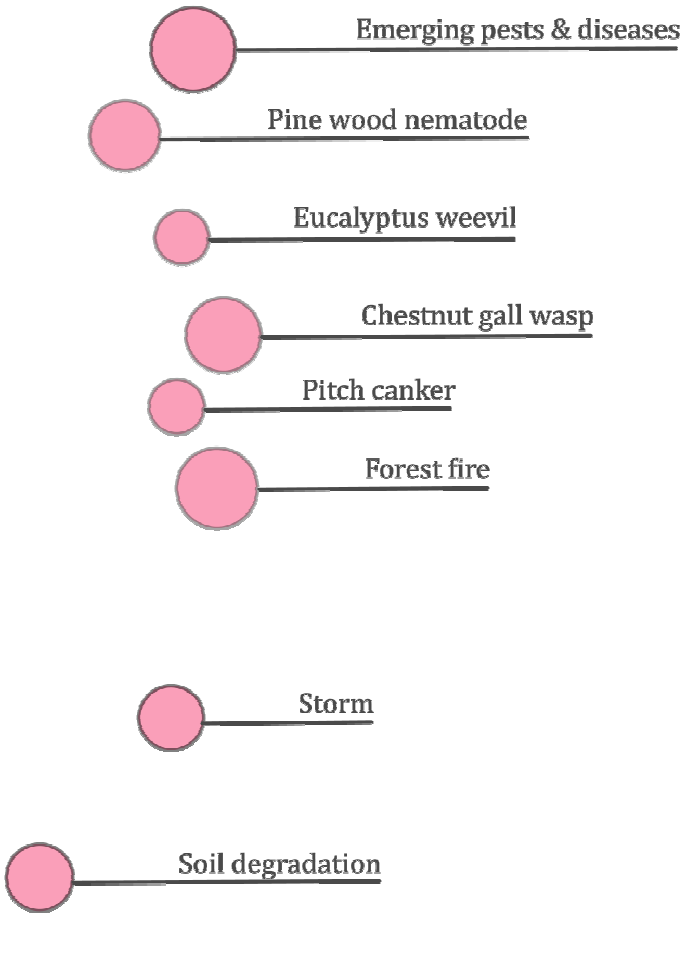
Deliverables 3.1.1. and 3.2.1.

EVALUATION OF THE STORM RISK MANAGEMENT PLAN

Workshop and economic assessment



February 2019

EVALUATION OF THE STORM RISK MANAGEMENT PLAN.

To evaluate the Storm risk plan we followed a methodology, called “Expert cross-viewing”, where during a workshop, the participants (experts and stakeholders) become aware of the contents of storm risk plan, discuss their strengths and their weaknesses (deliverable 3.1.1). Also, an economic assessment was done, based on the excel sheet provided an economic assessment. This assessment followed two different scenarios: i) no forest management intervention for storm prevention in a rural area (business as usual); ii) forest management intervention for storm prevention in a rural area using storm simulators (deliverable 3.2.1.).

Workshop

A meeting of the Forestry Advisory Group (FAG) of Baskegur was held on the 10th of December 2018 in Toki Alai, home of the Urkiola Natural Park. Baskegur is a professional association, voluntary meeting organ and consultative center of the Basque wood forest sector and its associated industries of wood. This Forestry Advisory Group is a group, made up of the same public and private members as Baskegur, who meets periodically in order to review the Basque forest facts and to advise the board of directors of Baskegur.

In this meeting, Alejandro Cantero from HAZI presented the storm risk plan for the Basque Country and made a series of comments for interested parties to make their contributions.

Figure 1 – Toki Alai, home of the Urkiola Natural Park in Abadiño (Bizkaia).

The attendants of the meeting were the following:

- Juan Carlos Uriagereka, Chief of the Forest Service of Diputacion Foral de Bizkaia
- Ismael Mondragón, Chief of the Forest Service of Diputacion Foral de Gipuzkoa
- Andoni Urteaga, from the Forest Service of Diputacion Foral de Alava
- Mario Michel, from the Basque Gouvernement
- Fernando Otazua, from the Forest Owners Association of Gipuzkoa
- Eduardo Rodriguez and Fernando Azurmendi, from the Forest Owners Association of Bizkaia
- Amelia Uria, from the Forest Owners Association of Alava
- Pedro Albizu, from Smurfitkappa
- Josu Azpitarte and Oskar Azkarate, from Baskegur
- Leire Salaberria, from USSE
- Ander Gonzalez Arias and Eugenia Iturritxa, from Neiker.
- Alejandro Cantero, from HAZI, as meeting leader

All the presentations were related to the scope of the PLURIFOR project, in its wind risk section. Alejandro Cantero (HAZI) presented the results of the review and recommendations for the improvement of storm risk plans carried out for the Basque Country and the web page to support the development of available plans.

At the end of the workshop a survey was given to the assistants for the economic evaluation of the storm risk prevention plan and of the meeting in general. There is a possibility of repeating the meeting in January 2019.

Below are the questions and the main results obtained.

Figure 2 – Pictures from the workshop

Questionnaire results

After a short report explaining how the evaluation was processed, the main updates needed on the plan evaluated (where/when/how/ methodology used/results/list of attendance/pictures) are:

1. **Which is your institution?**

   20% of the people (3 of 15) came from the Basque Forest Services.

   27% of the people (4 of 15) came from the Basque Government or public enterprises (HAZI or Neiker).

   No staff attended from Municipalities or Universities.

2. **What are the advantages of the application of the criteria for the development of storm risk prevention plans?**

   For all the respondents, one of the advantages of applying the presented plan would be the improvement in the location of the areas to be managed to minimize possible damages (mainly, by management plans or by public funds as RDP). Other advantages of the application of the presented criteria would be: an increase in the knowledge of the risk, reduction of costs and uncertainty, reduction of the intensity of the storm facilitating the prevention, invigoration of the rural environment, reduction of damages to the population and to the natural environment and optimization of media in crisis situations.

3. **What elements do you think should be incorporated into a storm risk prevention plans?**

As for the elements that should be incorporated, several ideas were mentioned, all at the same level of importance. The elements cited are: inclusion of the climate change effect; land property; identification of vulnerable zones; consider climatic and demographic factors; in minimization activities, increase the coordination and communication of the agents involved; that the emergency technicians gather and share the information with research teams to validate the already existing models of storm behaviour; promote the participation of the storm affected sectors; integrate the silvopastoral activities, the public use and road access; consider the effects of wind regime and weather warnings.

4. **What elements do you consider priority to protect in a storm risk management plan?**

According to the responses to the survey, the priority elements to be protected by a storm risk management plan are the people and population centres, followed by areas of high forest and landscape value. Other elements that also have been considered are the communication routes, the mosaic landscape and the fauna.

5. **What would be the main economic losses in the event that a storm risk management plan was not applied?**

The main economic losses in case of not applying a storm risk plan would be for the respondents those related to the affectation of property and infrastructures, loss of the forest mass, loss of ecological values and loss of human lives. Other losses considered in the surveys are related with grazing or agriculture damages and restrictions on grazing and hunting after storms.

6. **What has been your overall impression of the workshop? Do you think it has been useful?**

For the majority of respondents the impression of the workshop has been good or very good, and even demanded a longer duration of the same.

In fact, at the next Baskegur-FAG meeting (Zamudio, 16th January 2019), comments on aspects of the plan continued.

"Forecast Comparison" for the Economic Assessment (Deliverable 3.2.1)

For the economic evaluation of the application of the storm risk plan, we followed the methodology shown in the Excel sheet that has been developed within the framework of the PLURIFOR project. To this end, a case study has been developed in which the potential storm behaviour in an area is evaluated for the development of a spatial plan for forest planification with the objective of reducing the negative impact of storms that occur in the area. Subsequently, the effect of a storm on a section of this area was evaluated, evaluating its behaviour in case of preventive treatments or not in this section.

To evaluate the plan, a characterized area that covers a total of 20.596 hectares was selected, the Markina-Ondarroa "comarca" or region. The population registered in 2016 was of 26.014 people.

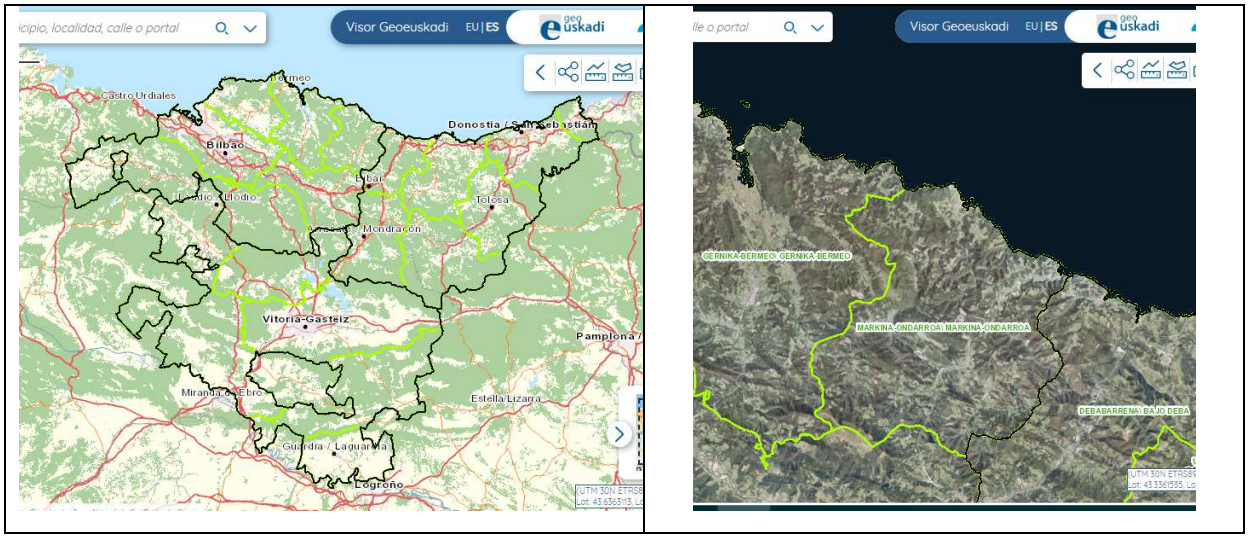


Figure 3 – Markina-Ondarroa in the north of the Basque Country.

The private property covers the 95% of this total surface. Its total forest area covers 75% of the territory, dominated mainly by radiate pine (71.30%), broadleaved mixed forests (7.96%) and eucalyptus (7.69%). The surface of radiata pine is in retreat in front of the eucalypts (E. globulus and E. nitens) due to economic and phytosanitary reasons.

In addition to this, this region has been chosen for two main reasons: its extensive pine forests have the highest average age of the entire Basque Country (30.3 years), which will mean important final cuts in the coming years, and the relative high risk of wind damage in their pine forests.

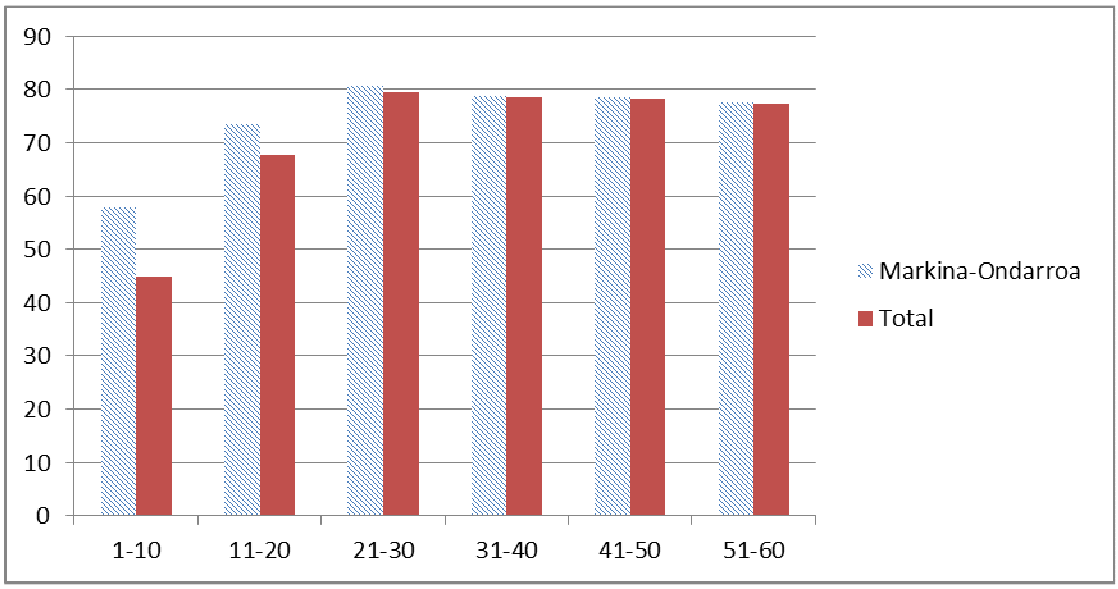


Figure 4 – Slenderness ratio (mean height / diameter) in pine forests according to age classes (years). High values are appreciated in the intermediate classes and their slow decline with age.

The SUDOE *FORRISK project: natural risks in the Atlantic forest* (2012-2014) allowed to HAZI the development of wind risk maps, based on LiDAR data. https://www.hazi.eus/es/proyectoshazi.html/4123-proyectos3.html

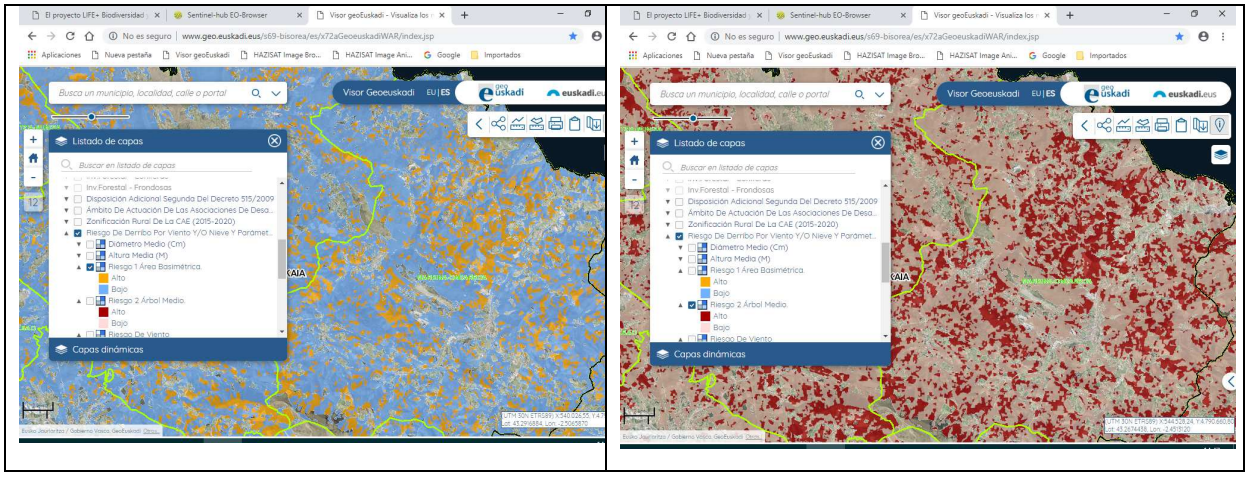


Figure 5 – FORRISK wind risk maps for the , based on LiDAR data. On the left, it appears the forests at risk by high density (basal area) and on the right, by the average size of the pines.

Regarding the meteorological risk, within the mentioned project SUDOE FORRISK, Barry Gardiner elaborated two risk maps for the Basque Country from the Euskalmet meteorological stations: the Weibull distribution A-factor (up, left) and k-factor (up, right),

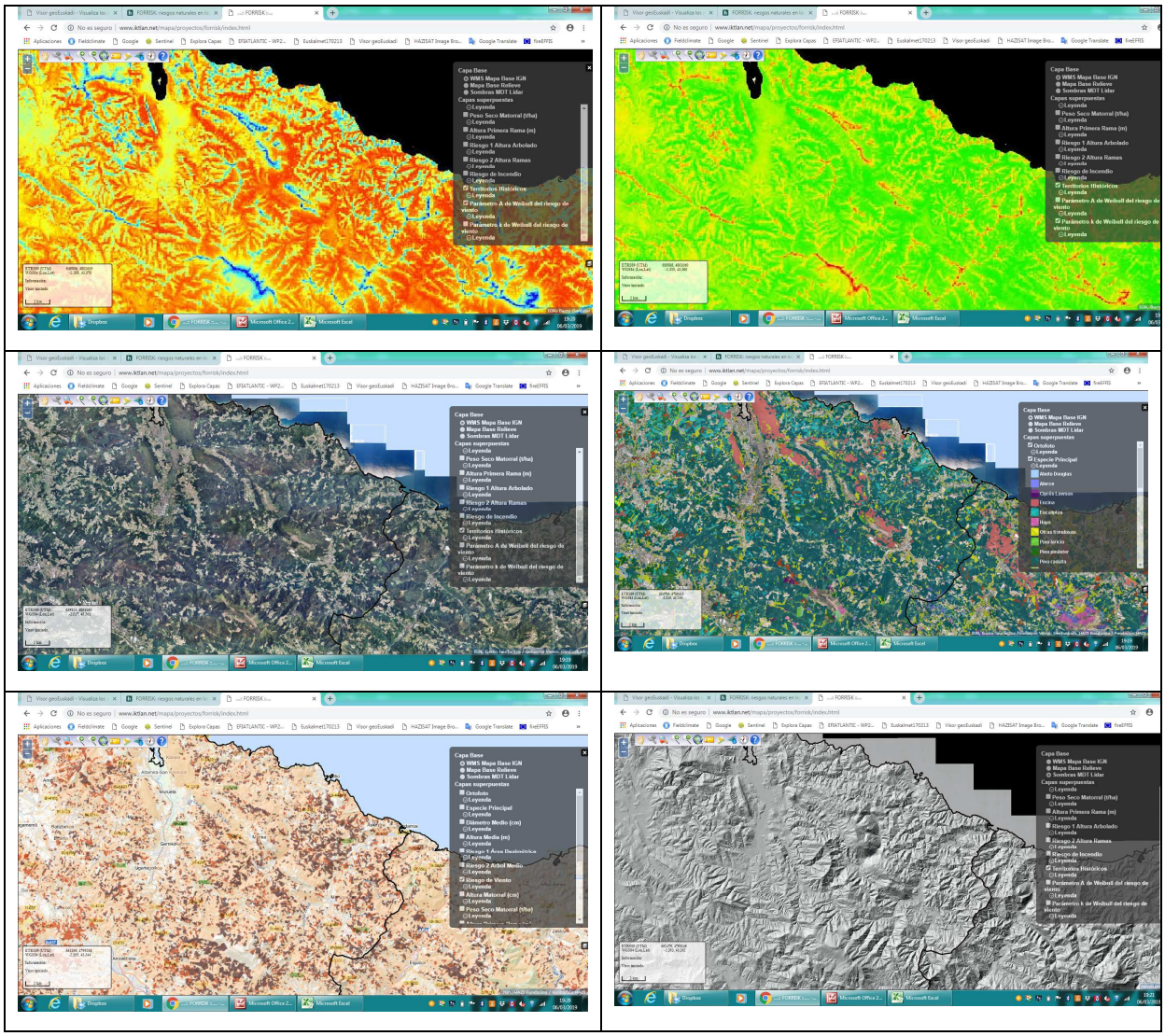


Figure 6 – FORRISK wind risk maps: Weibull distribution A-factor (up, left) and k-factor (up, right), together with the integrated map of risk of demolition by wind of the forest (down, left) and the DTM (down, right). It can see the irregularity of the mountains of this region and the high risk of falli in their pine forests. The central images (orthophoto and forest map) show the huge extension of the pine forests.

To determine the strategic areas to intervene in wind risk management, Basaize software was used, a new PLURIFOR product developed by Barry Gardiner for the Basque Country.

As a reference, this software has been used to compare the critical wind speeds in two representative forest situations in four types of forest stands in the geographical center of Markina-Ondarroa: radiate pine, eucalyptus, oak and beech. In both situations, the greatest risk of wind generated in radiate pine stands.

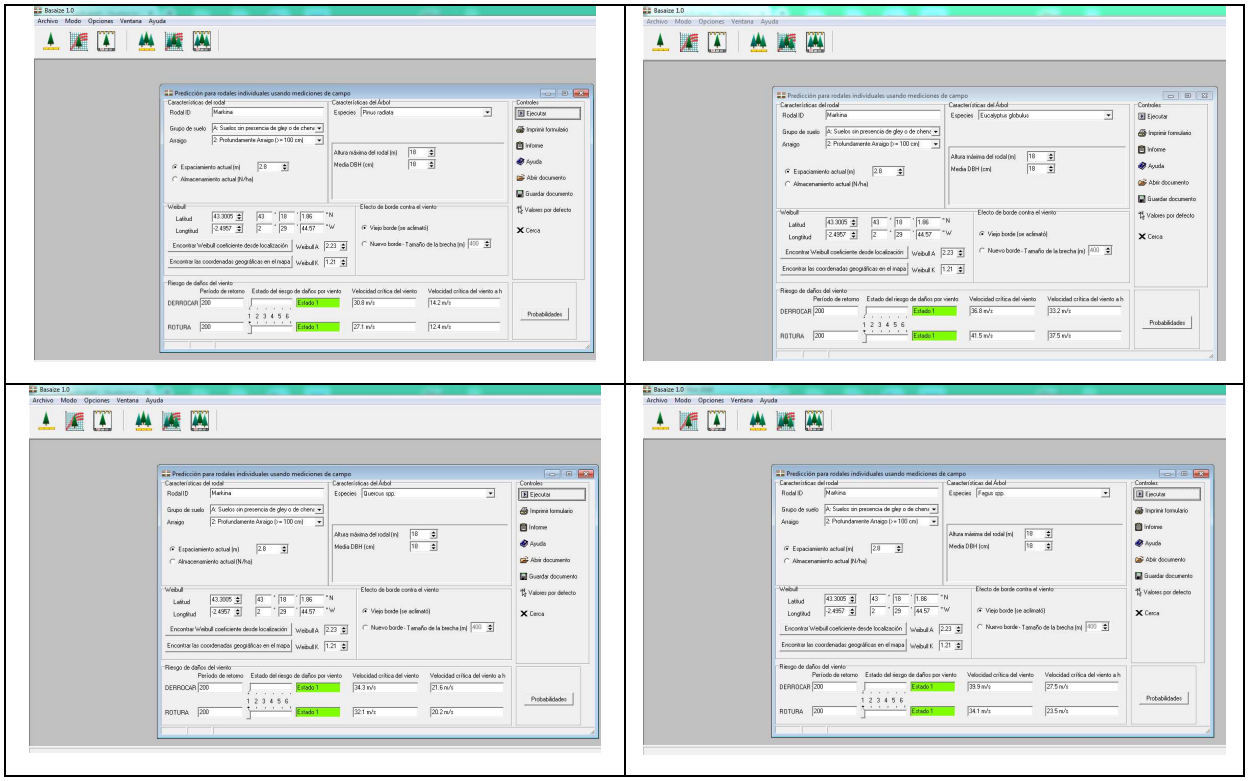


Figure 7 – Situation 1: High density (1.275 stems/ha), smaller average size of the trees (average diameter 18 cm) and continuous forest, without discontinuities

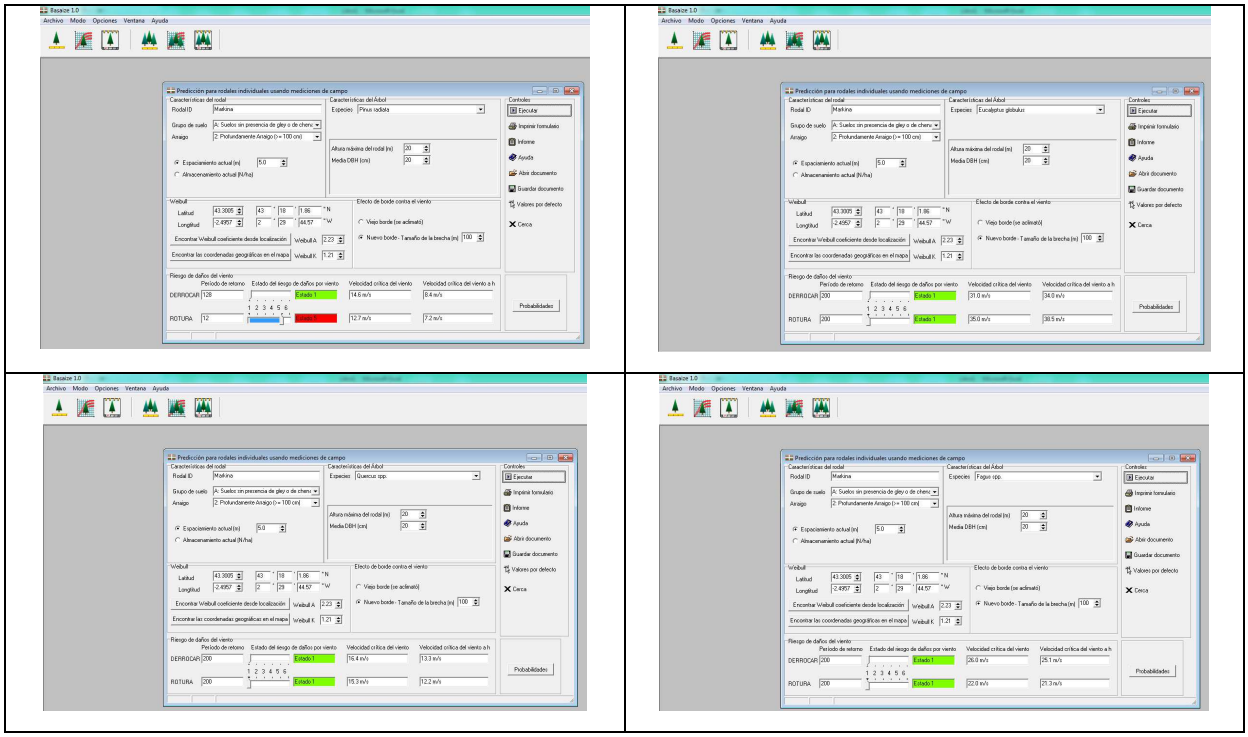


Figure 8 – Situation 2: Lower density after thinning (400 stems/ha), higher average size of the trees (average diameter 20 cm) and discontinuous forest

Critical wind speed (m/s)	Situation 1	Situation 2
Radiata pine	30,8	14,6
Eucalyptus	36,8	31,0
Oak	34,3	16,4
Beech	38,3	26,0

The area used for proposed scenario (case study), so, the area to be treated by wind risk management, will be 3000 hectares of radiate pine stands that will be cut in next 3 years and that they are located in high-risk areas due to wind. The hypotheses in this simulation are going to be:

- After the final cut of the pine forest, 1000 hectares will be reforested with eucalyptus, 1000 hectares with oak and 1000 hectares with beech
- Although this area of pine forest would be lost, its total wood productivity is maintained due to its replacement by species of growth: 3000 ha * 12 m3/ha-year (pine) = 1000 ha * 24 m3/ha-year (eucalyptus) + 1000 ha * 5 m3/ha-year (oak) + 1000 ha * 7 m3/ha-year (beech)
- The current high wind risk decreases strongly with these species changes, since the pine forest is replaced by other forests of lower risk

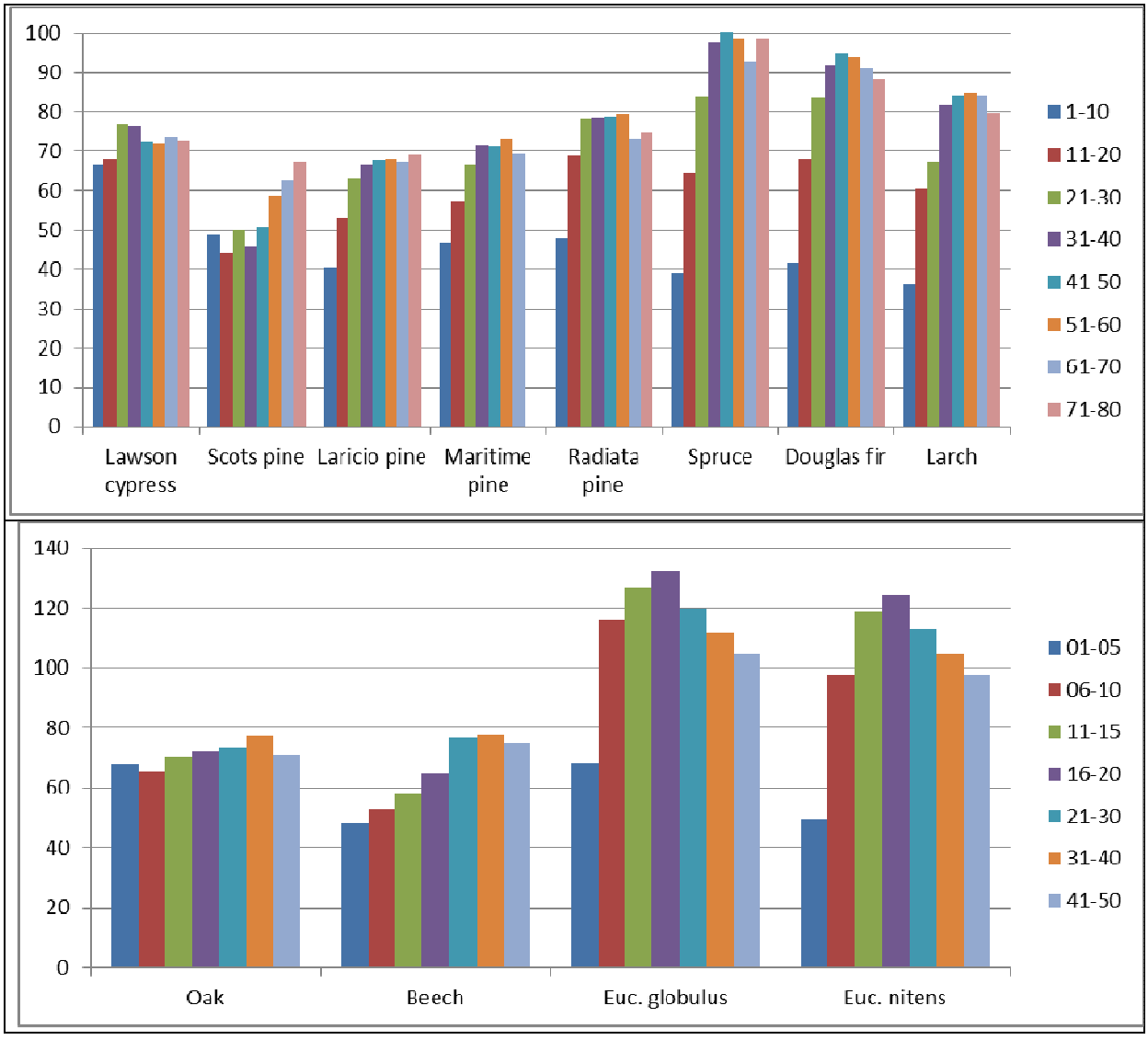


Figure 9 – Slenderness ratio mean values (dominant or top height / diameter) in several forest types in the Basque Country, according to age classes (years). High values are appreciated in the intermediate age classes and their decline with age.

Next tables will show the assumptions, the prevention management activities and the economic assessment in the case study.

PLURIFOR PLANS ECONOMIC ASSESSMENT

Workshop	Dates	10/12/2018
	Venue	
Scenario used to assess the plan	1. Game role	
	2. Forecast comparaison	
	3. Expert cross-viewing meeting	x
Assumptions made for the assessement		
Scenario total area	20596	ha
Forest area affected	3000	ha
Number of months from the first expenses to the last one	36	month
Contributors	Forest Owner Associations Diputación Foral de Bizkaia 500 Private forest owners	
Comments	36 months to cut the radiata pine surface and to assess, to write and to approve the new forest management plans	

Figure 10 – General assumptions for the planned scenario.

Personnel costs

Organisation	Status	Type	Category	Month cost	Code
Forest Owner Associations	private	non permanent	Ingenieur	3000	Forest-Inge
Diputación Foral de Bizkai	public	Permanent	Ranger	2500	Dipu-Rang
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
					-
TOTAL				5500	

Figure 11 – Personnel costs.

Expenses associated to the plan execution

STEPS	Categories	Actions	Cost description	Direct cost description	Direct cost E/ur	Units	Total cost	HR involved	HR person	HR costs
Early warning/Alert	Travel	Assess/advice to the owner	Diputacion Ranger	Travel/visit to the forest	50	500	25 000.00 €	Dipu-Rang	36	90000
	Travel	Assess/advice to the owner	Simple management plan	Simple management plans	150	500	75 000.00 €	Forest-Inge	36	108000
Crisis management	-	-	-	-						
Reconstitution	Reforestation	Support for reforestation Eucalyptus	No subsidies	No grant for owner (€/ha)	3 200	1000	3 200 000.00 €			
	Reforestation	Support for reforestation Oak	Includes subsidies 95%	With grant for owner (€/ha)	210	1000	210 000.00 €			
	Reforestation	Support for reforestation Beech	Includes subsidies 95%	With grant for owner (€/ha)	210	1000	210 000.00 €			
TOTAL							3 720 000.00 €			###########

Figure 5 – Expenses associated to the plan execution

Losses avoided by the plan

STEP	Description damages avoided	Direct cost €/ur	Units	Total cost saved	Comment/sources/additional nformation about this estimate
Stage 1	additional casualties (€/person)	1000000	1	1 000 000.00 €	Forecast of 1 mortal victim each 1 Mm3 of fallen wood
Stage 2	Support for reforestation Radiata pine (€/ha)	740	3000	2 220 000.00 €	Includes subsidies 80%
Stage 3	risk of pine forest collapse and depreciation of wood (€/ha)	1800	1500	2 700 000.00 €	Basque Government: aid for loss in forests <25 years
Stage 4	risk of pine forest collapse and depreciation of wood (€/ha)	1100	1500	1 650 000.00 €	Diputación Foral de Bizkaia: aid for loss in forests 5-17 years
Stage 5	Recovery costs of damaged forest roads (€/km)	3000	150	450 000.00 €	Possibility of public subsidies
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
				- €	
TOTAL				8 020 000.00 €	

Hypothesis 1: direct damage in 50% of the pine forest (1.500 ha with high damages) and in 150.000 m of forest roads (100 m/ha of mean density)
Hypothesis 2: economical value of the damaged wood is equivalent to its extraction cost (no income for the owner)
Stage 3: Direct payment for the removal of damaged Stands after Klaus storm
Stage 4: Direct payment for logging and extraction of affected wood after Klaus storm

Figure 6 – Losses avoided by the plan

Final remarks

Although it can give the idea that the area protected by the wind risk management is small (about 10% of total radiate pine surface), it will decrease the damages and impacts in the vegetation, but also in infrastructures like roads or houses.

Also this scenario provided doesn't count with the efficiency of the storm fighting activities. Forest planification and management also promotes the decrease of storm intensity, which decreases the impacts not only on the vegetation, but also in the fauna, soil and health impacts on humans. Simultaneously, it creates storm fighting opportunities for emergency crews, to act in a more efficient and safe way in case of an extraordinary wind event.

This economic assessment doesn't pretend to study the economic impacts in depth (like analysing the impacts in soil, carbon footprint, wood supply for forest industry, etc.) but only to give a general quantitative view of the importance to promote storm prevention to avoid big economic losses.