Creation and Implementation of a Certification System for Insurability and Fire Risk Classification for Forest Plantations

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Summary—*Currently, the Chilean insurance market sells forest fire insurance policies and agricultural weather risk policies. However, access to forest fire insurance is difficult for small and medium enterprises (SMEs), with a significant proportion (close to 50%) of forest plantations being without coverage. Indeed, the insurance market that sells forest fire insurance policies does not have an evaluation system based on known standards accepted by the market; rather, it is discretionary, with each company evaluating risk with their own specific parameters. This lack of standardization reduces access and increases costs due to uncertainty, assigning a high risk rating by default. At present, over 19,000 SMEs and more than 810,000 forested hectares are affected by difficulties in getting fire insurance policies.*

This situation is being addressed through a project funded by the Chilean Foundation for Agriculture Innovation (FIA), along with government institutions, forest companies, insurance companies, and insurance adjusters and brokers, and executed by the Chilean Forest Institute (INFOR). The proposed solution is a certification system of fire risk classification for forest plantations (named SAFOR –Sello de Asegurabilidad Forestal- as per the Spanish acronym), that will be created and implemented, allowing the SMEs to have access to the insurance market.

The system has two elements, the standard, built as a formal national norm that describes objectively how to evaluate the risk, and the certification system that will transfer the standard into the market based on an appropriate accreditation of auditors through the fulfillment of certain procedures.

The implementation of SAFOR certification is expected to have several different benefits and positive impacts, improving several indicators. Forest companies with plantations close to SMEs plantations may also benefit from a decrease in fire risk. The adoption of fire management best practices that landowners may apply to reduce the risk and therefore obtain lower insurance premiums could reduce the fire occurrence, contributing to the environment and also to the State investments, since owners of plantations established with State contribution could continue in the forest business after a fire, preserving the rural economy.

Introduction

Chile has a population of 16.6 million inhabitants, a per capita Gross Domestic Product (GDP) of US$ 18,945, a total continental area of 756,000 km^2, a forest area covering 17.3 million hectares, with 2.3 million in plantations, and total annual forest exports amounting to US$ 5,714 million (INE 2014).

Forest plantations are essential in the forest activity since they supply 98% of the timber used by the industry. Forest ownership is concentrated in two big companies that hold over 50% of the total forest plantations (Op cit.).

Fire statistics indicate a burned area of 1.2 million hectares between 1990 and 2013, with more than 137,000 fires and losses of forest assets worth more than $50 billion a year market value, plus other losses that have been estimated in 8-10 times that amount. Forest fires are caused mainly by human activities. The annual average burned area reaches an average of 49,000 ha, and the fire forest insurance market is US$ 9.1 million (CONAF 2013).The Chilean insurance market offers two products for forest plantations: initial insurance, which operates during the first three years after plantation and deals with weather damage (drought, excessive rainfall, flood, frost, hail, snow and wind), and fire for new forest plantations; and the fire insurance policies and agricultural weather risk policies. Nevertheless, it is very difficult for forest SMEs (small and medium-sized enterprises) to obtain fire insurance policies for forest plantations because the insurance market has few specialized agents in forest plantations. As little quality information is available regarding fire risk in forest plantations, agents typically assign a high risk qualification by default. This increases

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policy costs because of the uncertainty. Therefore, the lack of standardized information, which affects over 19,000 owners and more than 810,000 hectares of plantations, poses serious barriers to forest SMEs, with important socioeconomic implications.

An ongoing project intended to solve the problem of market asymmetry affecting forest SMEs, funded by the Chilean Foundation for Agriculture Innovation (FIA) along with government institutions, forest companies, insurance companies, insurance adjusters and insurance brokers, is being implemented by the Chilean Forest Institute (INFOR), with a total budget of US$ 410,000, allocated in three years (2013 to 2016). The project is implemented by an advisory council formed by representatives of each associated member, FIA and INFOR, which contributes with and validates results and decisions.

Forest plantations, a very valuable asset for the country, are subject to multiple risks, including fire. However, a significant proportion are not covered by fire insurance, with several negative implications, especially for SMEs, whose proportion of uninsured plantations is higher than that of large companies, increasing the gap between socioeconomic stakeholders. This gap is caused by a lack of a standardized methodology, hindering assessment of fire risks by insurance companies.

A certification system of fire risk classification for forest plantations (named SAFOR as per the Spanish acronym), will be created and implemented, allowing the access of SMEs to the insurance market.

The solution has two elements. The first element is a set of standards, built as a formal national norm generated by the Chilean Standardization Institute (INN), which describes how to evaluate the risk in a methodological and objective way. The other element is the certification system, which will enable plantations to demonstrate that they meet the designated standards based on an appropriate accreditation of auditors by following certain procedures, and facilitate the commercialization process of fire insurance policies. The insurance market will adopt the certification system as a source of information to qualify fire risk associated with insurance policies. In turn, the clients will pay for the certification to break the entrance barriers by evaluating the risk. Thus, policy price should decrease and the number of SMEs insured should increase, allowing forest SMEs to hire fire insurance policies at sustainable prices, according to the forest activity. The forest fire insurance market is expected to grow as a result of the adoption of the SAFOR certification system, because it will provide reliable information for the evaluation of fire plantation risks. In addition, the following potential benefits have been identified:

-Increase of the insurance forest market size and greater competition, because new companies are expected to join the activity;

-Improvement of self-protective management, including an increased fuels management by plantations, in order to get a lower risk qualification;

-More controllable fires;

-Improved access for SMEs to the financial system and to government promotion tools/funds due to the risk reduction;

-Better information on SMEs technology and productivity;

-The forest subsidy allocated to the establishment of new forest plantations will be protected, increasing its socioeconomic profitability;

-Environmental benefits, such as reduction of impacts to soil, water and biodiversity, as well as reduced air pollution and greenhouse gases.

It should be noted that the need to evaluate risk to a level of sophistication that will meet the needs of the insurance industry reaches far beyond Chile.

Development Process

The proposed development process is organized in four phases:

1. Feasibility analysis, considering forest sector conditions, insurance market, legal requirements, technical issues to be used in the standard construction, and the potential client's willingness to pay through a contingent valuation methodology according to Hannemann (1984), Arrow and others (1993), Vásquez and others (2006) and Tietenberg (1996). Sample size was determined according to Piñeda (2004).
2. Development of a National Standard to quantify the fire risk level in forest plantations. The standard development process follows the national authority scheme, defined in the national standard 1 (NCh 1 cR2010), and considering the risk management standard (NCh-ISO 31,000).
3. Design, creation and validation of the certification system.
4. Implementation of the new certification as a pilot project.

Due to the project characteristics, special importance has been given to joint public-private collaboration because of its potential to expand and its long-term sustainability.

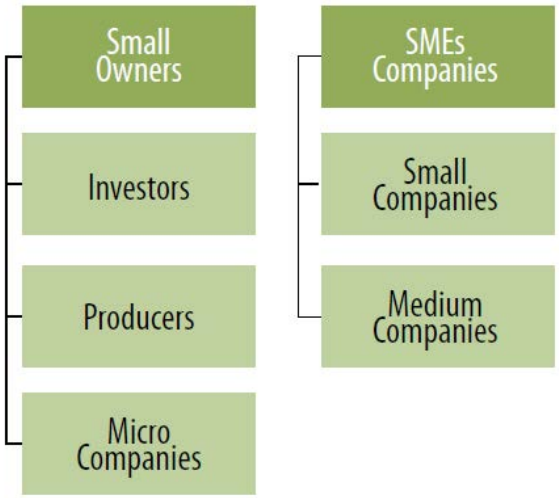

Figure 1—Demand target market segmentation.

Among the main stakeholders involved are the insurance market, SMEs and small owners of different types (Figure 1) from the private sector, the Forest Institute (INFOR), Forest Service (CONAF) and the Ministry of Environment from the public sector.

Results

Since the project has only recently begun to develop the standard, here we present the results for the first phase, which consists of a feasibility analysis. This feasibility study conducted and completed five different analyses: 1) forest sector and insurance market overviews, 2) legal aspects, 3) an examination of the insurance market in Chile, 4) socio-economic issues focusing on willingness to pay, and 5) forest management procedures. The main results (Loewe and Vargas 2014) are summarized below:

Forest Sector and SMEs Baseline

The study conducted by Loewe and others (2014) showed that forest plantation ownership is strongly concentrated, with two companies owning more than 50% of all plantations, distributed in four regions (72% from Maule to Los Ríos). On the other hand, SMEs plantations are concentrated from O'Higgins to Los Rios (88%) (Table 1) (INFOR 2013). However, little information on SMEs was available concerning how they are divided between SMEs and Small and Medium Owners (SMOs), being the threshold, for statistical purposes, among small and medium size owners 200 hectares.

Table 1—Area of forest plantations by owner and region.

Region	Big Companies (Hectares, %)		SMEs (Hectares, %)	
O´Higgins (VI)	7,725	7	105,039	93
Maule (VII)	247,831	55	204,971	45
Biobío (VIII)	654,496	72	252,860	28
Araucanía (XIX)	274,198	57	206,240	43
Ríos (XIV)	128,654	68	61,557	32
Lagos (X)	23,101	33	46,928	67
Total	1,336,005	60	877,595	40

Source: INFOR (2013)

Plantations of big forest companies are mostly devoted to radiata pine (77.3%) and *Eucalyptus globulus* (12.1%), whereas SMEs and SMOs have a more diversified resource (50% of radiata pine and 35.9% of *Eucalyptus globulus*).

Regarding age structure, most plantations are 0-20 years old. Age structure is more spread across age segments in the big companies than in SMOs/SMEs, reflecting a lack of planning due to fragmentation by the latter.

Tenure of plantations in SMOs/SMEs at the municipality level

In O'Higgins region, four municipalities (Pichilemu, Marchigüe, Litueche and Paredones) accounted for 70% of the forest plantations that belong to SMOs, located in the regional coastal zone. In Maule region, the municipalities Cauquenes, Constitution, Curepto, San Javier and Curepto accounted for 46% of SMOs/SMEs forest plantations, also located in the coastal region (INFOR 2013).

In Bio Bio region, about 25% of forest plantations within this socioeconomic segment were concentrated in five municipalities (Quirihue, Mulchén, Los Angeles, Santa Barbara and Cobquecura), whereas in the Araucanía region, six municipalities located in the central valley (Los Sauces, Traiguen, Lumaco, Galvarino, Nueva Imperial and Angol) accounted for nearly 50% of plantations.

Finally, in Ríos region, six municipalities (La Union, Los Lagos, Corral, Valdivia, Mariquina and Paillaco) accounted for 70% of forest ownership, and in Los Lagos region, four municipalities (Fresia, Purranque, San Juan and Rio Negro) accounted for 65% of their forest patrimony at the regional level.

Fire Statistics

Fire statistics are produced annually by the National Forest Service (CONAF) from data on fire occurrence and affected area by season (from July 1st to June 30th of the following year).

From 1990 to 2013, the burned area totaled 1.2 million ha, with 137,000 individual fires, and losses of assets with a commercial value averaging over US$ 50 million per year (Table 2) (CONAF 2013). However, non-commercial losses were much more critical because of their impact on the environment and quality of life for inhabitants, both in rural and peri-urban areas of towns and cities. These impacts,

Table 2—Fire occurrence and historical national damage (1990–2013).

	Forest Service	Companies	Total
Total Fire N°	93,070	44,092	137,162
Average (N° of fires/season)	3,878	1,837	5,715
Incidence (%)	67.9	32.1	100
Total affected area (ha)	983,420	192,537	1,175,957
Average (ha/season)	40,976	8,022	48,998
Incidence (%)	83.6	16.4	100
Protected area (ha)	34,000,000	3,000,000	37,000,000
Incidence (%)	91.9	8.1	100

Source: CONAF (2013)

whose valuation is not straightforward, were estimated to be 8-10 times higher than direct losses, being US$ 400-500 million/year, not including the incalculable value of loss of human lives (Julio 2012).

On average, 49,000 ha are burnt each season, in about 5,700 events, with an average of 9 ha affected per event. Nevertheless, the range of burnt area historically varied widely, from a minimum of 10,000 ha in the 2000-2001 season to over 100,000 in the 1998-1999 season. There is no relationship between occurrence and area affected; for example, in the 2011/12 season, in Quillón about 25,000 ha were burnt only in one fire event.

The four seasons that caused the highest damage coincided with big fires, and although they are known to have been originated intentionally (simultaneous outbreaks), investigations have failed to identify culprits.

Interestingly, big forest companies had 32% of fire occurrence but only 16% of the affected area, because they control a smaller area and have detection and control systems (Op cit.).

In Chile, wildfires principally originate from anthropogenic activities and are strongly linked to attitudes of the value of the forests. If people assign a low value to the forest, they behave carelessly, negligently or recklessly; on the contrary, if they assign a high value to the system they live in, they will behave wisely. At the national level, for the period 2003-2013[1], accidents accounted for 57% of the area burned (including agricultural and forest residue prescribed fires, trash burning, neglected cigarettes and fires, transit and recreational activities, among others); intentional fires accounted for 26.8%, unknown causes, 16% and natural causes accounted only for 0.2%. Even though this is a complex reality, it has the advantage that through education human behavior related to fire and fire management can be improved.

The fire statistics of the Forest Service comprises 326 municipalities, not including geographically extreme regions. Of these, 29 concentrate over 50% of wildfires and have received prevention, control, suppression and attack budgetary allocation since the 2010/2011 season.

Forest companies focus their efforts on the basis of knowledge of physical parameters (vegetation, topography, weather and fire behavior) in order to protect their forest resources. Forest companies intend to foster their protection programs and continue increasing coordination and collaboration agreements with other companies to strengthen self-protection. Accordingly, the most relevant aspects for companies are coordination and collaboration agreements with other forest companies, early detection systems, minimization of fire spread and attack resources.

[1] Statistics from CONAF, 2013.

Legal Analysis for the Development of SAFOR Certification System in Chile

The implementation of a forest plantation insurability certification was analyzed from a legal point of view (Lobo 2014), and was found to be quite feasible as no impediments were identified in our legislation.

Given the legal nature of the insurance contract, the parties may agree to include in the insurance policies terms and conditions to quantify fire risks in forest plantations through a certification process, which could be accepted by insurance companies when deciding on issuing a given policy and when setting the premium cost.

Then the Superintendence of Securities and Insurance (SVS), based on its legal powers, will validate these new terms and conditions to be endorsed in case the amount of the annual insurance premium is lower than a stated limit in support of a transparent business for SMEs; if the parties do not comply with this obligation, they cannot use a new policy or term. If the annual insurance premium exceeds the previous amount, and the insurance beneficiary is a legal entity, the mentioned obligation is no longer valid because it will be a private agreement, with those parties being free from incorporating the certification.

This conclusion is reinforced by the general rules of the Commercial Code, whose Article 516 concerning the information that policies must contain for all kinds of insurances, states that the policy must describe "the situation of the insured property," without indicating how this statement should be expressed.

Thus, there are no legal impediments for the parties to agree that part of the condition of the insured resource is determined by a third party who technically certifies the fire risk of a forest plantation through the SAFOR standard.

The Insurance Market in Chile

The analysis performed by Forestsur (2014) includes two parts. The first part describes the structure of the insurance market in general terms, including stakeholders (insured, regulator, brokers, reinsurance, adjustors and support agencies), the regulatory environment, business practices, market dimension and insurance types, in order to explain the insurance market functioning and role in the economy of Chile. The second part describes the insurance market from the point of view of supply and specific operation for forest plantations in Chile.

General Insurance Market

An increasing trend in the industry is observed: life insurance companies have increased over time, exceeding the general insurances.

Specifically in insurances for SMOs and SMEs, there would be a disadvantage in the products offered by the insurance market (coverage), because they were not designed for a specific customer segment or size; rather, they are generic, so the insurance market can access a broad market (clients or insured) but has the disadvantage that often small potential customers face entry barriers due to business size or risk rate.

Moreover, the supply of insurances is growing, with a variety of increasingly specific interests to satisfy insured needs. In addition, there is a fairly detailed legislation on what the various stakeholders in the industry may or may not do which regulates the amount of investment, diversification, policy contract components, etc., regulated and supervised by the SVS.

The incidence analysis of the total annual premium distribution for the different insurance branches shows that fire and earthquake reach 35%, and excluding the compulsory automobile insurance, it would reach 50%; given the high variety included in "others" (theft, liability and several others), fire and earthquake branch is the most important of all general insurances.

This market will probably continue to grow during the next years, both in variety and size, i.e., increasing the number of actors, both insurance and reinsurance companies and brokers, and it will improve the offered insurances, diversifying the investment portfolio.

The insurance industry in Chile is transparent and has a stable institutional framework, governed by clear laws and regulations, which has led to a sustained increase in investment value, reaching US$ 5 billion in 2012.

This has particular positive implications for SAFOR project, because when demand is added to the insurance market, it will find a market ready for taking risks quantified by the certification. This opportunity means that forest SMOs and SMEs will gain access to this market.

Insurance market for forest plantations in Chile

In the case of forest plantations, insurance companies are classified as General Insurance Companies. In the case of forest fires coverage, even if it is a standard procedure from the point of view of the product (policy type), its value chain relies heavily on reinsurance capacity and on the analysis of the inherent risks to forest plantations. Reinsurance capacity is made up of the involved reinsurance companies that cover these risks and their financial capacity. Regarding risks, each reinsurer has defined capability coverage (coverage limits) for forest plantations in Chile, and depending on the risk analysis, a structure of coverage is set, i.e. rates, compensation limits, deductibles, and special additional coverage. Risks become insured capital, then placements and finally insurance policies.

To analyze the risks, the insurance market uses discretional procedures without standardized information; among the considered elements are plantation location, forest management and operational performance, historical fire occurrence; as well as forest neighbors' protection programs, cooperation agreements and business volume.

The main stakeholders are insurance companies, insurance brokers and sales agents, reinsurers and adjusters (SVS 2013a).

Of the total plantation area insured, amounting 1,234,190 ha, eucalyptus species represent 17%, radiata pine 81%, and only 2% correspond to other species.

The three most important regions for insured plantations are Bio Bio (52%), Araucania (22%), and Maule (15%), making a total of 89% (Table 3).

The SAFOR certification system is oriented to SMOs and SMEs, including several actors, as shown in Figure 1.

An important finding was that big forest companies have a correct administration of their fire insurance policies through catastrophic coverage, concentrating in coverage for large losses, which is logical given the substantial appreciation of their resource. Therefore, if premiums were higher, the cost would be much higher given the high self-protection costs.

It was concluded that the total insurable plantations, only in the regions of O'Higgins, Maule, Bio Bio and Araucanía, exceed 1,950,000 ha, equivalent to 82% of the insurable plantations at a national level. Of these, over 1,170,000 ha are already covered, with only 18.5% belonging to SMOs and SMEs: In these four regions, 750,000 ha have not been insured, and most of that area would belong to this stakeholder segment.

The area without insurance, on which SAFOR is focusing, is located in four regions (O'Higgins, Maule, Bio Bio and Araucanía), because the insurance market has 95% of forest fire insurance policies in these regions and it is where fire hazards are higher. It has been estimated that in those regions there are 15,700 forest owners, 400 being SMEs and the remaining ones, SMOs (SVS 2011).

Regarding the estimated business volume, a conservative scenario that considers incorporating 30% of this potential area in 5 years would represent a real increase for the insurance forest market of 20%, which is relevant for a general insurance market that grows annually at a rate of 6 to 7%.

Table 3—Insured plantation area by region and insurance company.

	Region										
Insurance Company	**IV**	**XIII**	**VI**	**VII**	**VIII**	**IX**	**XIV**	**X**	**XI**	**XII**	**Area (ha)**
Magallanes	75	98	3,515	33,072	35,613	11,149	1,566	2,342	514		87,944
Mapfre		521	1,626	1,741	7,138	654	251				11,931
Penta		50	1,548	8,11	21,134	7,02	25,294	835			63,991
RSA (SMEs)			679	12,088	30,208	19,116	1,713	454		7	64,265
RSA (Big companies)			63,796	135,31	550,538	236,688	10,167	9,561			1,006,060
Insured plantation area (ha)	75	669	71,164	190,321	644,631	274,627	38,991	13,192	514	7	1,234,191
Region weight (%)	0	0	6	15	52	22	3	1	0	0	100

Source: Elaborated with information from the Superintendence of Securities and Insurance (SVS)

Socioeconomic Analysis and Willingness to Pay for SAFOR Certification

Forest fires are currently a very important concern given the occurrence of large disasters in the country in recent years, which have affected forest plantations and surrounding communities, causing irreversible damage to the heritage of many Chilean families, and also to companies that support many families. In this scenario, given the externalities that directly affect people's welfare, a study was conducted to assess the willingness to pay for SAFOR certification by potential users (SMOs and SMEs). The study was performed by García (2014) in two stages: first, surveys were conducted among SMOs and SMEs to gather data on their socioeconomic characteristics, perception of forest fire risks, reasons for not buying fire insurance policies, as well as to explore their interest in SAFOR certification. Second, the survey results were analyzed using the contingent valuation methodology to assess the willingness to pay for the new certification.

This methodology evaluates the possible willingness to pay for SAFOR certification as a private concept that depends on the income of potential users, considering that it would remove entry barriers through an objective risk assessment, reducing existing asymmetries in the current market.

The model simulates through surveys and hypothetical scenarios a market for an asset or group of assets for which no market exists. This method is used to estimate changes in welfare of people, especially when these changes involve goods or services that do not have a price. One case applied to prescribed fires in the wild land urban interface in Colorado (USA) was reported by Kaval and others (2007).

The methodology recommended by the National Oceanic and Atmospheric Administration (NOAA) (Arrow and others 1993) was used to design and implement the surveys and the sample size (72 surveys) was calculated for 90% confidence.

The analysis allowed us to characterize socially and economically the objective SAFOR stakeholders, who were found to be of low educational and low-income levels.

Surveys were concentrated in the municipalities of Nueva Imperial (18%), Hualañe (16%), Santa Barbara and Cauquenes (14% each) and Arauco (13%).

Regarding social characteristics, the educational level shows that 50% of forest owners have basic education level (years 1 to 8) and only 10% received university education; 5% have no formal education at all. Of all the respondents, 66% are married and 3% divorced. On average they have 2 children, and 23% have 3 children.

As per the income level, 66% earned less than US$ 330/month, 11% between US$ 331-640; 9% between US$ 641-1,090; 6% from US$ 1,091-3,630 and only 5% earned more than that amount. It should be considered that when answering income-related questions, people tend to report smaller values, leading to bias in the responses.

Concerning forest characteristics, respondents own on average 261 ha of plantations, and are concentrated in the Maule and Bio Bio regions, with the former locality being the one with the highest forest plantation area.

Of all of the owners, 65% indicated not having been affected by forest fires in the last 5 years, whereas 35% gave a positive answer, reporting an affected area ranging between 1 and 480 ha. The fire origin was diverse, including arson, controlled burns by neighbors, neglect, illegal burning, electric lines, etc. Roughly 20% of the total area surveyed was affected by a fire.

Regarding damage caused by fire, 88% of the respondents declared to be aware of it and, only 9% were not, showing that although they know about fire damage, they do not use this type of insurance.

The analysis of fire insurance showed that only 7% of respondents have an insurance policy, indicating the existence of buying barriers; among the mentioned reasons for not hiring are high costs (35%) and ignorance (22%); only 3% consider that the fire risk probability in their property is low.

Of all the respondents, 85% saw value in buying a policy and only 15% did not. Potential customers were willing to pay for a fire insurance policy US$ 5.5-12.7/ha/year (74%), 12.7-25.5/ha/year (4%), 25.5-42/ha/year (4%); only 3% would pay a higher amount.

Interestingly, 74% did not request a quotation from an insurance company, despite the importance given to buying a policy. Therefore, it is inferred that they ignore the requirements for accessing an insurance policy; in fact, 78% of the respondents declared not being aware about the requirements for buying a fire insurance policy.

Regarding the SAFOR certification, 59% of the respondents would get it, whereas 38% are not interested and 3% did not answer.

The willingness to pay for the certification declared in 50% of cases ranged between US$ 1.3-3.3/ha/year; 15% would pay US$ 3.3-4.2/ha/year; 23% would pay US$ 4.2-6.5/ha/year; 8% would pay US$ 6.5-9.8; and 4% over US$ 9.8.

The results of the contingent valuation analysis, using the Probit model (Pucutay 2002) (Table 4), to determine the willingness to pay for the certification, corrected for the relevant variables and salary, indicated an average willingness to pay of US$ 5.1/ha/year. Considering that the average price for fire insurance is currently US$ 36/ha/year, the certification would correspond to 14%.

The significant variables that affect the decision to buy the certification correspond to region of residence (especially Bio Bio and Maule), marital status (especially married), and the interest in buying insurance policies. The willingness to pay is strongly positively correlated to the total plantation area.

Although some of the respondents did not have the necessary education to use insurance policies, they showed interest in improving their conditions and having access to both certification and fire insurance policies.

Technical aspects related to forest management

Forest management planning provides a framework to establish priorities, set objectives and devise strategies to deal with risks (Day and Pérez 2013). Several aspects related to forest management and fires were addressed by Pinilla (2014). Every year the country is affected by forest fires that consume large areas of native forests and plantations; therefore, once a fire starts, much of the efforts are focused on losing the smallest area possible. In the case of forest plantations, the significant area planted with radiata pine and several

Table 4. Contingent valuation results through Probit model application

ξ	Coeff.	Std. Err.	z	P>z	95% Conf.	Interval
β_o	-10.2336	6.3628	-1.6100	0.1080	-22.7045	2.2373
β_1 (Bio Bio region)	4.6831	2.7814	1.6800	0.0920	-0.7683	10.1345
β_2 (Maule region)	7.0493	2.7047	2.6100	0.0090	1.7482	12.3504
α_2 (marital status)	-2.3498	1.2508	-1.8800	0.0600	-4.8013	0.1017
θ_3 (interest in buying fire policy)	7.1935	3.4821	2.0700	0.0390	0.3688	14.0183

Source: Estimations made from survey information

eucalyptus species create a scenario where the probability of fire occurrence is affected by a number of factors. Whenever a forest fire occurs, a serious problem arises that affects forest resources, infrastructure, services, ecosystems, as well as, and most importantly, loss of lives. In addition, forest fires cause the release of greenhouse gases, potentially increasing the negative effects of climate change.

Due to the anthropogenic origin of fires, either unintentional, through carelessness or negligence, or directly intentional, all prevention measures and early control are based on silvicultural and community actions, and recently, on increasing the penalties for the ones guilty of causing forest fires.

Therefore, efforts to mitigate damages and losses from forest fires in plantations include community awareness campaigns, education, preventive actions, availability of human and technical resources, and joint collaboration between institutions, forest companies and owners (Urzúa and Cáceres 2011).

This scenario has led to consider that, in general, higher forest fire risk areas are associated with roads and nearby population centers, recreational zones and areas where agricultural and forest activities are developed. This is associated with the chance of fire, as determined by the presence and activity of agents of ignition, known as fire hazard (CIFFC 2013).

The amount of fuels associated with forest management is very important. The occurrence likelihood and factors involved in the generation of a wildfire largely determine the fire insurance price, the investments made in forest plantations protection and the expected returns. Insurers then need elements to decide premiums for selling fire insurances.

This demonstrates the need for information and analysis of the main factors that are necessary to describe objectively the risk of fire in a forest plantation to be protected.

There are multiple forest and environmental factors that can be used to explain fire occurrence and spread; however, many of these are difficult to quantify, estimate or model, especially those related to environment, climate, topography and vegetation, as well as the relationships among them, which limit their usefulness as elements when insurance companies model or estimate these risks.

In this scenario, there are some forest or environmental factors that are more objective when determining whether to consider them as wildfire risk descriptors.

Among the most frequently mentioned silviculture factors at a national and international level are forest composition (species, age, distribution, land use planning), presence of agricultural activities, existence of forest operation planning (establishment, management, harvesting), early prevention and attack plans, fuel management, existence of perimeter firebreaks as well as the implementation of Best Management Practices (BMP) (INFOR 2006).

Other factors to be considered as part of the setting are nearby towns, topography and climate, as well as land management elements and protection used by associations, forest companies and local government.

It is concluded that the proper fuel biomass management through silviculture reduces wildfire probability when focusing on the definition and assessment of risk areas, minimizing damage at the local, personal, environmental and economic levels. Through forestry practices it is possible to reduce the number of fires and their magnitude, preventing erosion and enhancing soil protection, water movement, wildlife, etc., and if the fire has already started, to limit the associated damage (Peña and others 2004).

In this context, *Preventive Forestry* was defined with the aim of reducing the threat of and vulnerability to forest fires, seeking to reduce the number of fires, and more importantly, their size. It integrates all protective measures to achieve this objective by implementing a plantation management oriented to minimize this type of damage.

Accordingly, in 2006, the USDA noted that the decrease in stand density, understory and surface fuel loads are factors that explain historical fire rates. Hence, the efforts to prevent damage and losses in plantations aim at including measures related to firebreak use, decreasing horizontal and vertical fuel continuity, prevention measures in harvest or thinning areas, fuel management, proper zoning and management of plantations, among others, that contribute to the reduction of wildfire likelihood, minimizing losses and supporting actions for a rapid extinction if it occurs.

WWF (2013) recommends identifying critical points and most vulnerable forests, and designing specific fire prevention plans. These plans should aim, among other objectives, to:

- Refine urban uses in the forest, reducing the urban-wildland interface.
- Require that local actors located in forest areas develop and implement prevention and defense plans against fires, including selective vegetation control and access control protocols.

Regarding investigations to predict fire behavior, location and intensity in real time and the possible effects and consequences on forest resources, infrastructure and security, significant efforts have been made, concluding that more information is required to reduce model uncertainty, and that

modeling is complex, involving significant uncertainty (Taylor and others 2013).

Therefore, forest management factors should be included in the development of the proposed insurability certification system, which associated with a new Chilean standard will lead to an objective forest fire risk classification. This classification will be recognized by insurance companies, which would take into account the risk level when determining fire insurance premiums.

In order to develop the standard, different factors have been identified. Below are some of those factors grouped by category, according to their characteristic of risk, hazard, or fire control which are analyzed as potential contributors to fire risk:

1. *Forest Risk*, including history of past fires, intentionality level, proximity to main roads, proximity to population and/or recreational centers, electric lines and high risk adjacent focusses.
2. *Hazards*, including those that will likely determine the fire development and behavior once already started, such as vegetation fuel model (considering silviculture practices), slope and weather parameters.
3. Firefighting organization and prevention measures, including firebreaks, fuel treatments, owned available protection resources, distance to specialized firefighter teams, distance to big enterprises plantations and agriculture activity in or close to the property.

Based on these factors a fire risk index will be built considering the national situation and other information such as that reported by Schneider and others (2008) based on relative greenness; by Alexander and De Groot (1988) based on weather information; by Koetz and others (2008) and Hawkes and others (1995) based on fuel types and properties; by Rodríguez and Silva and others (2012) based on economic vulnerability; and by Holecy and Hanewinkel (2006) based on a forest insurance model.

Conclusions

Based on several studies, the feasibility analysis concluded that:

1. Forest plantations are a highly valuable resource for the country, and are subjected to multiple risks, with fires among the most important. Over 50% of forest plantations are not covered by fire insurances, with potentially negative implications, especially for SMOs and SMEs, in which the proportion of non-insured plantations is higher, increasing the existing gaps between the sectorial stakeholders.
2. The legal analysis did not identify administrative or legal restrictions that could affect the development of the proposed certification system in Chile.
3. The industry of insurance market in Chile is transparent and framed within a stable institution system, ruled by clear laws and procedures. This is particularly positive for the project because the increasing demand will find a prepared insurance market ready to deal with the certified risks. This means allowing forest small owners and SMEs to gain access to the market, which is also an attractive business opportunity.
4. The insurance companies lack a standardized methodology for evaluating the occurrence of forest fires risk, which is a market disadvantage.
5. The potential insurance business is significant even in a conservative scenario, with an estimated increase of 20% for the market, which is relevant in the general insurance market that grows by 6-7% annually.
6. There is agreement both in national and international standards about the parameters that can be used as indicators of forest fire prevention and that therefore can be used for generating the risk evaluation standard.
7. From the risk point of view, there are non-controllable factors, such as climate and vegetation, but also controllable factors that can be used as technical parameters in risk evaluation.
8. Several studies have identified important technical and commercial gaps that affect the project beneficiary sector; that information turns out to be relevant for the future implementation and adoption of the SAFOR brand certification.
9. The socioeconomic analysis performed through a Contingent Valuation analysis indicated, with a 90% confidence level, that although 88% of SMEs are aware about the fire risk in their plantations, an important proportion does not buy insurance policies. However, 74% of them declare to be interested in contracting insurances, and 59% is willing to pay for the certification on average US$ 5.1/ha/year when corrected by salary level. Variables that resulted in significant differences were: (1) legal status (married); (2) region (higher in regions with greater forest plantation areas, especially Maule and Bio Bio); (3) interest for buying fire insurance policies.
10. Forest SMEs will need to build partnership relations to buy fire insurances in order to protect their heritage, to articulate networks of state support and to develop agreements of detection, firefighting and suppression systems.

The performed feasibility analysis validated the initial assumptions and at the same time recommended the national standard development, currently under construction. Once officially registered, the certification system will be created, validated and implemented to transfer the standard into the insurance market.

The analysis also indicated the existence of elements that provide the opportunity of studying the establishment of a government subsidy, both for fire insurance and for the SAFOR certification system.

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