v. 4, n. 1, 2024

International Journal of Biological and Natural Sciences

FOREST FIRES IN CHILE: EVALUATION OF THE ECONOMIC AND ENVIRONMENTAL IMPACT ON NATURAL CAPITAL

Luis Gonzales Carrasco

Isidora Lara Ochoa

Joaquín Vial R-T

Abstract: Forest fires are caused by intentional action or by natural reasons, and the degree of exposure has been increasing due to the combination of both reasons. Climate change is exacerbating these events. The case of Chile is a good example, intentional factors cause the origin of fires, which are aggravated by heat waves and water stress among other climate-related factors. This document estimates the cost of the 2017 forest fire, which affected 518,174 hectares, being the largest in the recent history of Chile in terms of affected area. The cost of the fire is estimated in terms of natural capital, for plantations and native forest, and the effect on carbon fixation. Considering the replacement cost for plantations at non-productive ages and the potential productive volume for mature trees, losses of natural capital in plantations are estimated at USD$1,046 million. On the other hand, the 68.2 million tons of CO_2 eq emitted by the fire and the 547 million tons of CO_2 eq of capture capacity lost due to the fire, reaching estimated damages of USD$ 2,983 million and USD$ 18,666 million respectively.
Keywords: Natural Capital, Forest Fires, Sustainable Development.
JEL codes: C13, E22, Q51

INTRODUCTION

In a world where climate change threatens to intensify natural disasters, it stands out that forest fires are becoming more frequent and catastrophic events across the planet. By both devastating vast areas of land and releasing enormous amounts of carbon into the atmosphere, forest fires are a growing threat to humanity and biodiversity. In this global context, Chile has experienced particularly severe episodes.

The recent 2022-2023 fire season left 431 thousand hectares affected. This event was preceded by the 2017 megafire that affected 520 thousand hectares, being the largest fire, at least since the second half of the last century. During the months of January and February, 501,168 hectares were burned in total, of which half occurred in just 5 days.

Currently, forest fires caused by intentionality and natural causes are occurring with greater frequency and intensity due to climate change.

It is essential to address not only the extent and causes of these disasters, but also their impact on national heritage. Forest fires affect both produced capital, which includes housing, infrastructure and machinery, and natural capital. The latter refers to the value of ecosystems and the services they provide for human well-being. Its degradation has a significant impact on the reduction of ecosystem services, including carbon sequestration.

Quantifying natural capital is challenging due to difficulties in measuring it and assigning value to ecosystem services, which are often not traded in traditional markets. In this document, the cost of the 2017 forest fires is estimated only in terms of forest capital, and its effect on carbon sequestration. Taking into account the replacement cost for plantations at non-productive ages and the potential volume for trees close to harvest age, losses of natural capital in plantations are estimated at USD$1,046 million. On the other hand, the 68.2 million tons of CO_2 eq emitted by the fire and the 547 million tons of CO_2 eq of collection capacity lost due to the fire, reaching estimated damages of USD$ 2,983 million and USD$ 18,666 million respectively.

Considering the loss of natural capital stock, especially in forest managed soils and native forests, has significant implications for industry and biodiversity. This study, therefore, highlights the need to address wildfires not only as an emergency management challenge, but as a critical environmental sustainability and conservation issue. Finally, we seek to

promote the development of management strategies and public policies that integrate a broader understanding of the economic and environmental costs associated with forest fires in Chile, taking into account the integrity of ecosystems and the various services they provide.

BACKGROUND

During the months of January and February of this year, a wave of forest fires occurred in the center-southern of the country that caused loss of life, property and productive capital, in addition to the natural capital of the affected areas. In relation to the latter, plantations and native forests suffered serious damage, which had repercussions on the provision of ecosystem services, and consequently, on the economy and human well-being.

Formerly, in economics, the term capital was used mainly to refer to tangible assets. However, the concept has evolved to also encompass intangible and non-alienable assets such as human and natural capital and over the years methodologies have been developed to quantify their value for individuals and society.

It is vital to understand how wildfires affect natural capital and, consequently, ecosystem services. The services of ecological systems and the reserves of natural capital that produce them are critical to the functioning of the Earth's life support system. They contribute to human well-being, both directly and indirectly, and therefore represent a part of the total economic value of the planet (Costanza et al., 1997).

Given the importance of natural capital, particularly in areas affected by wildfires, it is essential to address the economic valuation of these resources. Considering the social scarcity of natural capital, it is important to estimate accounting prices or "shadow prices", these prices reflect a combination between what is socially desirable and what is socio-ecologically possible. Unfortunately, traditional macroeconomic theories that have shaped our beliefs about growth and development do not recognize or consider humanity's dependence on nature (Dasgupta, P., 2021).

To address the intrinsic relationship between humanity and nature, the Common International Classification of Ecosystem Services (CICES) has been developed as a system that identifies the contributions that ecosystems make for human well-being. The system classifies ecosystem services into three groups, provision services, regulation services and cultural services. Provision services include the supply of materials and energy, regulation and maintenance services are related to the regulation of ecosystem processes, and cultural services correspond to non-material benefits such as spiritual experiences and aesthetic values (Dasgupta, P., 2021).

In Chile, more than 90% of forest fires are caused by human actions, resulting in the loss of between 6 and 14 million hectares of forests annually. These fires lead to significant economic losses, environmental damage, and loss of human life. Globally, for example, it has been estimated that large tropical forest fires in one year could be equivalent to one-third of the emissions from burning fossil fuels (Rowell and Moore, 2000).

Given the deep relationship between fires and climate change, analyzing fire data is crucial to understanding the magnitude of the problem and its impacts. The 2017 mega fire affected almost 100 thousand hectares (ha) more than this year's fire, which reached 398,818 hectares as of April 4. Figure 1 shows the affected area in hectares in January and February and the cumulative amount from July to January by season.

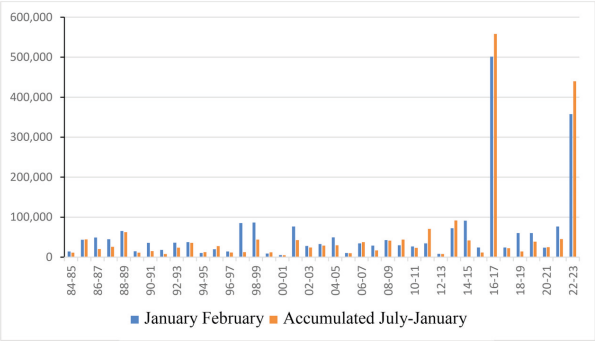

Figure 1. Affected area (ha) in January-February and accumulated July-January by season

Source: Own elaboration with data from CONAF (2023).

When analyzing the catastrophe by region, this year the most affected regions were Biobío and La Araucanía, with 226,397 hectares and 88,487 hectares affected respectively. Another region that was also severely affected is the Ñuble region, with 21,164 hectares affected and, finally, the Maule region with 18,583 hectares affected. In 2017, the most affected region was the Maule region, reaching an affected area of 244,289 hectares during January and February, as seen in the following figure (See annex figure A1). The Biobío region was widely affected, and only in January and February 2023 a larger surface area was burned than in the entire 2016-2017 season, reflecting the speed with which the incident occurred.

The analysis by region demonstrates the seriousness of the problem and highlights the need for solutions aimed at conserving natural capital and mitigating the impacts of wildfires on affected communities. Along these lines, the government announced that of the regions of the south-central zone that were affected by forest fires, it is intended to begin restoration processes in 355 hectares of the Maule Region, 77 hectares of the Ñuble Region and 57 hectares of the Biobío Region, adding a total area to intervene of 489 hectares (Gob.cl, 2023).

A relevant public policy concern is trying to understand and establish the causes of these events, with the aim of implementing preventive and management measures. As can be seen in Figure 3, what stands out most is the systematic increase in intentional fires, which are also becoming increasingly damaging.

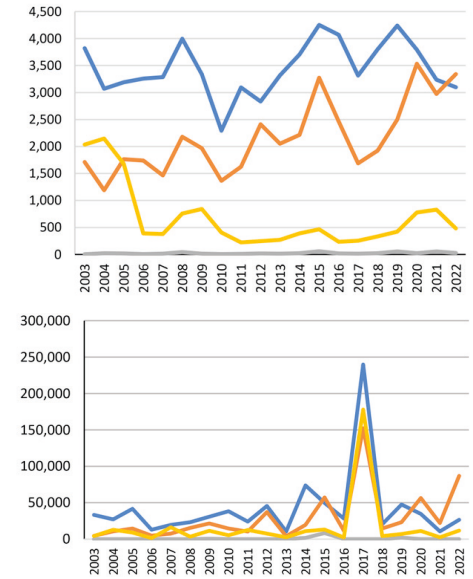

Figure 3. Affected area (ha) in January-February and accumulated July-January by season

Source: Own elaboration with data from CONAF (2023).

However, beyond the immediate and historical causes, the geographic patterns of fires also deserve attention. The available evidence shows an important spatial correlation between fires and estimated areas with high vulnerability to climate risks (See figure A3: Comparison of estimated future fire risks and observed fire outbreaks). On the map you can see the estimated future fire risk in ARCLIM, that is, "the risk of native forest fires in the future climate (2035-2065 under the RCP 8.5 scenario) is quantified as the multiplication of the threat, sensitivity and exposure. "As all the indices have been normalized, the risk presented in this map

corresponds to a ranking among the various communes of the country".

Table 1 shows the surfaces affected by the last two largest fires that we have had in Chile in recent years (2017 and 2023) according to type of land use. The surfaces affected by the fire this year, 2023, correspond to the information available as of April 4, 2023.

There have been multiple attempts to quantify the costs of these types of fires. For this year's catastrophe, at ClapesUC on February 7 we estimated fiscal costs amounting to US$ 278 million and an impact on the regional GDP of US$ 197.7 million (Gonzales and Hernández, 2023). Then, private companies estimated losses of US$540 million. On the other hand, the Ministry of Finance updated estimates of accounting costs, which now amount to US 309 million. All of these estimates refer to income flows from production losses, from higher expenses for fire control or to support affected communities, particularly in the case of the Treasury. There are also some mentions of the effect on the flow of carbon emissions. But in general, there are few mentions of capital losses, beyond those recorded in the accounting of affected companies.

As mentioned above, the concept of capital has evolved to also encompass intangible and non-alienable assets such as human and natural capital, recognizing that human life depends on the integrity of ecosystems and the various services they provide. Natural capital is defined as the stock of natural ecosystems that produce a flow of valuable ecosystem goods or services into the future (Cleveland et al., 2008), or also as the discounted present value of ecosystem services, valued at "shadow prices". accounting" that depend on the state of the ecosystem (Dasgupta, 2021). However, natural capital remains an abstract concept given the enormous practical measurement challenges it represents (World Bank, 2018, Vial, 2023).

Valuation challenges arise mainly due to difficulties in measuring and pricing ecosystem services, since these goods and services are not usually traded in traditional markets.

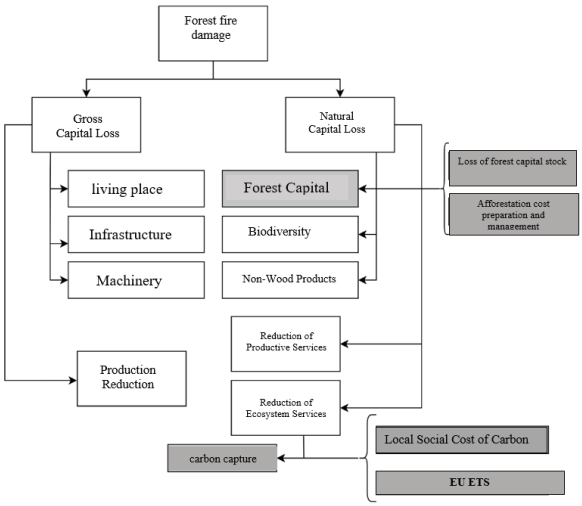

Figure 4. Scheme of capital losses associated with fires

Source: Own elaboration.

In the diagram (see annex figure 4) it can be seen that, when there is a forest fire, it generates damage to two types of capital, produced or traditional capital and natural capital. The loss in produced capital, which we usually measure in national accounts, corresponds to the traditional definition, which incorporates housing, infrastructure and machinery. This loss of the produced capital stock in turn generates a reduction in future production capacity, which can be represented by a reduction in the trend Gross Domestic Product (GDP).

On the other hand, the fire generates a loss in natural capital, composed of capital to produce wood, biodiversity and ecosystem services and non-wood goods. As with produced capital, this loss in natural capital in turn generates a loss of flows, which in this case can be represented as a reduction

in productive services, but perhaps more important and of greater magnitude, a reduction in ecosystem services. current and future. This study estimates the costs in timber capital, both in plantations and native forests, and the cost associated with the loss of a particular ecosystem service, carbon sequestration.

It is important to highlight that there are many other ecosystem services that are affected by forest fires. Some examples of them are the protection of soils, protection of water courses, loss of flora and fauna, among many other services that we know that ecosystems provide us, but that we are not in a position to evaluate on this occasion.

ESTIMATES

This document presents the results of the estimates of the fiscal and economic cost of the 2023 forest fire. In addition, for the 2017 fire, it measures the loss of forest capital stock in plantations, considering two types of estimates. For plantations that do not yet have productive value, the cost of afforestation, preparation and management was used, and for plantations in productive age, their potential productive volume was valued at prices of the same year. On the other hand, the damage was estimated in terms of emissions, the emission caused by the fire, and in turn, the loss of carbon capture. For both valuations, the local social cost of carbon (LSCC) provided by the literature and also the EU-ETS for 2017 and 2022 was used as the price.

FISCAL COST ESTIMATES AND IMPACT ON REGIONAL GDP: FIRE 2023

The estimate of the fiscal and economic cost of the event in 2023 considers the particularities of this episode. In five days, the number of affected people reached a total of 3,276, with a number of deaths close to double that observed in 2017.

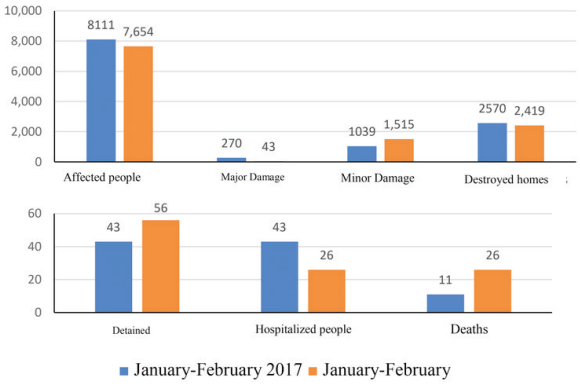

Figure 5. Scheme of capital losses associated with fires

Source: Own elaboration based on SENAPRED (2023).

A relevant precedent that was considered was the estimated fiscal cost for the 2016-2017 season, which amounts to US$333 million dollars. To estimate the fiscal costs of the fire this year, 2023, we begin with the reference of the fiscal cost of 2017. Then, they are updated for inflation and regional characteristics. Finally, it is weighted according to the area affected in the current season, estimating fiscal costs of US$218 million.

To assess the damage to the homes, the classification was used based on the level of damage suffered by each home delivered by Senapred. Categories included "Minor Damage," "Major Damage," and "Destroyed." For this valuation, the housing construction estimates from "Estimates of the Direct Fiscal Cost of the New Constitution Proposal" by Betancor, et al., 2022 were considered. The

value of a home in UF corresponds to 1,152 UF with technical standard DS49 + improvement, and 1,500 UF with DS19 technical standard. On the other hand, the estimated value for the housing repair/expansion subsidy is used to estimate repair costs. A unit cost of 110 UF in the low scenario and 153 UF in the high scenario is assumed for homes with minor damage. For the calculation, it is assumed that the cost of a major damage repair is twice that of those requiring minor repairs.

Table 2 provides a preliminary assessment of the damage suffered by the homes due to the 2017 fire. For the destroyed homes, the unit value of the home was used for each technical standard, to which is added between US$ 132.3 million to US$ 172.9 million for the damage to the affected homes.

Households	Amount	DS49 + improvement (US$ million)	DS19 (US$ million)
Destroyed	2.419	124,4	162,0
Subtotal		124,4	162,0
Households	**Amount**	**DS49 + improvement (US$ million)**	**DS19 (US$ million)**
Minor damage	1.515	7,4	10,3
Major damage	43	0,4	0,6
Subtotal		7,9	10,9
Total		**132,3**	**172,9**

Table 2. Assessment of damage to homes front system June 2023

Source: Own elaboration with data from SENAPRED, (2023). For this valuation, the housing construction estimates from "Estimates of the Direct Fiscal Cost of the New Constitution Proposal" by Betancor, et al., 2022 were considered.

Between January and February the fire was concentrated in 4 regions of the country, affecting homes, productive activities, national parks and tourism. The estimated cost in the regional GDP for those months amounts to US$197.7 million, 2.2% of the monthly regional GDP.

FOREST CAPITAL COST ESTIMATES: 2017 FIRE – PLANTATIONS

In figure 6 you can see the distribution of the surfaces that were affected by the 2017 fire according to species and age. In the case of pine, the distribution is quite homogeneous. However, in the case of eucalyptus there is a greater proportion of younger trees, 26% from 1 to 5 years old and 28% from 6 to 10 years old.

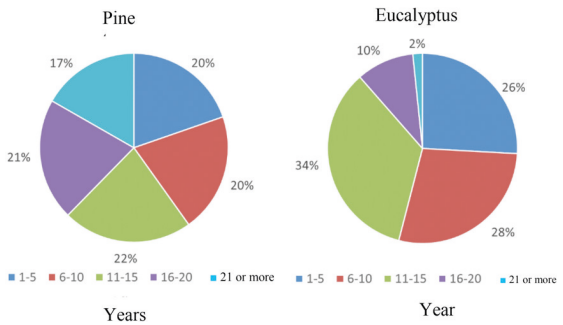

Figure 6. Scheme of capital losses associated with fires

Source: Own elaboration based on INFOR, 2018.

This is relevant, because in the estimation it is considered that trees from 0 to 5 years old have no productive value, and, therefore, their value is estimated according to the costs of afforestation, preparation and management, considering the following assumptions:

1. General costs of afforestation of exotic species by region.
2. Preparation and handling costs by species.
3. Percentage of impact of 50% of total loss.

It can be seen in table 3 that of the total of 41,690 hectares affected with trees between 0 and 5 years old, 75% are pine and approximately 25% are eucalyptus. Based on the aforementioned assumptions, losses of

forest capital in plantations are estimated at $USD 26.3 million.

For trees 6 years old or older, the estimate is made according to the value of the potential productive volume of the affected hectares. Considering the following assumptions:

1. Potential volume per hectare according to age range and region (m3ssc / ha)
2. 2017 distribution of products of wood origin
3. Percentage of impact = 50% total loss*
4. Average m3ssc price 2017:

- Pine Pulp = 14,044 CL$
- Sawn Pine = 65.843 CL$

That is, for each species, age, region, the volume of potential lost production is calculated, the lost production is added for all ages, regions and species. It is valued at the average price of m3ssc/ha for the same year 2017. A total loss or percentage of impact of 50% is also considered according to INFOR, 2018.

$$ha_{aer} * vol_{aer} * 0{,}5 = lost\ volume_{ear}$$

$$\sum_{a=1}^{5}\sum_{r=1}^{6} ha_{aer} * vol_{aer} * 0{,}5 = total\ volume\ lost_{e}$$

$$\sum_{s=1}^{2} total\ volume\ lost_{e} * Average\ price_{e} = total\ loss\ in\ plantations$$

Where s corresponds to an index for each species, pine and eucalyptus, a corresponds to the index corresponding to the age, and r corresponds to the region index. corresponds to the number of hectares affected for each species, age and region, and corresponds to the potential volume for each species, age and region. Table 4 presents the results, estimating a loss of forest capital stock in plantations, of trees 6 years old or older, amounting to $USD 1,019 million.

Table 5 summarizes the results of the estimations of forest capital loss in plantations. The sum of the losses for trees without productive value (0 to 5 years) and with productive value (6 years or more) amounts to a total loss of forest capital of $USD 1,046 million due to the 2017 fire.

COST ESTIMATES FOR CO_2 EQ EMISSION: FIRE 2017

In addition to the loss in forest capital, fires have a direct effect on carbon capture since burning trees releases the carbon stored in them. The 2017 fire generated an emission of 68.2 million tons.

The valuation of carbon emissions and CO_2 eq is still part of the technical discussion. In this study, three reference prices per ton of CO_2 eq emission are used to perform a sensitivity analysis: the European emissions trading system (EU-ETS) of 2017, the local social cost (LSCC in English) and the EU-ETS of 2022.

In 2017, according to the World Bank (2023), carbon pricing systems, whether by tax or tradable emissions permits, covered 12.03% of global emissions, the EU-ETS covered 3.05%. % of the total the system with the greatest coverage of all the others. Therefore, to take a reference price for the year, the average price per year was taken, which reached US$ 6.2 per ton CO_2 eq. With the same logic, the average EU-ETS price in 2022 is taken as a reference, reaching US$ 86.5 per ton CO_2 eq. It is important to note that the total carbon price systems in 2022 cover 22.31% of emissions.

Beyond market references, economic theory seeks to have a price that reflects the cost of the damages created by an extra ton of carbon dioxide emissions. According to Pizer (2014), Pindyck (2019), Tol (2011) and Cruz and Rossi-Hansberg, (2023) this price is the social cost of carbon. When a ton of carbon dioxide is emitted into the atmosphere, it remains in it for a time and causes warming that affects the economic and social activity of humanity. The social cost of carbon is the total

damage that an additional ton of CO_2 eq has on these activities, converted to dollars.

The social cost of carbon helps reveal how much society must sacrifice to avoid climate change. Based on the above and taking the evidence of the heterogeneity of the effects of CO_2 climate change by geographical area in Cruz and Rossi-Hansberg (2023), the local price of the social cost of carbon for Chile from Ricke et al (2018) was taken, Tol (2019) and Cruz and Rossi-Hansberg, (2022) which is equal to US$ 43.7 per ton of eq

The LSCC provides the information to determine how much to sacrifice to combat climate change. This is because the local social cost of carbon is the benefit, or in other words, the harm avoided, of reducing CO_2 eq emissions in a specific locality.

In table 6 you can see the valuation of the 68.2 million tons of CO_2 eq issued by the fire at different prices, reaching estimated damages between USD$ 422.8 million and USD$ 5,899.3 million. The LSCC value (almost 3 billion dollars) is not only an intermediate value, but is the best available representation of the loss of current and future income in Chile, as a consequence of the damages associated with climate change associated with these emissions.

In figure 7, you can see the greenhouse gas inventory published in 2022, in which you can see that in 2017 the usual emissions were exceeded due to the fire. The emissions caused by the fire, corresponding to a flow, are directly related to carbon neutrality, since due to the fire, 68.2 million tons of CO_2 eq were emitted, which corresponds to 7.9 times the park's emissions. car of the year 2017.

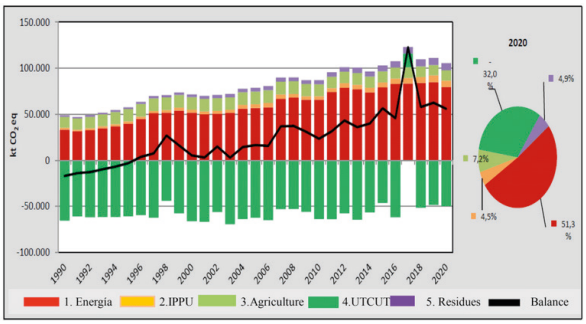

Figura 7. INGEI de Chile: balance de GEI (kt) por sector, serie 1990-2020

Source: MMA Technical Coordinating Team, GHG Inventory (2022))

COST ESTIMATES FOR LOSS OF ABSORPTION OF CO_2 EQ: FIRE 2017

To calculate the loss of future absorption capacity due to the trees lost by the fire, a weighted average of the age of the trees that were standing in the hectares that were burned was calculated, reaching an average of 12 years old, which is compared to an average harvest age of 21 years. With this, we have that the affected hectares still had (not counting the year 2017) 9 additional years of capture of CO_2 eq.

Considering that the capture loss for the year 2017 was 54.7 million tons of CO_2 eq annually, for the entire period (10 years) there is a total absorption loss of 547 million tons of CO_2 eq, which valued at the local social carbon price (LSCC) amounts to USD$ 18,666 million.

FOREST CAPITAL COST ESTIMATES: 2017 FIRE – NATIVE FOREST

For preliminary estimates of the costs of afforestation and conservation of native forest species, the afforestation costs per hectare and coverage obtained from Patricio Toledo Eco-Solutions (2023) and the information on affected surfaces from CONAF, 2023 were considered. It can be seen In table 8, the cost of reforestation by forest type, for the total hectares of native forest affected, has a cost of

USD$ 143.3 million.

Forest type	Total (ha)	Afforestation cost (millions $USD)
Cordillera Cypress*	303	-
Sclerophyll	33.978	78,2
Chilean Palm	7	0,0
Oak-Hualo	12.157	27,7
Oak-Rauli-Coihue	3.979	7,6
Always green	76	0,2
Native With Wild Exotics	16.233	29,6
Does not apply *	89	-
Total	66.823	143,3

Table 8. Afforestation costs of native species in 2017

Source: Own elaboration based on afforestation cost data obtained from Patricio Toledo Eco-Solutions, 2023. Categories "Ciprés De La Cordillera" and "Not applicable" were not valued due to the difficulty of assigning costs.

For the Roble-Raulí-Coihue forest type, there is information on conservation costs, which depend on the coverage of the surface. There are a total of 3,979 affected hectares of Roble-Raulí-Coihue, for which the conservation costs would amount to USD$ 19.1 million.

OAK-RAULI-COIHUE	Total (ha)	Conservation cost (millions $USD)
Very open	-	-
Open	299	1,0
Semi dense	1.758	7,6
Dense	1.922	10,4
Total	3.979	19,1

Table 9. Total losses of forest capital stock caused by the fire 2017

Source: Own elaboration based on data from CONAF, 2023.

ESTIMATED TOTAL DAMAGES: FOREST CAPITAL AND EMISIÓN

Figure 10 presents a summary table with the results of the estimates of this study. In capital stock, there are forest capital losses that amount to USD$ 1,046 million and, on the other hand, the losses in capture capacity for the period amount to USD$ 18,666 million valued at the LSCC. On the other hand, the losses corresponding to emissions of CO_2 eq of that same year are USD$2,983 million.

Cost category	Value (millions US$)
Loss of forest capital in plantations	1.046,1
Loss of absorption to LSCC	18.666

Cost category	Value (millions US$)
Emissions of to LSCC	2.983,1

Table 10. Estimated damage to forest capital and issuance of

Source: Own elaboration.

CONCLUSIONS

The contribution of this study focuses on the costs associated with productive purposes of forest capital and the ecosystem service of absorption of greenhouse gas emissions, carbon fixation. In addition, the need to improve the disaggregation of data, assumptions, and prices for a more accurate valuation is identified.

Although only these two specific costs are estimated, very relevant cost magnitudes are reached. The loss of forest capital produced in 2017 corresponds to 7.8% of the capital produced in the agricultural, forestry and fishing sector.

Finally, it must be noted that in the future it is necessary to include a broader evaluation of the functions of other ecosystem services, which are not considered in this study due mainly to the difficulties in their identification and assessment.

The economic impact of the loss of forest

capital and reduced carbon sequestration is considerable, even when only these two elements are considered. This underlines the importance of investments in conservation and restoration, and sustainable management of forests, as well as the need to improve methodologies for the evaluation of ecosystem services.

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ANNEXES

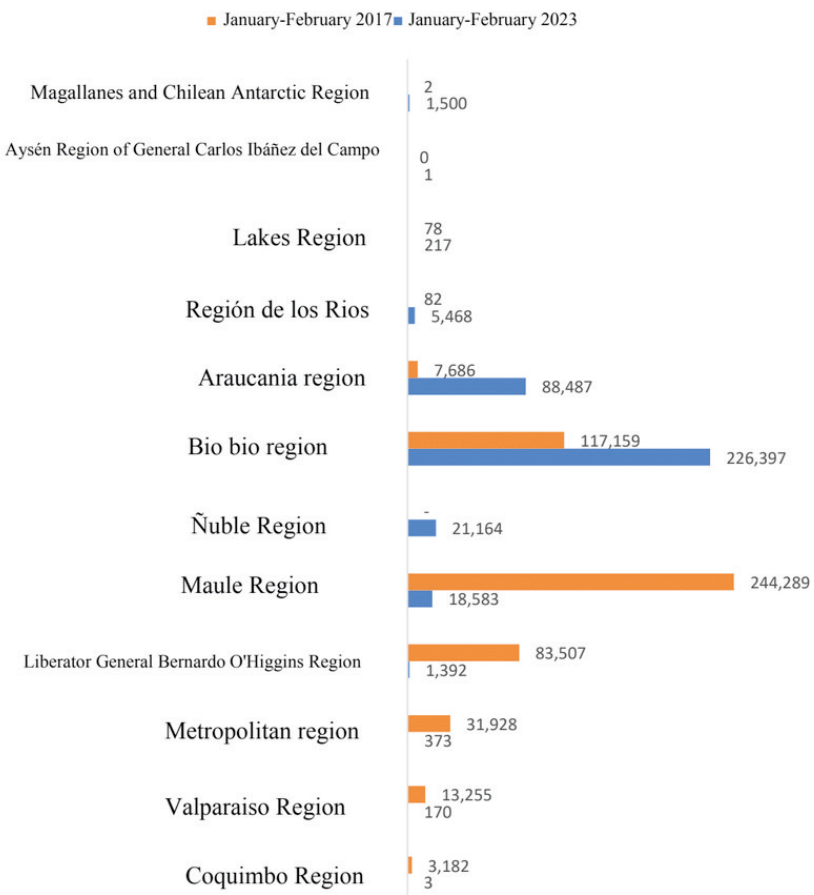

Figure A1. Affected area (ha) in January-February by region

Source: Own elaboration with data from CONAF (2023).

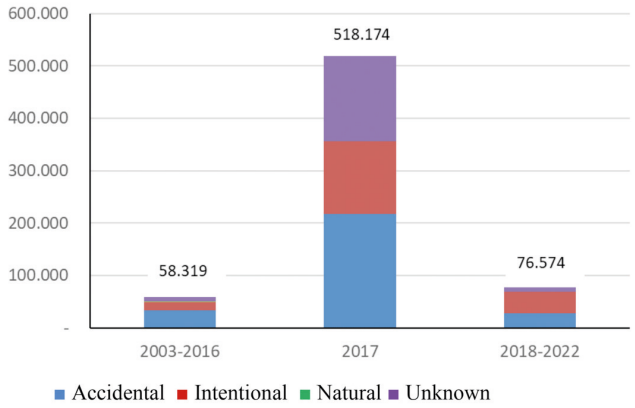

Figure A2. Area affected (ha) by forest fires by type of cause

Source: Own elaboration with data from CONAF (2023).

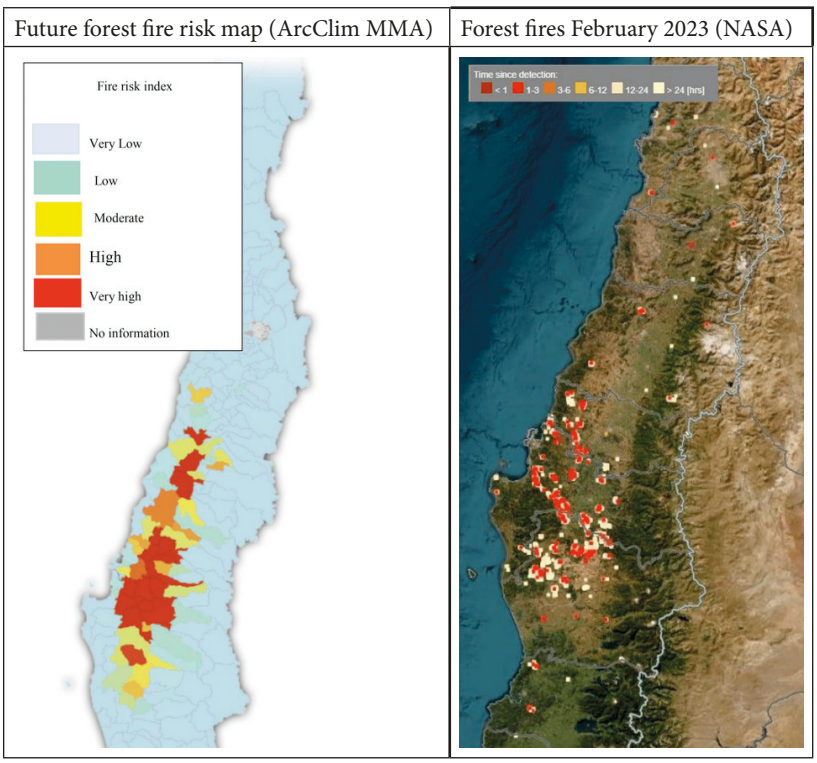

Figure A3. Comparison of estimated future fire risks and observed fire outbreaks

Source: Own elaboration based on ARCLIM data and NASA satellite images.

Region	General cost of exotic forestry per hectare
Valparaíso	421.933
O'Higgins	490.690
Maule	436.497
Biobío	436.497
La Araucanía	466.330
Los Ríos	466.330

Table A1. General cost of afforestation of exotic species at 2017 prices

Source: Own elaboration based on data from CONAF, 2011.

Item	Additional cost of preparation and management per hectare
manual box	59.482
Tractor furrows	45.703
Moderate erosion	108.065
Handling costs	
First pruning *	66.055
First thinning	37.432
Professional advice	75.810
Total	392.548
Total Eucalyptus	326.492

Table A2. Preparation and management cost for exotic species at 2017 prices

Source: Own elaboration based on data from CONAF, 2011. Note: The costs of first pruning for Eucalyptus plantations are excluded.

Panel A: Pine					
Region/Age	1-5	6-10	11-15	16-20	21 o más
Valparaíso	0	30	71	200	289
O'Higgins	0	36	85	240	346
Maule	0	58	106	288	420
Biobío	0	67	117	304	446
La Araucanía	0	73	128	334	491
Los Ríos	0	77	135	351	515
Panel B: Eucalyptus					
Region/Age	1-5	6-10	11-15	16-20	21 or more
Valparaiso	0	102	186	226	248
O'Higgins	0	122	223	271	298
Maule	0	134	244	295	325
Biobío	0	159	275	326	359
La Araucanía	0	175	303	395	395
Los Ríos	0	184	318	377	415

Table A3. Potential volume per hectare according to age range and region (m3ssc / ha)

Source: Own elaboration based on data from INFOR, 2017 for the regions of O'Higgins, Maule and Biobío. For both species, it is assumed that the O'Higgins region produces 20% more than Valparaíso. Los Ríos 5% more than La Araucanía and in Araucanía 10% more than in Bio Bío.

Product	Pine tree	Eucalyptus
Pulp	32,3%	51,4%
Sawn timber	51,6%	0,7%
Boards and sheets	9,7%	1,7%
splinters	3,2%	45,5%
Other products	3,2%	0,7%

Table A4. 2017 distribution of products of wood origin

Source: Own elaboration based on data from INFOR, 2018.

Forest Type / Cover	Very open	Open	Semi-dense	Dense	Average
No. trees per hectare	100	300	600	1200	-
Mountain cypress	-	-	-	-	-
Sclerophyll	704	1.578	2.889	5.512	2.671
Chilean palm		3.027	5.787	11.306	6.706
Oak-hualo		983	1.700	3.133	1.939
Oak-raulí-coihue		983	1.700	3.133	1.939
Always green		983	1.700	3.133	1.939
Native with feral exotics		983	1.700	3.133	1.939

Table A5. Establishment cost per USD/ha, depending on forest type and coverage

Source: Own elaboration based on afforestation cost data obtained from Patricio Toledo Eco-Solutions, 2023. Note: Number of trees per hectare estimated by coverage.