Subsequently, the ratification of the Washington Agreement in 1967, and the creation of CONAF in 1973, gave start to a thorough management and planning process, which led to the enactment of Law No. 18.362 in 1984 that defined the objectives and structure of the current National System of Wildlife Areas Protected by the State (SNASPE).

Today, 29% of the country's native forests are conserved through SNASPE. This provides an effective degree of protection to the variety of 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





Alerce, Alerce Andino National Park • Ostriches, Torres del Paine National Park. Chilean Patagonia



<sup>&</sup>lt;sup>22</sup> Mittermeier Russell et al. *Hotspots: Earth's biologically richest and most endangered terrestrial ecoregions.* Center for Applied Biodiversity Science at Conservation International, CABS, 2004.

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the development of recreational activities. The system currently comprises 105 units, organized into three management categories: 41 National Parks, 46 National Reserves, and 18 Natural Monuments, which cover a total area of over 18 million hectares, 4.1 million of which are native forests. The total area of SNASPE represents a little over 21% of the national territory, four points above the goal established in 2010 by the Conference of Parties (COP) of the Convention on Biological Diversity (CBD) in Nagoya, Japan, which agreed to protect 17% of the world's lands and 10% of its oceans by 2020. It is worth mentioning that the Aysén and Magallanes regions located in the southern end of the country, concentrate over 80% of the total area under protection, leaving less than 20% for the rest of the national territory.

The 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 native peoples, whose traditions and current ways of life reflect a true mosaic of cultural heritage expressions which are rooted in these protected natural spaces. Many of these conservation areas also represent important testimonies of the country's archaeological, paleontological and historical heritage, of great scientific, ecological, cultural, social, aesthetic and spiritual value. The institution in charge of these protected areas, CONAF, fosters the development of various activities, including a wide range of research initiatives related to the ecosystems, social and cultural systems present in these areas.

**Chile's ecosystems are also relevant for the conservation of the world's biodiversity.** Its biodiversity is characterized by a relatively high endemism of species concentrated in very varied and small environments, which are home to approximately 30,000 species among plants, animals, fungi, and bacteria. Nationwide, almost 25% of registered species are endemic, while about 46% of native vascular are endemic. Importantly, the central and southern part of the country hosts one of the world's 35 biodiversity hotspots due to its critical conservation status, known as "Chilean winter rainfall-Valdivian forests".



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 just over USD 3,097 million from incoming tourism alone, equivalent to 3.3% 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 National Parks and Protected Areas as its main attractions. In the 2017-2018 season, the country's Protected Wildlife Areas combined reached a record 3,412,980 visitors, 13% more than the 2016-2017 season. Protected Areas, on the other hand, also represent an important source of economic value, contributing approximately USD 2,000 to USD 2,400 million a year in environmental services.<sup>23</sup>

While the State has been the main driving force for the establishment of Protected Wild Areas, over the last three decades the private sector has also made important efforts to safeguard the country's critical ecosystems. In the 1990s, American businessman Douglas Tompkins and his foundation, The Conservation Land Trust, embarked on a long journey towards land acquisition for conservation purposes that concluded in March 2017 with the donation to the State of Chile 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 to the in March 2019 under CONAF's administration. Other national and international conservation organizations have also engaged in the protection of wildlife areas. Pumalín Douglas Tompkins National Park

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Economic value of the Environmental Services of Wildlife Protected Areas

US\$**2,000** to US\$**2,400** million per year

<sup>23</sup> Figueroa, Eugenio. Detailed economic valuation of protected areas of Chile. GEF-MMA-UNDP Project, Creation of an Integrated National System of Protected Areas for Chile, 2010.



Private Conservation initiatives (ICP) 2017



As a result, as of 2017, according to the records of the Ministry of the Environment, 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% of Chile's insular and continental territory. Similarly to the SNASPE, PCIs are focused in the south parts of the country, with 82% of them being located in four regions: Magallanes and the Chilean Antarctic, Aysén del General Carlos Ibáñez del Campo, Los Ríos, and Los Lagos.

Chile is a Party to several international agreements aimed at the conservation and protection of its natural resources which allows for the development of complementary in situ conservation instruments. Since 1981 – year in which Chile became a member of the Ramsar Convention— to date, 14 Ramsar sites have been established covering an area over 362,020 hectares, inclusing wetlands with fresh and salt water, both inland and coastal, of which 9 are within the SNASPE and the rest are under different protection and management categories. In addition, Chile counts with 10 areas recognized as Biosphere Reserves by the United Nations Educational, Scientific and Cultural Organization (UNESCO), which together cover 10,937,253 hectares, the core zones of which are situated within SNASPE units, surrounded by buffer and transition zones. Another international conservation designation consists is World Heritage Sites under the UNESCO World Cultural and Natural Heritage Convention, of which counts with five, with the Rapa Nui National Park standing out for its world-renowned natural, cultural and archaeological value.

# Categories of the National System of Wildlife Areas Protected by the State (SNASPE)



**NATIONAL PARK** 

Generally a large area with several unique or representative environments of the country's natural and ecological diversity, without having been significantly altered by human activity, and which are capable of self-perpetuation.

### NATIONAL RESERVE



Areas aimed at the conservation and sustainable use of natural resources, where all flora and fauna is protected to an extent compatible with the purposes for which such reserves are created.

### NATURAL MONUMENT



Generally a smaller conservation area, which features native species or geological sites that are scenically, culturally, or scientifically relevant.





# Innovation and knowledge

The expansion of Chile's forest industry has not been just about planting more trees; but also, about planting better trees. The introduction of exotic species required the installation, early on, of a high research and development capacity in the country to build a solid knowledge base. The Forestry Institute (INFOR) -an institution affiliated with the Ministry of Agriculture- was assigned with this task which, since its inception as a FAO Project in 1961, began to establish demonstration plots that were fundamental for the development of the new plantations. INFOR was a pioneer in developing intensive silviculture approaches for forest plantation management, by establishing methods for seed selection and management, techniques for plant nursery and plantation development, also developing the first programs for genetic improvement and improved material propagation. International cooperation by countries with advanced forestry sectors, such as New Zealand, Australia and South Africa, was also essential to the work carried out by INFOR during the first years of forestry research, particularly in terms of genetic improvement, seed collection, and plantation establishment methods for Radiata pine and Eucalyptus trees.

Silvicultural management practices have been continuously evolving from the establishment of the first plantations in the 1960s and up to the to the present day. In the first generation of plantations, what is now known as site preparation techniques were not applied extensively, including fertilization, subsoiling and other procedures that are widely today used to ensure high productivity, especially in the second rotation. Bioforest Research Center



95%

Research programs for genetic improvement have been essential in improving the productive capacity of both exotic and native species. The majority 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. As such, 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% of planted forests in Chile come from improved genetic material.<sup>24</sup> In terms of forest plantations, it is important to mention that the first research and development efforts were carried out by INFOR in the 1960s, when the first selections of insigne pine were made, and progeny tests were established in order to assess the genetic material of the individuals. Today, both pine and eucalyptus trees are planted with genetically improved material, originating from high tech nurseries which allow for the insolation of seedlings. These nurseries are essential for adjusting production schedules and have robotic irrigation systems with a retractable roof that can withstand wind, humidity and rain. Eucalyptus plantations, which were previously managed through sprout regeneration, are currently reforested with genetically improved plants and intensively managed in 10 to 14 year rotations.

After more than forty years since plantation-based forestry was first established, much remains to be researched. 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.<sup>25</sup>



<sup>&</sup>lt;sup>24</sup> CONAF. *National report of Chile. The state of world forest genetic resources.* FAO, 2011.

<sup>&</sup>lt;sup>25</sup> Prado, José Antonio. *Forest plantations. Beyond trees.* CIFAG, 2015.

# Biomass contribution to clean energy generation

**Forest biomass has great potential to sustainably contribute to the decarbonization goals that the country has set for 2050.** According to the Ministry of Energy, in 2018, biomass contributed 2.1% (501 MW) of the installed capacity of net electricity generation to the National Electric System, representing 11% (1,284 GWh) of the total injection of Non-Conventional Renewable Energy (NCRE).<sup>26</sup> Based on data from the National Energy Commission, Chile also has 6 MW of installed power in biomass projects that are in testing phase, with another 6 MW under construction, in addition to having 1,087 MW with their environmental qualification resolution approved, and 12 MW in projects that are in the qualification stage.

In 2017 biomass contributed with 24% to the country's primary energy matrix, equaling coal. Forest biomass in Chile is mainly used for residential heating and cooking (67%), and it originates primarily from native forests. The remaining 33% is used as industrial fuel for thermal generation, electrical generation and co-generation. Chile is well poised to continue promoting the development of forest biomass as an alternative energy source due to the ample availability of forest resources resulting from the sustainable management of native and planted forests. Developing and using biofuels in the decarbonization process of the national energy matrix is not only relevant for electricity generation, but also for meeting industrial and residential power demand, where cogeneration can play an important role.



# Monitoring of forest and vegetation resources

Assessing and quantifying forest resources has been one of the priority tasks of Chile's forestry policy since the 1990s. In 1994, the "Cadaster and Assessment of Chile's Native Vegetation Resources" 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, establishing a baseline of cartographic information for the vegetation resources of each region, province and county in the country. The Cadaster 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 cadasters with a minimum cartographic unit of 0.5 hectares for the forest use class. This approach has established the Cadaster and its updates an essential digital cartographic support system that provides data on the location, distribution,



<sup>26</sup> National Energy Commission. *Energy Statistical Yearbook 2018*. Ministry of Energy, 2019.



Screenshot of CONAF's Territorial Information System (SIT)

# Continuous Inventory of Chile's Forest Ecosystems Established in

Integrated System of Monitoring and Evaluation of Native Forest Ecosystems (SIMEF) Established in 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 of Chile, providing key data to inform public policies related to the management of forest resources and the environment. The Cadaster is also a key tool for the compilation of Chile's National Greenhouse Gas Inventory to the UNFCCC.

Since 2000, Chile also counts with 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 dasometric 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 measurement and the first update. INFOR currently runs the inventory in 4-year cycles, remeasuring 25% of the plots each year, and projecting the remaining 75%. In addition, INFOR is responsible for collecting economic and industry statistics with the objective of generating strategic data and information for that are relevant to both public and private actors engaged in the forest sector.

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

# **2.2** THE KEYS TO THE SUCCESS OF THE CHILEAN FORESTRY MODEL

This section describes the enabling conditions and circumstances that were fundamental to the development of the Chilean forest sector.





# A long-term forestry policy that enabled the establishment of planted forests

For over a century, the State of Chile maintained a stable policy in support of forest plantation development through different instruments, including tax exemptions to promote afforestation and reforestation in privately-owned degraded lands, direct investments in afforestation activities, and, finally, an incentive mechanism to stimulate private investments in the forest sector. Aerial view of forest plantations

The foundations of the Chilean forestry sector were built on the basis of a long-term public-private alliance that supported the expansion of planted forests for productive purposes. While this policy was an initiative that sought to recover millions of hectares of degraded lands, resulting from the systematic destruction of native ecosystems between the 18th and the mid-20th century, the introduction of two fast-growing species —mainly Pinus radiata and Eucalyptus globulus— soon proved their economic and industrial potential, which was then promoted by the State and implemented by the private sector.



Industrial nursery

<sup>27</sup> Prado José Antonio. *Forest plantations. Beyond trees.* CIFAG, 2015

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<sup>28</sup> Nazer, Ricardo. *History of the Chilean Economic Development Agency (CORFO)* 1939-2009. Patrimonio Consultants, 2009 The first afforestation and forestry development incentive in the country dates back to 1873, and later to 1931 with the enactment of the Forest Law that stipulated tax exemptions on private lands planted with forest species. Thanks to the incentives of this law and a continuous public policy supportive of afforestation and reforestation, around 300,000 hectares were planted between 1931 and 1974, mainly with Radiata pine.<sup>27</sup> These plantations were mostly grown on soils degraded by agricultural activities, and became the foundation for the development of the national pulp and paper industry, particularly the forest areas in the Concepción region planted by CMPC and the industrial complex of the Cholguán Pines Pressed Woods, developed in 1953.

A key role in implementing this policy fell under the responsibility of the Chilean Economic Development Agency (CORFO), a public institution created in 1939 to support national production. CORFO played an active role in forestry development through the planning and execution of reforestation programs, forest inventories, forestry pilots, cooperation agreements with international organizations, and capital investments for industrial development. During the 1950s, this agency developed a Forestry Development Plan that included financial assistance and support to private entrepreneurship in forestry, 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. Subsequently, in the mid-1960s, CORFO decided to invest, as a majority shareholder, in 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.<sup>28</sup>

The period between the1950s and 1960s represents a milestone in the creation of vast extents of forest plantations through the establishment of several afforestation and reforestation programs. Since the mid-1950s, the country begun addressing the challenge of soil erosion and land degradation through the development of extensive regional reforestation programs. One of the most emblematic programs was the Colchagua Plan, which sought to recover highly degraded lands and incorporate them into the regional economy as the

basis for the future establishment of forest industries. The program promoted the stipulation of reforestation agreements with agricultural owners that led to the planting of approximately 40,000 hectares.<sup>29</sup> The positive experience of this Plan gave rise to the creation of the Reforestation Corporation (COREF), an institution that had a brief duration but a lasting impact. In 1972, its statutes were amended to give way to the National Forestry Corporation (CONAF), which was not only assigned with the tasks of its predecessor, but also others related to forest protection and the conservation of natural resources, including the management of State-owned Wildlife Protected Areas.

The rapid growth of forest plantations was mainly due to the enactment of Decree Law No. 701 (DL 701), which established the legal framework for forest lands and "lands preferably suitable for forestry" (see box), along with a set of instruments to support forest sector growth. This law, enacted in 1974, consolidated Chile's policy in support of land restoration through the active involvement of the private sector, by regulating and incentivizing the protection, expansion, rational management and promotion of forestry activities. DL 701 also allowed for the shaping of the industrial projects that were implemented in subsequent decades, and it is considered as the cornerstone in the development and modernization of the Chilean forest sector.

From the moment DL 701 was first implemented, the private sector reacted favorably to the stimulus generated by the incentives provided by the State, which gradually abandoned direct investments in afforestation and had a limited participation from 1980 onwards. According to CONAF studies, from 1970 to 1974, of the approximately 170,000 hectares planted by both the public and private sector, 111,000 hectares were plantes by the State



<sup>29</sup> Prado, José Antonio. *Forest plantations. Beyond trees.* CIFAG, 2015



Sources: INFOR. Chilean Forest Statistics 1996 (Statistical Bulletin N° 50). INFOR 1996; INFOR. Statistical Yearbook 2010 (Statistical Bulletin N° 128). INFOR, 2010; INFOR. Statistical Yearbook 2019 (Statistical Bulletin N° 168). INFOR, 2019



Main modifications to DL 701 through Law Nº 19,651 of 1998

• Afforestation incentives in Soils Preferably Suited for Forestry exclusively for small owners.

 Afforestation incentives for medium and large owners restricted to fragile or eroded soils. and just over 58,000 by private actors. In 1981, in contrast, 91,628 out of 91,729 hectares were planted by private actors, and only 101 hectares by the public sector. As a result, between 1976 and 2013 the annual rate of afforestation and reforestation combined averaged over 100,000 hectares per year. Today, Chile's forest plantations cover close to 4% of the national territory and represent just over 17% of the national forest estate.

To promote private participation, DL 701 contemplated a series of incentives for forestry activities that significantly contributed to increasing the area of planted forests. The incentives stipulated in DL 701 can be summarized in three categories: a) those that guaranteed property rights and assurance that lands declared Preferably Suitable for Forestry (APF), demonstrated through a technical qualification study approved by CONAF, would not be expropriated; b) tax-related incentives, which granted an exemption on land tax to the areas with subsidized plantations; and c) financial, by granting plantations established in APF lands with a one-time 75% subsidy of the net afforestation costs. Importantly, DL 701 regulations also established the obligation for private land owners to perpetually reforest the lands that received this subsidy after each harvesting cycle.

DL 701 went a long way in meeting the objective of promoting plantation-based forestry. However, it is also acknowledged that it did not immediately favor small landowners, which eventually led to a reform towards a more inclusive model. Consequently, the enactment of Law N° 19,561, in 1998, amended DL 701 in order to achieve greater participation of small and medium-sized land owners in forest sector development, in addition to expanding the area of degraded lands to be restored, and updating the procedures of the forestry subsidy system. Under the amended law, 38% of State forestry subsidies were now allocated to small forest owners, a number significantly higher than the 5.8% achieved during the first period (1974-1998).<sup>30</sup> It is important to mention that the incentive system established by DL 701 was in force for almost 40 years as it was meant to expire in December 2012, which means that afforestation and other forestry activities carried out since 2013 are not subject to subsidies anymore.

# Lands Preferably Suitable for Forestry:

DL 701 defines "forest lands" or "lands preferably suitable for forestry" as all lands "which, due to their climatic and soil conditions, should not be permanently plowed, whether or not they are covered with vegetation, with the exclusion of those that without been degraded may be used in agriculture, fruit-culture, or intensive live-stock farming." This implies that the forest sector occupies lands with a low opportunity cost, representing an important development benefit by incorporating areas that would otherwise be unproductive in the national economy.<sup>31</sup>

<sup>&</sup>lt;sup>30</sup> Prado, José Antonio. *Forest plantations. Beyond trees.* CIFAG, 2015

<sup>&</sup>lt;sup>31</sup> Cabaña, Carlos. *Historical review of the application of DL 701 of 1974 on Forest Development*. CONAF, 2011



Radiata pine forest

# A balanced approach that combines productive and environmental goals

The introduction of Radiata pine and Eucaliptus globulus in the country aimed not only to allow for the mitigation of soil erosion and restoration of degraded lands from an environmental perspective; it also contributed to economic development due to their productive abilities and adaptability to Chilean soils.

By late 19th century Chile, the conviction that establishing planted forests with fast-growing species was the solution to the soil erosion challenge of the country, particularly its central zones, became mainstream. Two species that found their way into the country, namely *Pinus radiata* and *Eucalyptus globulus*, quickly demonstrated their adaptability to Chile's climate and soils and became key in the country's afforestation efforts and strategies. As a result, between 1931 and 1974 about 300,000 hectares of degraded lands were afforested or reforested, mainly with *Pinus radiata*;<sup>32</sup> today, the area covered by these two species has reached 1,865,624 hectares, accounting for 82% of all planted

<sup>32</sup> Prado, José Antonio. *Forest plantations. Beyond trees.* CIFAG, 2015

# MAIN PLANTED SPECIES

### Pinus radiata (Radiata or Monterrey pine)





20.2

tCO<sub>2eq</sub> ha/yea

**Sequestration** 

Ē

Carbon



Growth rate: 20-30 m<sup>3</sup>/ ha /year

### Wood Characteristics:

Very versatile wood, abundant, pliable and easy to dry and impregnate.

# Distribution and Habitat:

It grows between the Valparaíso and Los Ríos Regions, and its optimal growth is between Constitución and Valdivia.

#### Environmental co-benefits:

• Carbon dioxide sequestration capacity.

 Good adaptability in degraded and eroded soils.

• Precipitation interceptor. Helps prevent sediment transport to watercourses, which contributes to water basin regulation.



### Products and Industrial Applications:





There is high demand of Radiata pine wood due to its versatility in industrial applications. Its attractive grain, good screw and nail-holding and fastening capability, workability, finishing texture and polishing make it a very attractive product for the final consumer. It is used as interior and exterior cladding, in housing structures, furniture manufacturing, and in moldings and packaging. Radiata pine is also used to produce wood pulp.

### Eucalyptus globulus and Eucalyptus nitens



### **Origin:** Tasmania and Australia.

Rotation: 20 years

Growth rate: 30-40 m<sup>3</sup>/ ha /year

### Wood Characteristics:

White-cream color wood, featuring medium gloss, and fine and even texture. Visible growth rings.

### Distribution and Habitat:

These species are planted between the Valparaíso and Los Lagos Regions. The best plantations are found in the Concepción and Arauco areas

# 🕅 Environmental co-benefits:

- Carbon dioxide sequestration
- capacity
- Good adaptability to degraded and eroded soils

Planted area: 858.600 ha\*

## Products and Industrial Applications:





Eucalyptus plantations are mainly devoted to biomass and chemical pulp production. It is intended for short fiber pulp production, although its timber is also increasingly used in wood flooring, veneers, moldings and furniture manufacturing, in well-lit structures and, in general, in high added-value products. In recent years, both Eucalyptus globulus and Eucalyptus nitens are used for the production of firewood and pellets due to its high calorific value, high wood density and low humidity. Its leaves produce essential oils which are mostly exported.

\* INFOR. Forestry Yearbook 2019. Inventory of plantations as of December 2017





Pinus radiata

Eucalyptus globulus

# History of two species

Originally from the State of California, United States, it is thought that Radiata pine first arrived in Chile inadvertently through a businessman and farmer, Arturo Junge, who imported Douglas fir seeds which had among them some pine seeds (Radiata or Monterrey pine) that ended up growing more quickly. Junge became interested in them and ordered more, consequently introducing this species in the country.

On the other hand, the German forest engineer Konrad Peters promoted Eucalyptus plantations as posts for the coal mines in Lota. Subsequently, in 1944, CORFO brought to Chile a group of international experts, headed by Dr. Irvine Haig, who along with a group of Chilean specialists recommended that the Government formulate a forestry policy focused on reforestation.

Since then, a search for the most appropriate introduced species begun through several trials in over 8,000 plots between the Coquimbo Region, in northern Chile, and the Aysén Region, in the Chilean Patagonia. With the support of private landowners, INFOR tested a total of approximately 160 species, particularly pine varieties, of which the Radiata pine stood out due to its great adaptive capacity to the different soil conditions and climates of Chile.

Among the broadleaf species, various from the Eucalyptus genus demonstrated outstanding growth in different regions of the country. Eucalyptus globulus —originally from southeastern Australia and Tasmania— proved to have greater plasticity for the production of different wood products by allowing its structure to be modified (chips, shavings, sawdust) in different applications, such as solid wood products (sawn wood and plywood), reconstituted wood products (wood-based panels), and pulp. Eucalyptus globulus, on the other hand, also showed a great degree of adaptability to different climate and soil conditions between the Valparaíso and Los Lagos Region. land in Chile. Another species with great adaptability to national conditions was the *Eucalyptus nitens*, which now represents 11.8% of the total planted area, while the rest of the species contribute with 5.2% of planted forests in the country. Although Radiata pine is the species that covers the most area (56%) according to INFOR data, its participation has been declining since 2013, and experienced a sharp drop in 2017 as a result of the megafires during the summer of that year.

In Chile, 90% of forest plantations have been established on lands affected by or under risk of soil erosion. Pines, in general, are effective rainfall interceptors, due to their permanent foliage, large leaf surface, and significant amount of organic matter they accumulate on the topsoil (pine needle litter cover), making them an effective tool in mitigating soil erosion and regulating watersheds by preventing sed-

iment transport in watercourses. In addition to directly reducing soil degradation, the extensive use of both species also allowed reducing the pressure on the country's native forests, by generating a stable timber supply that now covers 99% of the raw material demand of the Chilean forest industry. It is important to notice though that this has not always been the case, and several studies prepared by CONAF, INFOR and the Central Bank of Chile show that native forest replacement by forest plantations in the last 50 years reached 250,000 hectares, equaling 10% of total plantated and 2% of the total native forests.

Planted forests also present a significant environmental benefit for global climate change mitigation, as they represent a natural carbon capture and storage tool, storing carbon in their biomass even after their conversion to harvested wood products. In the case of *Pinus* radiata, the annual carbon dioxide  $(CO_2)$  sequestration rate is equal to 20.2 tons per hectare per year. Eucalyptus globulus, on the other hand, sequesters 33.5 tons of CO<sub>2</sub> per year per hectare, while *Eucalyptus nitens* sequesters 48.5.<sup>33</sup> According to the National Greenhouse Gas Inventory of Chile compiled by the Ministry of Environment, the total volume of CO<sub>2</sub> captured in forest plantations subsidized through DL 701 is estimated to be approximately 33 million tons, of which 84.4% corresponds to Radiata pine plantations; 8.3%, to Eucalyptus globulus plantations, and 7.3%, to Eucalyptus nitens plantations. During the peak of afforestation activities, between 1980 and 2005, the contribution of forest plantations to net carbon sequestration was significant. Today, however, carbon storage matches to a large extent the emissions generated by harvesting through forest management.





<sup>&</sup>lt;sup>33</sup> INFOR-CORMA. Wood availability of Radiata pine plantations in Chile 2003-2032 (Technical Report N°170). INFOR, 2005; INFOR-COR-MA. Wood availability of Eucalyptus in Chile 2006-2025 (Technical Report N°173). INFOR, 2007.



Afforestation

# A supportive institutional framework

One of the key factors in the success of the Chilean forestry model is the establishment of a supportive and stable institutional framework that provided the legal, institutional, and economic foundations which allowed Chile to partner with the private sector in developing one of the world's leading forest industries.

The Chilean public sector focused its efforts early on in developing a solid institutional framework aimed at incentivizing private sector growth. Today, the country has long-standing forestry institutions, both public and private, that ensure compliance with the law, regulate the management of forest plantations and native forests, and promote a sustainable and inclusive development of the forest sector. The main institutions and agencies of the forest sector are presented below:

# **CHILEAN FOREST INSTITUTIONS AND GOVERNANCE**





 Park Ranger during an educational activity

### **National Forestry Corporation (CONAF):**

The main public institution of the forest sector is the National Forestry Corporation (CONAF), established by public deed on February 2, 1970. Legally, it is a private non-profit corporation which has been given public authority and functions through special laws. Effectively though, it fulfills the function of a State Forest Service, responsible for contributing to the country's development through the sustainable management of forest ecosystems and the associated natural environment, by promoting the establishment, restoration and management of forest and xerophytic vegetation; increasing tree cover in urban areas; mitigating and adapting to the effects of climate change; overseeing forest and environmental legislation; protecting vegetation resources, and administering the State-owned Wildlife Management Areas under SNASPE. According to the 2017 Budget Law, CONAF has an annual budget of approximately USD 80 million. While the Corporation's mission and strategic objectives are applicable to all of Chile's citizens, its actions are focused on small and medium-sized forest landowners located in the country's most rural areas.

CONAF has regional offices and directorates in all of Chile's 16 regions, as well as a special provincial office in Rapa Nui (Easter Island). Since 1974 it has been the responsible agency for managing the DL 701 and qualifying lands suitable for forestry. Another key function of CONAF consists in forest fire and pest management. In coordination with other State institutions, CONAF is a leading member of the National Plan for Preventing and Fighting Forest Fires, a program that counts with 2,515 brigade members dedicated to firefighting activities distributed in 238 brigades between the Atacama and Magallanes regions, and an additional 3,400 members from the private sector. The organization also operates a complex fire detection system that includes observation towers, and the hiring of helicopters, light airplanes and larger aircraft.

CONAF is also legally responsible for monitoring the country's forest resources through the Cadaster of Native Vegetation Resources of Chile, a tool that





INFOR researchers

provides basic data for public decision-making related to the management and conservation of forests and other natural resources. Additionally, CONAF has a mandate to contribute to the country's climate change mitigation and adaptation efforts, through the protection and expansion of vegetation resources, and ensuring compliance with forest and environmental related regulations. Per this mandate, CONAF has led the development of the Chilean Strategy for Climate Change and Vegetation Resources 2017-2025 (ENCCRV), which guides and integrates the forest sector's efforts to mitigate and adapt to climate change, as well as to fight desertification, land degradation and drought.

### Forestry Institute (INFOR):

The Forestry Institute (INFOR) is the main forestry research agency of the State of Chile, constituted as a private corporate entity and affiliated to the Ministry of Agriculture. Its origins date back to 1961, when it began its activities as a joint project between the Food and Agriculture Organization (FAO) of the United Nations and the Government of Chile, with the purpose of supporting the country's forest development. It was later officially created by the Government of Chile in 1965. The institution has five regional offices and is considered a reference for quality forestry information and research. INFOR focuses on the following research areas: data gathering, statistics and forestry economics; forest ecosystem monitoring, climate change mitigation and adaptation; management of native and exotic forest ecosystems; forestry development, including the restoration and recovery of vegetation resources; conservation and improvement of genetic material; productivity improvements for plantation forestry; non-wood forest products (NWFP); technology and harvested wood products aimed at developing alternative uses of wood to generate value-added. INFOR is also responsible for the Continuous Update on Forest Plantations Program -one of the oldest initiatives of the Institute, dating back to 1980-, the Continuous Inventory of Chile's Forest Ecosystems -- in operation since 2000-, and the Integrated System of Monitoring and Evaluation of Native Forest Ecosystems (SIMEF).





# **Universities:**

Chile counts with three Faculties of Forest Engineering with over 50 years of tradition. The first one was established in the city of Valdivia by the Austral University of Chile in 1965; the second by the University of Chile in 1976; and in 1992, the University of Concepción founded the School of Forest Science. All of them have been instrumental in developing the forest sector's industry and institutional framework. The rise of the forest sector led to the creation of 11 Forest Engineering programs in the mid-1990s, of which only 5 continue to exist today. Universities, both public and private, have placed a strong emphasis on basic forest sector research in collaboration with government agencies, the private sector, non-profit and international organizations.

## **Trade and Labor Union Associations:**

Union Associations have also been an important part of the institutional framework of Chile's forest sector. Among them, the Chilean Timber Industry Association (CORMA) is one of the most important private sector trade unions, bringing together the country's main forest companies, both large and medium scale, along forest sector professionals and contractors. The highest decision-making body within CORMA's institutional structure is its Members' Assembly, formed by representatives of forestry companies and companies associated to the forest sector, individual professionals, and higher education and training institutions, among others, grouped into subdivisions according to the nature of their activities, and into Regional Councils based on their location. CORMA actively participates in different public-private partnership initiatives. The main issues addressed by its members include forest fires, pest control,





genetic improvement, national timber simulation model, studies on future availability of timber, among many others.

In May 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 a union association aimed at promoting the rationalization, development, prestige and protection of the Forest Engineering profession. It also represents the positions and actions of its members in the public opinion and towards other organizations, both domestically and internationally. As a union association, it represents forestry professionals in the Forest Policy Council and other national bodies.

# **The Forest Policy Council:**

The Forest Policy Council was created in 2016 with the objective of developing a forest policy for "the Chile of the future" under a sustainability approach, balancing progress between environmental, economic, social, labor, technological, and political goals. The Council is formed by 15 members that represent various fields, such as universities, scientific entities, groups of small forest owners, indigenous organizations, union associations, environmental NGOs, and private companies. Chaired by CONAF's Executive Director, the Council has an advisory nature, focusing its actions in the integration of small and medium enterprises in forest sector development.

## **Other State institutions:**

Other State institutions that carry out activities related to the forest sector include the Agricultural and Livestock Service (SAG), responsible for the control and elimination of forest pests and diseases; the National Agricultural Development Institute (INDAP), which operates technical assistance programs targeting small forest owners aimed at improving their business and organizational capacities, as well as their integration into the rural development process; and the Natural Resources Information Center (CIREN), a technical support unit of MINAGRI providing geospatial data on natural resources and productive activities through the use of information technologies, to inform decision-making. CORFO is also a government agency that played an important role in the forest industry during the 1960s in terms of development and financing for the sector. However, its involvement today is limited to the development of programs primarily aimed entrepreneurship and timber use in construction. Financing for small and medium enterprises in the productive forestry sector is currently channeled through nine financial institutions that cover this segment in their product lines. Of these, eight are private commercial banks and one is a state-owned bank (BancoEstado), which, like CORFO played a bigger role in the past due to the greater governmental participation in financing policies and programs.







Lirquen Port. Biobío Region

# A market-oriented approach

A long history of export-oriented growth and the existence of strategic port infrastructure facilities facilitated the competitiveness of Chile's forest sector and its participation in foreign trade.

Exports have been one of the growth engines of the Chilean economy, including those of the forest sector. Based on a long-standing trajectory of exporting non-renewable natural resources, and with the aim of diversifying its export matrix, Chile turned to renewable natural resources products. During the early stages of the Chilean Republic, the main export products were basically guano, saltpeter, and grains, while over time the export drive became increasingly focused on mining products. With the reorientation of public and economic policies the mid-1970s that opened up the country to international markets, came a number economic policy measures: the exchange rate was raised, providing incentives to export activities and the transfer of resources to export industries; tariff reductions were implemented and export bans were abolished; different export promotion mechanisms were created, among them the establishment by the Central Bank of a drawback policy based on the amount of exports of new products; and, finally, a decree/law for the promotion of foreign investment was enacted, which resulted in a significant inflow of capital, knowhow, technology, and access to international markets. For the forest sector, these policies in practice meant the removal of export restrictions, such as for pine logs and low-quality timber. Thanks to the drawback, an export matrix of new products with greater added value was promoted and expanded, including remanufacturing, furniture parts and pieces, and finished furniture. This industrial momentum allowed exports to grow from (in current dollars) USD 1,100 million in 1970 to USD 67,000 million in 2007, positioning the forest sector, in 2018, as the country's third largest exporter based on natural resources.

Since the late 1990s Chile became part of a series of free trade agreements (FTA) with some of the world's largest economies, such as the United States, China, the European Union, Japan, and Australia. As a result, agricultural, forest, and fisheries products joined the more traditional mining sector exports. Currently, Chile has 26 trade agreements with 64 markets, allowing the country to expand its domestic market of 17.6 million Chileans to 4 billion potential consumers around the world. This remarkable exporting performance has positioned the country as the 42nd largest export economy in the world, according to the Economic Complexity Index (ECI). The main destination markets of these exports are China, the United States, Japan, and South Korea, which also represent the main markets for Chilean forest products.

Chile's maritime access provides a significant competitive advantage for international trade, in which ports play a strategic role. Along its more than 6,000 km of length, Chile counts with about 30 ports, 14 of which are administered by port companies under a under concession system. Exports moving through Chilean ports and the type of products exported are determined by the productive structure of each of the country's macrozone. The northern ports focus in the export of minerals and the import of fuels; those in the center of the country deal with seafood and fruit products, while those in the south and south-central zone have a large participation of forest products, estimated at 45% of the total export load, reaching up to 85% in some terminals. The geographical proximity of forest plantations and the forest industry with the country's ports has played a key role in the competitiveness of the national forest sector.



# Chapter 3

# TOWARDS AN INCLUSIVE AND SUSTAINABLE FOREST MODEL

Despite the significant achievements made in establishing a vast natural capital based of planted forests in the country, the forest sector faces new challenges. The key ones include the need to continue reforesting the country's degraded under a paradigm shift that takes into account climate change mitigation and adaptation; incorporating native forests in sustainable development processes; strengthening social inclusion and participation of local communities, indigenous peoples and other vulnerable groups; and the consolidating public institutions in accordance with the strategic importance of the Chilean forest sector.
Mixed forest in Lleulleu

1.1.



# **3.1** THE NEW GENERATION OF FOREST PLANTATIONS

Eucalyptus plantations.
 Ñuble Region

The economic incentives that supported the establishment of forest plantations allowed the country to expand its forest cover by more than 3.1 million hectares —mainly with pine and eucalyptus trees—. However, this growth has potentially reached its limits, posing new challenges for the development of a new generation of forest plantations for the future.

**Continuing expanding its forest cover poses a series of new challenges for Chile.** The vast majority of forest plantations were established under the umbrella of government incentives, mainly under the DL 701, peaking with a maximum annual afforestation rate of 95,933 hectares in 1992, which then started declining over the years. The end of the DL 701 afforestation incentives in 2012, coupled with a reduced availability of productive lands for afforestation purposes, is creating new challenges for Chile to continue its forest expansion efforts. In 2018, the afforestation rate reached a historical low of 1,525 hectares per year. On the other hand, while the afforestation rate has decreased, reforestation is presenting an increasing trend since, with the majority of forest plantations reaching maturity, the harvesting area has expanded, and so has reforestation which is required by the law.



Source: INFOR. Statistical Yearbook 2019 (Statistical Bulletin Nº 168). INFOR, 2019



<sup>34</sup> Flores, Juan Pablo et al. 2010. Determination of current and potential erosion of Chilean soils. CIREN.

It is estimated that there are at least 2.6 million hectares of land nationwide with varying degrees of degradation that are suitable for afforestation. Among Chile's most pressing environmental problems, soil erosion is identified as the most relevant in the agriculture, livestock and forest sectors, both for its environmental as well as its socioeconomic impacts. According to available figures, the total area of degraded soils in Chile exceeds half of the country's total territory.<sup>34</sup> This is particularly concerning, considering that the soils suitable for forestry in Chile represent about 46% of the national territory. In addition, there is an area of 518,000 hectares of land that was affected by forest fires in the 2016-2017 season (274,000 hectares of planted and 67,000 hectares of native forests), mostly concentrated between the O'Higgins, Maule and Biobío regions, which makes the total amount of land suitable for afforestation or reforestation equal to 3.17 million hectares.

REGION	TOTAL	º/o
0 <sup>-</sup> Higgins	288,261	11
Maule	294,152	11
Biobío*	410,536	16
La Araucanía	550,271	21
Los Lagos	338,342	13
Aysén	683,055	26
Los Ríos	65,593	2
TOTAL	2,630,210	100

INFOR, 2016

### as notantially afferented between O'Higgins and Auson

The main constraint that new afforestation efforts face in Chile is the increasing degree of degradation and fragmentation of available land. Currently available lands are usually of a lower quality than the ones previously planted, with severe constraints such as a high degree of erosion, limited water availability, and fragmented ownership among a large number of small and medium holders, often with irregular property titles and without sufficient financial capacity and/or affected by poverty. Another important challenge for this type of forest landowners is their limited capacity to adopt and implement -- through technology transfer- best practices in silviculture used in the country today so that their forests can reach productivity levels at similar yields as those required by large timber companies. For example, as seen in the related table, in the case of Radiata pine, large companies manage to obtain annual increment gains of 10%, while small

### Annual increment rates among different types of forest owners (%)

Type of ownership	P. radiata	E. globulus	E. nitens
Large enterprises	10	11	12
Medium enterprises	10	10	11
Medium owners	5	5	10
Small owners	3	3	5

Source: INFOR. Wood availability Pinus Radiata and Eucalyptus Plantations 2017-2047 (Technical Report N° 220). INFOR, 2018.

and medium owners on average reach less than half of that. In this context, genetic improvements -without considering other elements such as initial fertilization, herbicide treatment or soil preparation-, could potentially bridge this gap for small and medium owners in terms of volume at the end of the rotation period, which would not only represent and additional volume contribution for the national industry, but also a source of financial and social development for these landowners.

The Chilean forest sector also faces the challenge of maintaining the existing stock of planted forests and prevent it from declining. Amid the complex environmental scenario of recent years, mainly due to climate change resulting in a decrease in rainfall and longer drought periods, forest vegetation (both planted and native) has been affected, with a decrease in growth and lower productivity, higher vulnerability to pests, and a greater magnitude and intensity of forest fires. Under such conditions, maintaining the pulse towards the establishment, management, and protection of forests in lands preferably suitable for forestry is key for the forest sector to continue providing a wealth of social, economic and environmental benefits for the country. In this context, strengthening public-private partnerships represents an opportunity for maintaining the existing forest stocks by increasing the interest of private landowners in maintaining and eventually increasing their forest areas, preventing land-use change towards more profitable alternatives given ever increasing opportunity costs.

**Timber availability from forest plantations is expected to decrease in the near future.** The new standing volume projected for 2040 <sup>35</sup> shows a decrease in total timber supply of approximately 8% compared to previous estimates, <sup>36</sup> from 46,971,637 m<sup>3</sup> to 43,216,564 m<sup>3</sup>. With regards to specific species, Pinus radiata shows the greatest decrease in timber supply from 28.9 to 24.2 million m<sup>3</sup> compared to previous estimates. The same trend occurs for Eucalyptus globulus, with a decrease from 10.6 to 9.0 million m<sup>3</sup>. Regarding Eucalyptus nitens, the projected supply is greater than the one previously reported, increasing from 7 to 9.9 million m<sup>3</sup>. The main cause of this lower future timber availability is due to the magnitude of the megafires of the summer of 2017 that affected a significant area of plantations of standing Radiata pine and Eucalyptus trees. Other factors include the low afforestation rate in recent



<sup>&</sup>lt;sup>35</sup> INFOR. Wood availability of Radiata pine and Eucaliptus plantations 2017 -2047 (Technical Report N° 220). INFOR, 2018.





Degraded lands. Biobío Region ▲ Forest fires

<sup>36</sup> INFOR. Wood availability of Radiata pine and Eucaliptus plantations 2010 - 2040 (Technical Report Nº 194). INFOR, 2013.

<sup>37</sup> INFOR. Wood availability of Radiata pine and Eucaliptus plantations 2010 - 2040 (Technical Report Nº 194).
 INFOR, 2013.

years due to the end of the government incentives under DL 701; changes in species mix, mainly from small and medium landowners who plant eucalyptus after harvesting Radiata pine (motivated by the lower rotations), and the decrease in yield experienced in recent years for some species, especially in Eucalyptus globulus plantations due to the prolonged drought in the central area of the country and the impact of pests (Gonipterus platensis) affecting plantation growth. These projections indicate a stagnation in the growth of the forest sector of historic dimensions, with a decline in the production and consumption of raw material starting in 2018, without the ability to recover previous yield levels within the next 20 years. Estimates of raw material availability similar to the levels of 2017 are not projected until 2041. It is expected that this situation will affect all levels of 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 procuring woodchips, all of which will exert a higher pressure on the different forest products in the domestic market.<sup>37</sup>

These new conditions, both at the national and global level, place the new generation of forest plantations at the heart of the path towards an inclusive and sustainable forest model. Continuing to afforest the country's degraded lands under a holistic economic, social and environmental perspective, along with the application of soil and water conservation techniques, would provide small landowners with an incentive restore eroded soils with no viable alternative economic use, and generate direct local employment, in addition to delivering multiple environmental goods and services such as erosion control, carbon sequestration, and "water capture", among others, incentivizing forest-owners to permanently protect their forest lands.



## **3.2** VALUING NATIVE FOREST RESOURCES

Chile's native forests represent a vast natural capital of more than 14.6 million hectares. Despite a modern legislation regulating its conservation and sustainable use, the full environmental, social, and economic potential of this natural capital largely remains untapped. Finding ways to properly value the environmental goods and services provided by the country's native forests remains one of the great challenges of Chile's forest sector.



Chile has more than 14.6 million hectares of native forests with the potential to provide a range of environmental goods and services to its citizens. This vast natural resource represents a great economic opportunity for the country which could revitalize regional and local economies through the sustainable management of native forests. To reach this potential, however, several constraints have to be overcome, such as the "decapitalization" of its stocks and degradation of native forest resources in general, the poor market development for the goods and services that native forests provide and bridging the gaps that exist between the demand and supply of high-quality timber and wood products. Native forest. Araucanía region

### GHG Emissions from forest degradation 2001-2010

Region	tCO <sub>2eq</sub> / year
Maule	602,976
Biobío*	1,209,890
La Araucanía	1,907,344
Los Ríos	1,373,080
Los Lagos	4,050,103
TOTAL	9,149,392

\*Data for the Biobio region include the  $\tilde{\text{N}}\textsc{uble}$  region, created in 2018

Source: CONAF. 2016. Forest Level Emission Level / Forest Reference Level of Chile's Native Forests. Report submitted at the UNFCCC. CONAF, 2016 Despite their existing condition, native forests are enormously resilient, making it possible over time— to get them from their current state of wide-spread degradation and abandonment to a state of sustained productivity levels, with its consequent increase in biodiversity and supply of timber, non-timber, and ecosystem goods and services.

While Chile is one of the few developing countries that has managed to reverse its rate of deforestation and achieve a net increase in forest cover, the gradual degradation of its extensive area of native forests remains a challenge for the forest sector. Based on data from the National Forest Reference Level (FRL) submitted to the United Nations Framework Convention on Climate Change (UNFCCC), during the 2001-2010 period forest degradation reached 461,231 hectares in only six regions of the country (Maule, Biobío, Ñuble, La Araucanía,

Los Ríos, and Los Lagos), resulting in a total of 9,149,392 tons of  $CO_{2e}$  emissions per year due to forest degradation. These figures indicate that forest degradation is a key challenge for Chile in order to meet its commitments under the UNFCCC related to the conservation, enhancement, and sustainable management of GHG sinks and reservoirs, a category in which forests have a prominent role.

The main cause of degradation of the country's native forests is their continuous exploitation without established management plans, which results in an unsustainable use of the resource. Most of these forests have historically been subject to a practice called "floreo", i.e. the selective logging of the best individuals (bigger and higher quality trees), without due consideration to proper silvicultural practices (extraction levels and annual increment rates) for the protection and regeneration aspects of the residual forest.<sup>38</sup> This situation is further aggravated by a number of other drivers, such as the introduction of cattle in overexploited areas which prevent natural regeneration processes; the impacts of forest fires and drought exacerbated by the effects of climate change; pests and diseases; and the unsustainable management of tree plantations.<sup>39</sup> The main underlying cause of this situation is the relatively lower value of standing native forests compared to other land uses, meaning that they do not generate enough profit for landowners to incentivize their sustainable use something that often requires a timeframe that goes beyond the landowners' own life expectations, as for example, some native species such as Roble-Raulí involve harvesting cycles of no less than 40 years,<sup>40</sup> while for others such as Lenga cycles may go up to 120<sup>41</sup> years.

In addition, a significant portion of the country's native forests is in the hands of small and medium landowners, often in poor living conditions with insufficient resources to invest in sustainable forestry with long-term goals.

<sup>38</sup> Donoso Claudio et al. Evergreen Forests. In: Silviculture of the Native Forests of Chile. Eds.: Lara A. and Donoso C., 1999.

<sup>39</sup> CConsortium OTERRA, Forest Engineering School of Mayor University, Ernst Basler + Partners, AIFBN and CIREN. Final Consultancy Report: Analysis of the causes of deforestation, forest degradation and non-enhancement of forest carbon stocks; and identification of strategic options to address them within the framework of the ENCCRV of Chile. CONAF - GEDEFF, 2016.

<sup>40</sup> Grosse, Hans and Quiroz, Iván. Silviculture of second growth forests of Roble, Raulí and Coigüe in the central-southern regions of Chile. In: Silviculture of the Native Forests of Chile. Eds.: Lara A. and Donoso C., 1999.

<sup>41</sup> Schmidt, Harald and Caldentey, Juan. *Silvicultural interventions, growth and biomass in Lenga. Magallanes and Chilean Antarctic Region.* University of Chile and CONAF, 1991. At the same time, managing native forest resources with sustainability criteria represents an opportunity for these landowners to generate a sustained revenue stream and become part of the country's forest sector development. The underlying solution in order to avoid or reduce forest degradation, then, lies in finding appropriate instruments that can capitalize on the net present value of forest resources in a way that incentivizes landowners to care for their conservation, protection, and sustainable use in the long run, through the provision of (improved) forest products and environmental services.

The state of degradation of Chile's native forests means that this vast natural capital is currently operating below its potential, therefore depriving landowners, the timber industry, and society at large of the benefits that would be derived from its rational use. A clear example of this is that only 260,000 m<sup>3</sup> out of the 47.8 million m<sup>3</sup> of industrial timber consumed in 2018 in the country came from native forests (equal to 0.5%), while the share native timber forest products in total forest sector exports that same year was just 0.05%, following a downward trend over the past 12 years.<sup>42</sup> At the same time, it is estimated that from the 14.6 million hectares of native forests available, approximately 6.5 million hectares have good potential for bioenergy generation, industrial production, or conservation.<sup>43</sup> However, it is important to consider that, given the current status of degradation of native forest resources, due to historic overexploitation, any intervention to establish a sustainable forest management regime would require some degree of initial investment towards its recovery along with a silvicultural management practice involving successive interventions over a period of time to achieve the capitalization of forest stock resources and ensure their longterm profitability.<sup>44</sup> For instance, analyses carried out by CONAF<sup>45</sup> show that in order to ensure the sustainable management of Nothofagus, as well as evergreen and sclerophyllous forest types, these should undergo at least 4 to 5 silvicultural





<sup>42</sup> INFOR.*Statistical Yearbook 2019* (Statistical Bulletin Nº 168). INFOR, 2019

<sup>43</sup> CONAF. Final Report from the Evaluation of Government Programs: Native Forest Law Program. DIPRES, 2013.

<sup>44</sup> University of Biobío. *Determination of the cost structure of eligible silvicultural activities aimed at managing and recovering the secondary forests of Roble-Rauli-Coihue in the center-south of Chile for the purpose of wood production.* CONAF – Native Forest Research Fund, 2012.

<sup>45</sup> CONAF. *Cost analysis of activities to ensure good management of native forest and xerophytic formations.* CONAF, 2014





Nothofagus forest. Maule Region

Native Forest Management

interventions over time prior to harvesting, since, in order to generate high quality products, early and moderate silvicultural interventions along with relatively intensive management is required in order to continuously raise the quality of the forest stands. This inevitably requires landowners that are willing to invest their resources in silvicultural activities today, with the hope of ripping the benefits in a somewhat distant future a condition that very few landowners are able to meet regardless of their economic and social status.

Applying new silvicultural methods along with enhanced marketing strategies and forestry extension services can provide new opportunities for the valuation of native forests. For several decades now, Chile has been experimenting with different methods of native forest management seeking to improve both the quality and quantity (yields) of native timber throughout consecutive forest rotation cycles, in order to ensure a stable supply of quality wood from native forest stands that will allow them to gain sustained access to high-quality product markets. However, up until the present day there has been no systematic assessment of the silvicultural practices that can guarantee these results for the different types of native forests, and that could capture the interest of small and medium landowners. Therefore, a key and pending challenge for the sustainable management of Chile's native forest resources consists in developing and validating new silvicultural methods, while assessing the results of those already applied, in order to secure a second rotation of well-managed forest, avoid land abandonment, and ensure the sustainability of silvicultural interventions in native forests. Similarly, there is a need to improve research in product development, transformation and marketing in order to close the gaps between the quality of the native timber produced and that required by markets. According to studies conducted by INFOR for European and United States markets, Chilean native timber lacks consistency in terms of guaranteed quality and supply flows that would allow it to reach those markets. In addition, including small landowners in native timber supply chains requires a strong forest extension and marketing support system.<sup>46</sup> Current foreseen supply shortages of Radiata pine timber<sup>47</sup> due to the forest fires

<sup>&</sup>lt;sup>46</sup> Von Lüpke, Heiner. Sustainable Management of Native Forests, Marketing and Poverty. CMSBN Project, Cooperation Agreement CMSBN, CONAF and GTZ, 2004

<sup>&</sup>lt;sup>47</sup> INFOR. Wood availability of Radiata pine and Eucaliptus plantations 2017 -2047 (Technical Report N° 220). INFOR, 2018.

that recently affected the Maule, Biobío, and Araucanía regions, and their higher likelihood of reoccurrence due to climate change, could represent an opportunity to industrialize part of native timber resources in the regions that have adequate stocks and a suitable location, using silvicultural techniques that ensure the profitability and sustainability of native forest operations as a means of incorporating them into the market economy.

Deploying native forest resources for biomass production could be a means of creating economic opportunities for thousands of landowners while contributing to the country's decarbonization goals. In 2018, forest biomass contributed 24% to the country's primary energy matrix, becoming the second energy source after oil.<sup>48</sup> Firewood consumption in Chile is about 13.1 million m<sup>3</sup> annually, of which approximately 53% (7 million m<sup>3</sup>) consists of native forest biomass, estimated to originate from 21% of the potentially exploitable area.<sup>49</sup> Residential consumption is the most important in the country, with the urban and rural sectors jointly consuming 11.8 million m<sup>3</sup> of solid wood exclusively as firewood (90% of total consumption).<sup>50</sup> In socioeconomic terms, the value of the residential firewood market segment is estimated at around USD 800 million a year, with approximately 4,843 companies formally involved in marketing firewood, and at least 81,337 properties producing firewood from native forests. This market segment generates approximately 91,000 jobs, in addition to those generated by the traditional forest industry. However, inclusive participation in the firewood value chain for all players involved --particularly small producers and small and medium companies- and minimizing negative impacts both in the forest and in cities, are undoubtedly among the key challenges the sector faces.

The current model of firewood use as a source of biomass energy generates in significant negative externalities due to its inefficient use and informality. In principle, the use of wood biomass energy following sustainable forest management criteria can be considered carbon neutral according to the guidelines of the Intergovernmental Panel on Climate Change (IPCC). In Chile, however, the majority of native firewood is currently sold in a highly informal market, with only 19.6% of its supply regulated through Forest Management Plans. Combined with the inefficient use of wood energy and the resulting excessive wood energy demand from households, firewood is one of the main causes of forest degradation in the country, particularly in south and central Chile.<sup>51</sup> This informal market exacerbates the serious pollution problems already present in this part of the country, with several cities declared as atmospherically saturated areas due to the high levels of fine particulate matter caused by the combination of wet firewood burning, the use of low-tech heating equipment, lack of proper thermal insulation in households, and poorly informed consumers. On the other hand, high quality firewood (with a low moisture content) can reduce forest degradation pressure since less volume is required to produce the same amount of energy. Similarly, according to the Atmospheric Decontamination Strategy of the Ministry of the Environment (MMA), higher quality firewood could also reduce the concentration of fine particulate matter (PM2.5) in cities declared as saturated areas, provided that such energy resource is used in certified <sup>52</sup> combustion equipment that is properly maintained and handled. The economic benefits in



<sup>48</sup> National Energy Commission. National Energy Balance 2017 (Consulted on December 2019 at: http:// energiaabierta.cl/visualizaciones/ balance-de-energia/).

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<sup>49</sup> CONAF. *Dendroenergy Strategy 2015-2030.* CONAF - Dendroenergy Unit, 2015.

<sup>50</sup> Austral University of Chile. *Final report of the Project: Evaluation of the biomass market and its potential.* Ministry of Energy and CONAF, 2013.

<sup>51</sup> In the case of a city such as Valdivia, it can average 63,000 MJ/household/ year, which is 2 to 4 times higher than that of cities in developed countries at the same latitude.

<sup>52</sup> Supreme Decree 39/2011 of the Ministry of the Environment developed a Standard for Particulate Matter Emissions for appliances burning firewood and wooden pellets.

#### <sup>53</sup> The value of the UF as of April 1st, 2018 (1UF = CLP 26,966.89) and the average exchange rate in April 2018 (US\$ = 604 CLP) are considered.

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<sup>54</sup> CONAF. Critical and quantitative analysis of the set of policies of the Government of Chile related to the good management of forest biomass. Impact on climate change mitigation and associated co-benefits (Information Note ENCCRV N° 27). CONAF – UCCSA, 2018. terms of health associated with the sustainable use of firewood have been estimated up to USD 476 million<sup>53</sup> for a range of targets stipulated in official strategies, in addition to making a significant contribution to smallholders' income and generating other co-benefits.<sup>54</sup> Developing a forest development model focused on the sustainable production of wood biomass energy and promoting its efficient use can provide an important opportunity for valuing native forest resources, while reducing unwanted externalities such as air pollution and forest degradation, and contributing to the sustainability of the country's energy matrix and generating income opportunities for small and medium native forest owners.

### Benefits and associated co-benefits obtained by 2025 from achieving the dendroenergy targets set in different national strategies

Indicator	NCD	Forest Policy	Dendro-Energy Strategy	ENCCRV	PE2050	PDA
Native forest area with sustainable production management plans	50,000	1,680,000	202,200	16,000	434,000	42,000
Increase in native certified firewood (m <sup>3</sup> )	237,500	7,890,000	958,400	76,000	2,040,000	198,000
Avoided CO <sub>2</sub> emissions from management plans (tons)	680,000	22,869,000	2.752,448	217,800	5,907,825	571,725
Avoided CO <sub>2</sub> emissions by substitution of non- traceable firewood with certified firewood (t)	149,000	4,952,013	596,505	47,700	1,280,368	124,271
Job Creation (number)	1,144	37,996	4,577	366	9,824	953
Value added from marketing of certified firewood (in UF)	45,072	1,497,335	180,363	14,423	387,144	37,576
VAT from marketing of firewood (in UF)	52,97	1,730,713	208,475	16,671	447,485	43,432
Reduction of PM 2.5 emissions (tons)	759	25,196	3,035	243	6,515	632
Reduction of PM concentration (g/m <sup>3</sup> )	4.1	130	16	1.3	34	3.3
Avoided mortality (cases)	22	727	88	7	188	18
Health benefits (in UF)	321,694	10,687,005	1,287,317	102,942	2,763,180	263,191

Source: CONAF. Critical and quantitative analysis of the set of policies of the Government of Chile related to the good management of forest biomass. Impact on climate change mitigation and associated co-benefits (Information Note ENCCRV N° 27). CONAF – UCCSA, 2018.





Murta (Ugni molinae)

Morchella mushroom

Given Chile's high degree of endemism, Non-Timber Forest Products (NT-FPs) can provide an important opportunity for valuing native forest resources for commercial purposes. Recent decades have seen a growing market niche for the use and marketing of NTFPs from native forests, generating jobs and income for more than 200,000 people mostly in rural areas, with a strong gender perspective and cultural links to local communities.<sup>55</sup> An inventory compiled by INFOR in 2013 accounted for 480 different NTFPs used and marketed by the rural population in Chile, 432 (90%) of which come from native forest species. Among the most relevant NTFPs are species with medicinal properties and producing essential oils, edible fruits and mushrooms, ornamental species, and species producing fiber used for handicrafts. On the other hand, exports of NTFPs have increased significantly in the last 25 years, and the share of native forest NTFP in total NTFP exports increased from 7% in 1990 to 75% in 2015 compared to NTFPs from forest plantations. In 2018, NTFPs exports





<sup>55</sup> Valdebenito, Gerardo. Existence, use and value of Non-Timber Forest Products (NTFP) of native forests in Chile. Conference presented at the III Latin American Congress, IUFRO. Costa Rica, 2013 totaled USD 87.2 million, accounting for 1.3% of total exports from the forest sector, compared to the USD 12.7 million exported in 1990. The growing relevance of the NTFP market segment and its social and economic importance local communities indicate that further supporting their development can bring a significant opportunity for valuing native forest resources, based on sustainability considerations under an integrated management approach.

Native forests provide a wide range of environmental services, which -if properly valued-, could provide additional incentives to land owners for sustainable forest management. 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 NTFPs. The main challenge consists in that most of the benefits of the native forest have only been valued from the private perspective, considering only the market value of the products obtained from its harvesting, without taking into consideration the social benefits they provide, resulting in the premature logging of trees and the subsequent shortening of harvesting cycles. The public good nature of the environmental services provided by native forests, and lack of a market price for these goods prevent them from being considered in landowners' decision-making process regarding forest use. Estimates indicate that the Total Economic Value of the environmental goods and services provided by Chile's native forests to society totals approximately USD 16,000 million per year.<sup>56</sup> Recent studies show that depending on different prioritization criteria, the Net Present Value of afforestation activities with native species, and native forest restoration and management could reach USD 3,955 and USD 2,369 per hectare respectively.<sup>57</sup> Recognizing that healthy native forests are, directly or indirectly, a significant provider of ecosystem services to society creates an opportunity for their conservation and restoration.

Native Forest Environmental Services	AFFORESTATION	RESTORATION
Net Present Value US\$ 2,015/ha	3,955	2,369
• Carbon	53%	50%
• Wood		29%
• Biodiversity	20%	9%
• Water supply	9%	8%
• NTFP	5%	2%
• Tourism	2%	2%
• Nutrient regulation	8%	
• Erosion control	2%	
<ul> <li>Biological control</li> </ul>	0.3%	

<sup>56</sup> Navarro, Celso, et al. Market and economic potential: news and challenges of the native forest. AIFBN Native Forest Magazine, Nº 47, 2010.

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<sup>57</sup> CONAF. Economic valuation of the environmental and social benefits of the National Strategy for Climate Change and Vegetation Resources (EN-CCRV) 2017-2025 of Chile (Information Note ENCCRV N° 19). CONAF - UCCSA, 2018





Trekking in a National Park

Black woodpecker in Magallanes

Despite the extensive experience with Payment for Environmental Services (PES) schemes in Latin America, there are still no widely applied examples 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 that receive them for free in the form of positive externalities. As natural habitats slowly disappear, ecosystem services previously offered free of charge by nature are increasingly threatened. This growing scarcity makes them potentially subject of market transactions as economic goods and services. Studies in Chile have shown that the current economic incentives provided by the Native Forest Development Law are not sufficient to make forest restoration profitable, since the single payment per hectare provided currently by the Law does not compensate for the full costs forest owners face, thus resulting in negative returns.<sup>58</sup> This gap between social and private profitability makes it impossible for private agents to perceive the public benefits generated by native forests, indicating the need for an explicit recognition of the value of the positive externalities they generate. Incorporating an economic compensation proportional to the production of environmental services could significantly change this equation, making native forests a profitable private land use alternative in many cases. The central idea behind PES is that the beneficiaries of the ecosystem services generated by well managed forests make direct, contractual and conditional payments to native forest owners 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 in which they could be implemented.<sup>59</sup> In addition to carbon sequestration, the ecosystem services with the highest potential for a possible PES implementation related to native forests in Chile include: (i) drinking-water quality; (ii) water for crop irrigation (regulation of water flows); and (iii) scenic beauty in areas with tourism potential.<sup>60</sup>



Canopy activity in Chamiza National Park. Los Lagos Region

<sup>58</sup> Troppa, Constanza y Martínez, Laura. Applicability of the Native Forest Development Law No. 20,283 on initiatives with conservation and protection purposes, in the central-southern regions of Chile. Study presented at the Seventh Spanish Forestry Congress. Plasencia, Spain, 2017.

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<sup>59</sup> Cabrera , Jorge. *The State of the Art of Payment for Environmental Services in Chile.* INFOR and UICN, 2010.

<sup>60</sup> CONAF. Analysis for a design of Payment for Environmental Services schemes in Chile (Information Note ENCCRV N°31) CONAF-UCCSA, 2019.



Valdivian forest

The main instrument aimed at addressing the challenges of Chile's native forest management, Law 20.283 on Native Forest Recovery and Development (LBN), is yet to show its expected impact. Approved in 2008, the LBN establishes: (i) management plans as the main regulatory tool for the sustainable use of native forest resources; (ii) incentives for managing forests for timber production, non-timber production and protection under the Conservation, Recovery and Sustainable Management of the Native Forest Fund (FCBN); and (iii) research support through the Native Forest Research Fund (FIBN). Despite the efforts deployed by relevant agencies, implementation of this instrument in the 2009-2018 period resulted in the approval of 15,150 applications for management plans for an area of 220,367.91 hectares, equal to just 2% of the country's potential.<sup>61</sup> Of the approved applications, only 28% were granted the incentive payment

provided by the LBN, while the annual incentive amount actually paid to landowners -compared to the total amount awarded - only reached 16%. The assessments made by different entities on the low effectiveness of the LBN to date point to several factors, including: (i) the low amount of the incentives provided to landowners for eligible activities (it is estimated that 74% of subsidized activities are below the actual cost of their execution, covering only 5% of the total costs for sustainable forest management compared to traditional methods); (ii) the excessive administrative procedures for awarding the projects and for obtaining the permits needed to execute and verify the awarded activities (between two to four years from initiation to completion, 84% of which is spent on administrative processes); (iii) the lack of financing for technical assistance, considering that to date 85.4% of the awarded projects correspond to applications technically assisted by CONAF. Despite these shortcomings, it is important to recognize that the LBN represents a very important step towards the right direction for the recovery and sustainable management of Chile's native forests, indicating the areas where significant improvements can be made to increase the effectiveness of this instrument in achieving its objectives.

Despite the various challenges that need to be overcome to enhance the profitability and ensure the sustainability of native forests, new opportunities are arising for valuing this vast resource. National and international markets for NTFPs have increased considerably; energy generation from non-conventional renewable sources is being strongly promoted by national strategies where forest biomass can play a key role; the growing national and international interest in nature tourism where native forests are very relevant; and the importance that society is giving to forest ecosystem services, are some of the new areas that provide alternative development opportunities for the native forest sector.

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<sup>&</sup>lt;sup>61</sup> It refers to the potential of the country's private native forests, excluding the State-Owned Wildlife Management Areas (under SNASPE).

# **3.3** CLIMATE CHANGE, DESERTIFICATION, LAND DEGRADATION AND DROUGHT

Nature-based solutions are amongst the most effective ways of tackling climate change. The conservation and sustainable management of forests is undoubtedly one of the most important among them, not only because forests reduce emissions and sequester carbon, but also due to the multiple non-carbon benefits they generate, including combatting desertification, land degradation and drought.



Rural area. Valparaíso Region

Chile is particularly vulnerable to the effects of climate change in accordance to the vulnerability characteristics established by the UNFCCC.<sup>62</sup> According to section 4.8 of this Convention, countries with the following characteristics, of which Chile counts with seven out of nine, are recognized as priority for adaptation to the effects of climate change: (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 desert-ification; (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

<sup>62</sup> MMA. *National Climate Change Action Plan 2017-2022*. Government of Chile, 2017. production, processing and export, and/or on consumption of fossil fuels and associated energy-intensive products; and (i) Landlocked and transit countries. In this context, vegetation resources not only represent a mitigation tool due to their carbon sequestration capacity, but also a climate change adaptation strategy since they also contribute to soil conservation and erosion control; the conservation of biodiversity; and the regulation of hydrological flows through rainfall stimulation and recycling, and runoff interception and regulation.

The effects of climate change in Chile are expected to be widespread and diverse, with some of them already emerging such as the current megadrought and the recent megafires. In the last decade there has been a significant increase in the area affected by fires in most regions of the country, even though the total number of fires has largely remained unchanged. Between 1984 and 2018, the occurrence of fires across the country showed only a slight upward trend, averaging between 6,000 and 7,000 forest fires per year. However, during the last 10 years the average number of hectares affected by fires has increased significantly to over 107,000 hectares per year, compared to an annual average of 65,000 hectares during the entire 1984-2018 period, while the average over the last five years has increased even further to reach almost 165,000 hectares per year. More recently, around 250,000 hectares were burned in the 2014-15 and 2015-16 seasons, while the 2016-17 season, with 570,197 hectares burned, beat all records exceeding almost 10 times the historical average area burned. In only two weeks, forest fires swept 468 thousand hectares in an event that became known as the "fire storm" of February 2017. These new numbers may indicate that forest fires are growing in size and burned area towards a new normal in Chile.



### Increase of burnt forest area in 2010-2018 compared to 2000-2009



Source: University of Chile. *National Report on the State of the Environment in Chile 2018.* University of Chile – Center for Analysis of Public Policies of the Institute of Public Affairs. UTEM and CEPAL, 2019



The area of forest plantations affected by fire has grown at a faster rate than the area expansion of this type of vegetation.<sup>63</sup> According to the 2018 National Report on the State of the Environment in Chile, during the 1998-2008 period, fires affected 0.5% of the total planted area each year, while in the 2008-2018 period this figure increased to 1.5%. For other land uses, these indicators were closer to 0.25% during the 1998-2008 period, and increased to 0.4% for native forests and grasslands, and 0.6% for secondary forests during the 2008-2018 period. These numbers indicate that forest plantations have



Fires in planted forests, summer of 2017

<sup>63</sup> University of Chile. *National Report on the State of the Environment in Chile 2018.* University of Chile – Center for Analysis of Public Policies of the Institute of Public Affairs. UTEM and CEPAL, 2019.

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#### 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 a 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 (EC, 2017). Extinguishing the megafire required 3,297 firefighters from CONAF and the Chilean Army (BRIDEF), 64 aircrafts, 43,000 m<sup>3</sup> of water, as well as the construction of 590 kilometers of firebreaks. The Chilean Ministry of Finance estimated a total cost of CLP 242,833 million (USD 350 million) for the control of the forest megafire, including the expenses during the emergency and the reconstruction efforts.

The total area affected equaled 518,174 hectares, 236,039 (45%) of which was in the Maule Region. The affected area of forest plantations was 248,204 hectares, 228,904 ha (92%) of which were Radiata pine. The affected area of native forest was 91,745 hectares (18%), 17,719 ha of which were dramatically impacted, and 72,064 hectares (78%) corresponded to the Schlerophyll forest type. The area affected which contained species under conservation status reached 208,717 hectares. The most emblematic affected forest species was Nothofagus alessandrii (Ruil), which covers a total area of 350.8 hectares, 198.35 hectares (56%) of which were damaged by the fires. The total SNASPE affected area, under CONAF administration, was 154 hectares (CONAF, 2017).



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 sufficient firewalls is another factor that can explain the vulnerability of forest plantations. Finally, it is worth mentioning that homogeneous landscapes pose a higher risk of fire in the face of extreme events such as megadroughts.

Managing and addressing the increasing risk of larger fires will be one of the biggest adaptation challenges of the Chilean forest sector to climate change, in addition to representing a significant source of GHG emissions. The meteorological conditions that favor the occurrence of forest fires as per the "30-30-30 rule" -temperature over 30 °C, less than 30% of air relative humidity, wind speeds over 30 km/h- are expected to increase in frequency according to the projections of these variables under different climate change scenarios in Chile. Actions to manage and address the risk of increasingly-larger fires include: raising public awareness in order to reduce ignitions (almost all fires of known cause in Chile originate either accidentally or intentionally by humans); establishing more heterogeneous landscapes that reduce the risk of fires spread and increase their resilience to fires; applying fire prevention techniques and technologies, such as integrated fire management, preventive forestry (pruning, reduction of fuel load and continuity of combustible biomass in plantations, maintaining firebreaks and firewalls), advanced fire risk detection and monitoring systems, along with better preparation and interinstitutional coordination for effectively fighting fires when they do occur. Chile has made good progress in recognizing

Satellite image of 2017 forest fires in Central Area of Chile. Photo: NASA

### 518,174

hectares affected during the 2016-2017 Fire Storm



million



Source: CONAF. Updated Risk of Desertification, Land Degradation and Drought in Chile, under the framework of the National Action Program Against Desertification (PANCD-Chile 2016-2030) (Information Note N° 5) CONAF-UCCSA, 2016

the new fire conditions faced by the country, announcing as part of the 2019-2020 season the largest investment in its history to address forest fires through the National Plan for Preventing and Fighting Forest Fires, with a combined private-public investment of around USD 150 million and coordinated efforts between ministries, governments, agencies, security forces, and forestry companies.

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 measures are urgently needed to reduce its effects on the quality of life of its population. Desertification has been listed as one of the most severe socio-environmental problems in Chile. The arid and semi-arid lands affected by desertification cover more than 60% of the national territory, and these are the areas that suffer the most in terms of impacts on soils, biodiversity and silvo-agricultural productivity. As such, the rural population settled in these areas directly suffers the consequences, which translate into high rates of poverty, lack of economic opportunities, and strong migration rates.<sup>64</sup> According to the latest update of the national DLDD risk map developed in 2016, an estimated 57.5 million hectares of land, representing 76% of the country, are affected by one of the DLDD categories (severe - moderate - mild). The affected population nationwide amounts to 11.6 million, representing 65% of the country's inhabitants, distributed in 295 counties nationwide.<sup>65</sup> In addition, 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 a greater water deficit (precipitation). A drier and warmer climate is already deepening the stress on natural vegetation, agricultural and forest plantations, and facilitating the occurrence of large-scale forest fires, extending the fire season to most of the year in the south-central part of Chile.66

> <sup>64</sup> Frau, Carlos, et al. Characterization and monitoring of a semi-arid landscape in the Maule Region using satellite data. Brazilian Magazine of Agricultural and Environmental Engineering N°6, 2010.

> <sup>65</sup> CONAF. Updated Risk of Desertification, Land Degradation and Drought in Chile, under the framework of the National Action Program Against Desertification (PANCD-Chile 2016-2030) (Information Note N° 5) CONAF - UCCSA, 2016

> <sup>66</sup> University of Chile. *National Report on the State of the Environment in Chile 2018*. University of Chile - Center for Analysis of Public Policies of the Institute of Public Affairs. UTEM and CEPAL, 2019.

#### Map of accumulated rainfall deficit/surplus in November 2019, compared with the historical average for the same month between 1981-2010



Chile features the highest water stress risk level in Latin America.<sup>67</sup> Since 2010, the south-central part of Chile is experiencing an intense and long-lasting drought, labelled as a megadrought being the geographically most extense, prolonged and warm drought since 1900.<sup>68</sup> The megadrought continues till today with 2019 being one of the driest years during the last six decades. The most affected territories are located between the Coquimbo and La Araucania regions, with rainfall deficits of about 90 to 30%, having serious impacts on water availability for various productive activities, forests and other ecosystems.<sup>69</sup> Extensive areas of the country have been declared in a state of agricultural emergency, as water scarcity zones and as catastrophe zones due to the extreme drought by the Ministry of Agriculture, the Ministry of Public Works and the Ministry of the Interior, respectively. Nationally, it is estimated that approximately 72% of the territory in the country has some degree of drought in its different categories (severe, moderate, mild), corresponding to approximately 55 million hectares. The population affected by some degree of drought risk has reached approximately 16 million people equal to 90% of the country's inhabitants, with the majority located in the Metropolitan Region which is home to 6.7 million people. According to the Center for Climate Science and Resilience at the University of Chile, about a quarter of the rainfall deficit during the mega-drought can be attributed to anthropogenic climate change. This factor is expected to persist in the future, increasing the occurrence of droughts like the present one, as well as the desertification processes in central and southern Chile.70

Native forests are the main source of greenhouse gas removals for climate change mitigation in Chile. Maintaining global warming below 1.5 °C to avoid the negative impacts of climate change, as recommended

<sup>70</sup> Center for Climate Science and Resilience (CR<sup>2</sup>). *The megadrought of 2010-2015: a lesson for the future*. (CR<sup>2</sup>), 2015

<sup>&</sup>lt;sup>67</sup> World Resources Institute. Aqueduct Water Risk Atlas. (Consulted in December 2019 in https://www.wri.org/ resources/maps/aqueduct-water-risk-atlas)

<sup>&</sup>lt;sup>68</sup> Center for Climate Science and Resilience (CR<sup>2</sup>). *The megadrought of 2010–2015: a lesson for the future*. (CR<sup>2</sup>), 2015

<sup>&</sup>lt;sup>69</sup> Garreaud, René et al. *The 2010-2015 megadrought in Central Chile: impacts on regional hydroclimate and vege-tation*. Hydrology Earth System Sciences Nº 21, 2017.



Native Forest. Araucanía Region

by the Intergovernmental Panel on Climate Change (IPCC), requires removing large amounts of carbon dioxide from the atmosphere, as well as a drastic decrease in emissions. The carbon stored in forests, if maintained by avoiding deforestation and degradation, can play a crucial role in mitigating climate change, as it prevents large amounts of CO<sub>2</sub> from being released to the atmosphere. It is estimated that forests could store about a quarter of the atmospheric carbon needed to limit global warming to 1.5 °C above preindustrial levels.<sup>71</sup> The graph below shows the emissions and removals of the five sectors with the highest impact in the Chilean National Greenhouse Gas Inventory (NGHGI). The Land Use, Land-Use Change and Forestry (LULUCF) sector, which accounts for the contribution of forests, is the only one that captures CO<sub>2</sub>, thus helping to neutralize a large part (62%) of the emissions produced by other sectors such as power generation, industrial processes, agriculture, and anthropogenic waste. According to the latest NGHGI compiled by the Ministry of Environment in 2018, emission reductions from all types of forests reached 69.65 million tons of CO<sub>2eq</sub>, originating primarily from secondary-growth native forests, followed by forests in national parks and reserves, and forest plantations. While forest plantations removed 77.6 million tons of CO<sub>2eq</sub> in 2016, their net contribution to the NGHGI was lower when accounting for the emissions produced by harvesting, which equaled 65.9 million tons of CO<sub>2ea</sub>, resulting in a net contribution of 7.7 million tons. The contribution of plantations has been gradually decreasing over time given that afforestation rates have decreased to about 2,000 hectares per year as of 2012. These estimates show the importance of native forests in providing critical ecosystem services for climate change mitigation as natural solutions for carbon capture and storage.



<sup>71</sup> IPCC. Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems. P.R. Shukla, J. Skea, E. Calvo Buendia, V. Masson-Delmotte, H.-O. Pörtner, D. C. Roberts, P. Zhai, R. Slade, S. Connors, R. van Diemen, M. Ferrat, E. Haughey, S. Luz, S. Neogi, M. Pathak, J. Petzold, J. Portugal Pereira, P. Vyas, E. Huntley, K. Kissick, M. Belkacemi, J. Malley, (eds.), 2019.

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The net contribution of forestry to climate change mitigation could be considerably increased by accounting for two carbon pools which are not yet included in Chile's NGHGI. The first one is accounting for the carbon stored in harvested wood products. Today, all the carbon contained in harvested timber is considered to be emitted, even though a significant portion of it (ranging from 15 to 20% in the case of Chile) is destined for long-lived wood products with a lifespan that extends over several decades and even hundreds of years. The other significant pool is the accumulation of carbon in the soil which is also not accounted for in the NGHGI, as well as the carbon contained in root biomass, which is currently considered emitted at the time of harvest.

In response to these challenges, Chile has been an active member of the main United Nations Conventions on global environmental change processes and Sustainable Development Goals (SDGs). As a member of the United Nations Convention to Combat Desertification (UNCCD) since 1998, Chile has promoted actions in large part of the national territory through the implementation of several instruments promoted by the Ministry of Agriculture under the Chilean Action Plan Against Desertification (PANCD - Chile), such as incentives to promote afforestation, restore forest areas under desertification and soil degradation processes, apply sustainable and climate-smart agriculture practices in agricultural lands, and promote irrigation as the main tool for mitigating the effects of drought. Within this framework, the UNCCD promotes the concept of Land Degradation Neutrality (LDN) adopted by Chile, in line with SDG 15 to "Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss". Chile is also an active member of the United Nations Framework Convention on Climate Change (UNFCCC), having adopted the REDD+ approach, which promotes positive policies and incentives for Reducing Emissions from Deforestation and Forest Degradation,



and the role of conservation, sustainable management of forests and enhancement of forest carbon stocks in developing countries. Chile's commitment to global emission reductions is expressed in its Nationally Determined Contribution (NDC) submitted to the UNFCCC in September 2015, a commitment which became law with the ratification of the Paris Agreement through Decree 30 dated May 23, 2017. In its NDC, Chile commits to reducing its CO<sub>2</sub> emissions per unit of GDP by 30% by 2030 compared to 2007 levels, considering a future economic growth path that allows the country to implement appropriate measures to achieve this commitment. In addition, Chile's NDC sets specific goals for the forest sector by 2030, including the afforestation of 100,000 ha, mainly with native species, and the restoration and sustainable management of 100,000 ha of native forest. Chile's NDC goals that are currently under review and public consultation in order to increase Chile's NDC ambition as part of its Presidency of COP25.

To achieve its national and international commitments in the fight against climate change, desertification, land degradation and drought, the Ministry of Agriculture has developed the 2017-2025 Chilean Strategy for Climate Change and Vegetation Resources (ENCCRV). Based on a broad participatory process, the ENCCRV constitutes a public policy instrument focused on Chilean native vegetation resources that guides and integrates a variety of initiatives and measures for mitigating and adapting to climate change, as well as for combating desertification, land degradation and drought. The ENCCRV has allowed Chile to become an international pioneer in obtaining results-based payments for the implementation of REDD+ activities that have enabled the country to value the carbon sink environmental service provided by native forests, through the signing of Emission Reductions Payment Agreements (ERPA) with the Forest Carbon Partnership Facility (FCPF) Carbon Fund and the Green Climate Fund (GCF), having already achieved some 12.7 million tons of emission reductions between 2014-2016 from the reduced degradation of its native forests.

#### Chilean Strategy for Climate Change and Vegetation Resources (ENCCRV 2017-2025)



The ENCCRV defines a set of 26 direct and enabling measures that, based on a national technical and participatory design process, focus on addressing Climate Change, Desertification, Land Degradation and Drought (DLDD) through the sustainable management of vegetation resources in order to avoid or reduce the historical rates of deforestation, degradation, or devegetation of native forests, xerophytic and other types of vegetation, as well as to promote the restoration, re/afforestation, revegetation and sustainable management of Chilean native vegetation resources.

#### **GGeneral Objective:**

The General Objective of the ENCCRV is to reduce the social, environmental and economic vulnerability created by DLDD on native vegetation resources and the human communities that depend on them, increase the resilience of ecosystems and contribute to climate change mitigation by promoting the reduction and removal of GHG emissions in Chile.

#### **Specific Objectives**

**01:** Contribute to complying with Chile's international commitments related to vegetation resources under the UNFCCC, UNCCD, CBD and other national and international agreements and strategies.

- **02:** Inform technical, political and financial decision-makers to better position the role of vegetation resources in climate change mitigation and adaptation and DLDD strategies and as a priority in sectoral development policies.
- **03:** Manage mechanisms for the assessment and valuation of the environmental services provided by native vegetation resources, including performance-based payments in accordance with benefit sharing plans and environmental and social safeguards.

#### **Adaptation Goal:**

Reduce the vulnerability to land degradation through sustainable management of vegetation resources, and the direct intervention on at least 264,000 hectares between 2017 and 2025. The contribution to reduced vulnerability will be assessed through indicators related to biodiversity, provision of ecosystem services —such as water supply, flow regulation, and quality—, and soil productivity.

#### **Mitigation Goal:**

Reduce GHG emissions from forest degradation and deforestation by 20% by 2025 compared to the average of the 2001-2013 period, and increase the carbon sink capacity of vegetation resources.

Fund:	GREEN CLIMATE FUND (GCF)	FOREST CARBON PARTNERSHIP FACILITY (FCPF)		
Delivery Partners:	UNFCCC, FAO	WORLD BANK, AGCID		
Period:	2014-2016	2018-2025		
Amount:	US\$ 63.6 million	US\$ 26 million		
Volume:	<b>12.7</b> million tCO <sub>2e</sub>	5.2 million tCO <sub>2e</sub>		
Regions:	Maule, Ñuble, Biobio, La Araucania, Los Lagos y Los Rios			
Activities:	Conservation, afforestation, restoration, sustainable management and preventive forestry with native species, training and environmental education, among others			
Beneficiaries:	Mainly small forest owners according to Benefit Sharing Plan			

#### Emission Reductions Payment Agreements (ERPAs)

## **3.4** SOCIAL ACCEPTABILITY

Despite its contribution to the economic development of the country, the Chilean forest sector is frequently challenged by low levels of acceptability by different segments of society, indicating that there is still room for improvement in Chile's forestry model.



The Chilean forest sector is not exempt from criticism and faces a number of challenges in its relationship with the environment, indigenous peoples, and broad segments of society. Despite the contribution of the forest sector to the economy and the progress made with obtaining certification under different schemes, which has allowed companies to adopt a series of measures to comply with environmental and social regulations related to the wellbeing of communities and workers, the fast growth and expansion of the sector has not always kept pace with the expectations and demands of society for an inclusive and sustainable industry. Criticisms on environmental issues are related to the replacement of native forests by timber plantations, the depletion of water resources, pesticide hazards, and biodiversity loss. However, evidence also suggests that efficiently managed planted forests can fulfill important roles to protect ecosystems and produce environmental goods and services. In Chile, about 90% of forest plantations have been established on degraded lands, grasslands, or shrublands, providing a steady supply of wood to the growing demand for timber and other forest products, sustaining 99% of domestic industrial production while decreasing the pressure on native forests.

Kull kull, Mapuche instrument. Araucanía Region



Mapuche woman weaver

<sup>72</sup> Arriagada, Rodrigo. *Exploratory study* on potential impact evaluations to assess the relationship between forests, poverty and local communities under the ENCCRV. Consultancy report for the World Bank, 2018.

On the social side, the critique has focused on the relationship between forest plantations and poverty, and the existence of a wider social gap in predominantly forested regions and counties compared to other areas of the country. While several authors establish that forestry has become a significant economic engine that has fueled the growth of the country, particularly in forested regions, this narrative coexists with a social critique around the concentration of land ownership and forest companies in a handful of actors, in a scenario that exacerbates the perception of inequality. Another critique points to the spatial correlation between Chile's most forested regions with areas that present some of the highest poverty rates in the country. At the same time, Chile counts with detailed data on the historical evolution and current status of its forest cover, as well as on the historical evolution of income poverty and other socioeconomic indicators. However, the available literature suggests that Chile still lacks sufficient and rigorous scientific evidence on the effects of the country's main forest policies, such as the Decree Law 701, Forest Subsidies Program, Law 20.283 on Native Forest Restoration, and the National System of Wildlife Protected Areas, on the historical behavior of key environmental and socioeconomic indicators.<sup>72</sup> There is still room therefore to advance towards a better understanding of the impacts of forest policies, particularly with regards to the relationship between forests, poverty and local communities, and how this relationship can be addressed through targeted policies or programs.

Although the relationship of the forest sector with indigenous peoples -particularly of Mapuche origin- had made some improvements, challenges persist to the present day. The so-called "indigenous conflict" between the forest industry and the Mapuche communities is principally based on two core issues. Firstly, the presence of forestry companies on lands that are customarily claimed by the Mapuche peoples; and secondly, the environmental and cultural impacts posed by vast areas of land planted with monocultures on lands adjacent to the Mapuche communities. This situation has resulted in a historical controversy which has become of public interest given the scope and magnitude of the conflict. Recognizing the challenge of progressing towards a more culturally appropriate approach when operating on indigenous peoples' lands, particularly in the implementation of its management instruments, in 2018, CONAF developed 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. The PGRVTI includes a national diagnostic of indigenous lands and territories based on available geographic information on the location of indigenous communities and their properties, the coverage of forest and other vegetation resources, agro-climatic information, and other data that allowed the development of national maps to guide and focus CONAF's activities on these territories under the ENCCRV and other instruments. In addition, the PGRVTI includes an analysis on the set of actions, instruments, and initiatives currently managed by CONAF in regions with indigenous communities, and proposes several ways to promote a more culturally relevant management approach in indigenous lands across the four focus areas of the institution: Forest Development and Promotion, Environmental Control and Assessment, Protection against Forest Fires, and Wildlife Protected Areas. The PGRVTI also incorporates two intercultural plan-

### 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 working model that incorporates the worldview 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 objective of the MAIA model focuses on combining cultural dimensions (e.g. improving biodiversity, protecting and promoting cultural heritage, recovering Andean ancestral knowledge of nature) with productive initiatives (e.g. increasing forest-agriculture-livestock production, income and livelihood generating activities, 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 in Chile. It aims at promoting an intercultural approach to any action developed with participating Mapuche communities by recovering or developing environmental, cultural, religious, medicinal, productive, and/or ceremonial practices, among others, either for individual or collective use, and with a minimum time horizon of at least three years.

ning and management tools developed through a joint work between forestry professionals and indigenous leaders and specialists and based on the worldview and cultural practices of the Andean (MAIA) and Mapuche (MOFIN) peoples. A brief description of the main principles and characteristics of both tools are described in the box above.

Although 28% of small forest owners are women, the Chilean forest sector has been traditionally dominated by men. Despite the progress made in promoting gender equality and increasing women's participation in the Chilean workforce, their involvement remains low -only 48.5% of women are part of the Chilean labor market- and this gap is even more significant in the forestry sector where only 5% of the workforce is female, with most women working in forest nursery operations. Taking these facts into account, in 2014, CONAF created the Gender Equality Unit, which could be a good starting point for the generation of gender-disaggregated data and statistics that would allow for the development of a Gender Analysis and a Gender Action Plan for the forest sector. In the context of the UNFCCC COP25 in Madrid, CONAF launched an initiative to foster the inclusion and participation of rural women as part of the National Landscape Restoration Plan, called "Women and forests in the context of climate change". The program promotes the participation of rural women in the restoration of 500,000 hectares of degraded lands, as part of the 20x20 initiative that seeks to restore 20 million hectares by 2020 in Latin America, as part of the pledge to the Bonn Challenge.73



<sup>73</sup> CONAF. Women and forests in the context of climate change. CON-AF-GEDEFF internal report, 2019.

## **3.5** NEW INSTITUTIONAL FRAMEWORK

Chile's forest institutions and laws are currently undergoing a process of transformation to address the new societal and environmental challenges the country and the world are facing.



Plantations and Native Forests

Chilean forestry institutions are adapting to the challenges of the 21st century. The country is currently debating the creation of a new institutional framework to govern the forestry sector, through the National Forest Service that would replace and strengthen the current CONAF. Created as a State administrative body funded by the Constitutional Organic Law and ruled by statutes under private corporation laws that define its functions, CONAF faces a number of legal limitations in performing its duties to the full extent of a public service. In the past, CONAF was assigned with different public functions through laws and regulations which attributed such authority, including: the administration of State assets such as Wildlife Protected Areas; preventing and fighting forest fires; and the development, management, and control of the country's forest resources. However, in 2008, the Constitutional Court warned against this administrative ambiguity, urging the Government to define the legal nature of the country's main forest institution. This precedent has accentuated the need to create a new institutional framework with the full public authority that would allow the current CONAF to face the new environmental, social, and productive challenges the country is facing. This legislative process began in 2011 with the drafting of a bill seeking to create the National Forest Service (SERNAFOR) as a decentralized public service with its own legal personality and assets, under the supervision of the President of the Republic through the Ministry of Agriculture. A similar situation is experienced by the country's main forestry research institution, the Forestry Institute (INFOR). Being a private entity, it cannot fully concentrate its efforts on the long-term research often required by the forest sector



due to the long lifecycle of trees and forests, especially native species, having to secure short-term funding to ensure its survival. However, unlike CONAF, a change in its legal status is not considered at this stage, which could contemplate different sources of funding for its work, including the private sector, international organizations, and the Ministry of Agriculture.

A new, more integrated institutional framework devoted to the conservation of biodiversity and Wildlife Protected Areas is also currently being debated. In July 2019, the Senate approved the first legislative procedure for a draft bill that creates the Biodiversity and Protected Areas Service (SBAP), an initiative that has been debated in the National Congress since 2011. The new service would seek to ensure the conservation of biodiversity in Chile and manage all existing Protected Areas in the country, both marine and terrestrial, public and private. It is worth mentioning that the current system that regulates Protected Areas and the protection of biodiversity is scattered between five ministries, which the creation of a new institution would aim to unify under a single institution. This proposal was also recommended by the Organization for Economic Co-operation and Development (OECD), which Chile has been a member of since 2010, in its 2016 Environmental Performance Review of Chile, where it establishes that the existing division of roles and responsibilities in the country on this matter hinders the consistent and integrated management of Protected Areas. The OECD also estimates that despite current efforts, Chile will probably not be able to fully ensure operational management of its Protected Areas until 2050. While there is certain level of agreement between the scientific community, academia, and civil society organizations regarding the importance of establishing the SBAP, a unanimous consensus on matters related to administrative management, responsibilities, funding, and the transfer of Protected Areas from CONAF to another public entity is still to be reached.



Llanos del Challe National Park. Atacama Region

Tagua-Tagua, Private Park. Los Lagos Region

Several studies stipulate the need for a new forest development law to continue supporting the restoration of the country's degraded lands, focused on small and medium forest owners, and contributing directly to the goals of the NDC. Recovering degraded lands, granting exclusive support to small and medium forest owners, and paying for the environmental services that forests provide are among the key points contemplated in the Afforestation and Recovery of Burned Forests draft bill that is currently being debated in the country. The main purpose of this bill is to promote the afforestation, reforestation and establishment of permanent vegetation cover on lands affected by forest fires or at risk of erosion by granting incentives to small and medium-sized owners. There is a broad consensus on the need for this new legal body to support only small and medium forest owners, excluding large companies since given their current technical and commercial competitiveness conditions do not require government assistance. This would also allow to better allocate public resources to smallholders who own some of the most degraded lands in the country, and in many cases find themselves in a subsistence or production dependence condition with limited access to financing, knowledge and technology. The new forest development regulations would promote productive alliances among landowners in order to facilitate partnerships with forest SMEs, contemplating an additional 15% bonus granted to partnership projects, in addition to direct support for technical assistance and specific incentives for the establishment of native species. The draft bill also contemplates the reforestation of planted and native forests that have been affected by natural disasters or forest fires; afforestation of bare soils; the establishment of planted forests through afforestation in lands preferably suitable for forestry; and the provision of environmental services. The latter considers annual payments for maintaining permanent vegetation cover for the provision of environmental services, implying a 20-year conservation commitment between the landowner and the State, similar to the conservation easement deeds in the United States. The draft bill aims to recover 500,000 hectares of planted forests in 20 years (25,000 hectares per year) with an annual budget of USD 37.5 million.<sup>74</sup>

Achieving the ambitious goals laid out in the updated forest NDC would require making adjustments to the current Native Forest Recovery and Development Law 20.283 to allow increasing the area of native forest under sustainable management practices. The amendments that are currently being debated include: a) adjusting the activities currently subsidized by law to market values; b) including the provision of technical assistance as a subsidized activity; c) simplifying the bids under the law; and d) simplifying the current timber tracking system.<sup>75</sup> All these changes will be crucial for Chile to meet its international commitments under the United Nations Convention to Combat Desertification (UNCCD); the Convention on Biological Diversity (CBD), and the new goals proposed under its NDC for the forest sector under the United Nations Framework Convention on Climate Change (UNFCCC), announced during the 25th Conference of the Parties (COP25), in Madrid, Spain.



Native Forest. Los Lagos Region

<sup>&</sup>lt;sup>74</sup> Rebolledo, José Manuel. *Main aspects of the future Forestry Law and how it will contribute to combat climate change*. Conference presentation. Concepción, Chile, 2019

<sup>&</sup>lt;sup>75</sup> CONAF. Final Report from the Evaluation of Government Programs: Native Forest Law Program. DIPRES, 2013

# **3.6** TOWARDS AN INCLUSIVE AND SUSTAINABLE MODEL

The Chilean forest sector has achieved several gains to date, becoming a pillar of the national economy with global reach. Since the mid-1970s and in less than four decades, planted forests have been at the core of the Chilean forestry model, contributing to the development of a modern and highly competitive forest industry that supplies a growing national and international demand for timber and forest products, creating added value, jobs, and other economic benefits, especially in the south-central regions of the country. The development of the Chilean forestry model has been supported by a solid institutional framework in alliance with the private sector, along with a long-term forest policy focused on recovering degraded lands. From an environmental perspective, forestry has contributed to controlling erosion, restoring degraded lands, and increasing forest cover, placing Chile among the countries with the highest rates of forest growth worldwide. The incorporation of environmental certification systems in the production processes and the establishment of Wildlife Protected Areas to preserve the environmental services and biodiversity of native forests have also been an integral part of the Chilean forestry model. In recent years, the forest sector has played an important role in the mitigation of and adaptation to climate change, absorbing much of the GHG emissions generated by other sectors of the economy and making an important contribution to the national energy balance through the use of forest biomass.

The new social and environmental context poses new challenges for the Chilean forest sector to maintain current gains and continue to grow in an inclusive and sustainable manner. The effects of climate change -- with increasing temperatures and decreasing precipitation – are accelerating desertification, land degradation and drought processes and increasing the frequency and intensity of forest fires, affecting the quality of life of hundreds of thousands of people, the future availability of timber, and generating a variety of other impacts on the country's ecosystems. At the same time, there is a need to continue promoting the establishment of planted forests to recover degraded lands in marginal conditions through afforestation and landscape restoration incentives; while protecting biodiversity and finding ways to value the environmental goods and services provided by native forests. It is therefore crucial to continue the efforts and commitments for enhancing social and environmental performance and increasing positive impacts towards a more inclusive and sustainable forest development model, addressing social challenges such as the relationship with local communities and indigenous peoples in forest regions, the support for small and medium owners and enterprises, and the recognition and promotion of a greater female participation in the sector. This new scenario also entails the need to strengthen, modernize and adapt the current institutional framework to enable it to more effectively support the continuous growth of the forest sector in the current national and global context, and continue generating economic, social and environmental benefits for the country, while contributing to the generation of global public goods in line with its international environmental commitments and the Sustainable Development Goals, maintaining its global position and recognition in regards to forest development and sustainability.





A pillar for inclusive and sustainable development



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