



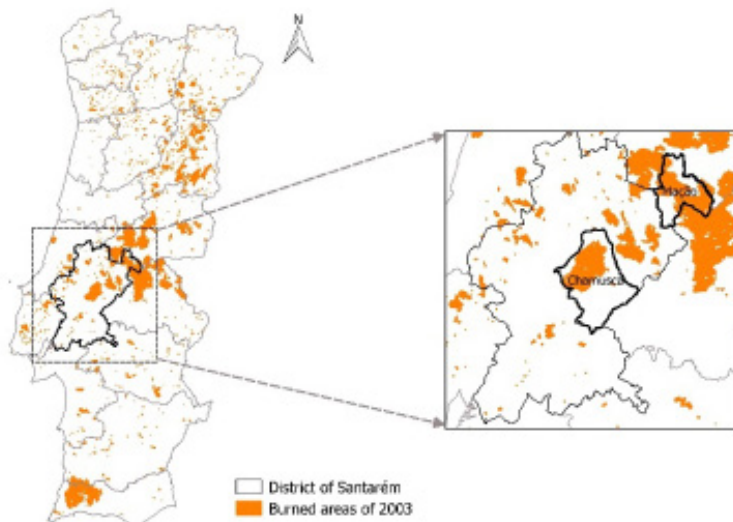
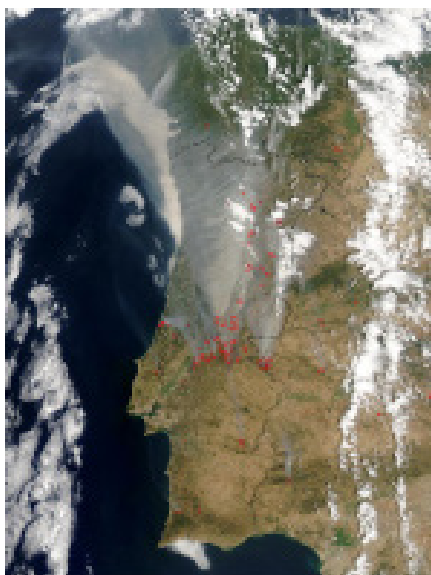
Introduction

Every year, forest fires have a major impact on urban areas and the environment in Portugal. In 2003, the district of Santarém, Central Portugal, was severely affected by wildfires, with almost 64 thousand hectares burned (INE, 2003). With respectively 26% and 48% of municipality area burned, Chamusca and Mação were most severely hit, facing multiple fatalities and several houses destroyed (ICNF, 2012a). Figure 8.1 shows the smoke plume from the 2003 wildfires in the satellite image (left) and the final shapes of fires showing the district of Santarém in Central Portugal (right). Considering the extent of area burned, and extensive damage sustained, the Santarém district offered a suitable case study for the ENHANCE project.

The goal of the Portuguese case study was **to analyse the Multi-Sector Partnership (MSP) and the economic instruments (e.g. insurance) which could promote the society's resilience to forest fires**. The case study area is one of the few areas in Portugal with two forest insurance products in place, one more directed to the pulp and paper industry and the other more directed to the diverse forest owners.

Figure 8.1.

Images of the 2003 wildfires. Left: 3rd of August 2003 satellite image, showing the smoke plumes from the active fires, which are shown in red. Right: the final extent of the burned area, for the whole of Portugal, the district of Santarém in Central Portugal, and the municipalities of Chamusca and Mação (Source: NASA Earth Observatory).



Several analyses were performed during the project to assess the viability of the MSP, the current risk levels, and the possible solutions to further manage risk:

- assessment of the MSP healthiness and preparedness using the ‘capital approach’ (see Ch. 1);
- forest fire risk assessment for the district, using probability loss curves;
- assessment of the meteorological component of the forest fire risk;
- assessment of the MSP perception of future scenarios;
- evaluation of the possible use of different economic instruments, including insurance and risk policy management.

Both quantitative and qualitative methodologies were applied.

The results were discussed with the members of the MSP studied, and their ideas and thoughts are included in this chapter.

Photo by Vladimir Melnikov/Shutterstock.



“Although partnerships are no ‘one-size fits all’ concept, learnings from Santarém can be transposed and adapted in other European Union regions.”

Multi-sector partnership

The multi-sector partnership consists of the Intermunicipal Commission for Forest Fire Defence (CIMDFCI – Chamusca) from the municipalities Chamusca, Alpiarça, and Almeirim, and the Municipal Commission for Forest Fire Defence in Mação (CMDFCI – Mação). The establishment of the Forest Fire Defence Commissions was mandated by law in 2004, (Decree-Law nº14/2004, of 8th May) with the objective *‘to articulate all means of action that intervene in the forest fire prevention in what concerns actions of fire prevention, education, surveillance, detection, supervision, first intervention, firefighting, mop-up actions and post-forest fire surveillance’*. The CMDFCI of Mação was formally created in 2004, whereas the CIMDFCI of Chamusca was created later in 2008.

The **Forest Fire Defence Commissions**, 220 in total, covering the entire country, were established as a response to the wildfire season in 2003, which was the worst ever recorded in Portugal. These commissions, or MSPs, were included as one of the strategic tools in the Portuguese National Plan for Forest Fire Defence (RCM nº65/2006). The MSPs develop their actions at a local level, in cooperation with the population, the forest owners, and the active forces from the municipality. They have the responsibility to coordinate the actions between the different stakeholders involved in forest protection, as well as to further develop **the Municipal Plan for Forest Fire Defence – PMDFCI** and **the Municipal Operational Plan – POM** (Decreto-Lei nº 17/2009 de 14 de Janeiro).

The MSP consists of both public and private institutions (**Table 8.1**), where each institution has very specific competences within the National System for Forest Fire

Defence. Although the public sector has a major role in the functioning and coordination of the MSP, the inclusion of the private sector is of major importance, since close to 90% of the Portuguese forests are privately owned. This means that the MSP would, for instance, strongly benefit from the inclusion of the forest owners’ associations or the pulp industries with their firefighting teams (AFOCELCA).

As a member of the MSP, the **Technical Forestry Office (GTF)** has the yearly responsibility to coordinate and elaborate both the four-year plan (PMDFCI) and the yearly Operational Municipal or Intermunicipal Plan (POM). The POM comprises of all the information concerning the forest fire defence system of each municipality. This includes the available means and resources, such as the institutions and/or key persons in the system, and their contacts and responsibilities in the fire season. The POM is the operational tool that provides guidelines and duties to every partner, in particular those guidelines and duties related to surveillance, detection, inspection, first intervention, fire-fighting, mop-up and surveillance post-fire (GTF, 2013). The document also contains the risk assessment from the PMDFCI, which includes the maps that support the commander decision (ICNF, 2012b).

While most of the work developed by the MSP reflects the strategic planning for both the structural (PMDFCI) and operational actions (POM), their coordination is the responsibility of the Mayor, and the municipality is responsible for management and implementation (Lei nº20/2009, 12 de Maio).

Table 8.1.

ENHANCE Insurance case studies (Source: Surminski et al., 2015a).

Entities	Role	Sector
Municipalities		Public
Mayor	The mayor is the President of the CMDFCI. He/she is responsible for putting together all the decisions taken at assembly and implement them.	
Technical Forestry Office (GTF)	Elaborate and develop the actions written in the Municipal Plan for forest fire defence.	
Municipal civil protection	Responsible to conduct actions that lead to prompt first intervention to extinguish a forest fire. He/she should support the operations in case of forest fire.	
Parishes		Public
President	Responsible to provide information about the territory to support the Municipal Operational Commander. He/she should also provide means to help firefighting, like tractors, track machines, or other equipment if needed. Also, it is his/her responsibility to communicate fire risk to the population, to signal forest infra-structures and make the local population aware of forest fires and forest prevention.	
Nature Conservation and Forest Institute (ICNF)	Responsible to coordinate public awareness actions; to provide specialised technical support to the Municipal Operational Commander (elaborate cartography, field maps, first intervention map and fire maps); to provide information to support the GNR in what concerns prevention, surveillance and detection decisions; to elaborate forest fire reports, burned areas by district comparing the information with previous years.	Public
National Republican Guard (GNR)	Responsible for the actions of prevention, surveillance, detection and control of access and circulation of people in critical areas. He/she is responsible to investigate the causes of forest fires and to identify possible authors.	Public
Public Security Police (PSP)	Responsible for the actions of control of the use of fire in the critical period and access and circulation of people in critical areas.	Public
Forest landowners organisations	They have an active intervention in the Forest Defence to Wildfires especially in the components of stands structure, preventive forestry, surveillance, first intervention and firefighting support.	Private
AFOCELCA	Give support in the firefighting operations in their pulp and paper company lands.	Private

Forest fire risk assessment expressed in monetary losses

Using the unit values for losses included in the National Forest Strategy of 2006 (DGRF, 2006) for the two categories of vegetation types (Shrublands: 0,6 K€/ha; Forest stands: 4,1K€/ha), a **probability-loss curve** was established (Figure 8.2; see also Chapter 2). The probability-loss curve shows values of estimated losses above €100 million for the Santarém district, for the three most extreme years (1991, 2003 and 2005). Probability-loss

curves were also developed for the whole of Portugal, to allow for a comparison (Figure 8.3). The probability-loss curves show that in extreme years (2003 and 2005) losses can attain very high values, above €1000 million. For both the the district of Santarém, and for mainland Portugal, the best probability distributions were Lognormal and Weibull, which were evaluated using data spanning a 35-year period (1980-2014).

Figure 8.2. probability-loss curve for wildfires in the district of Santarém.

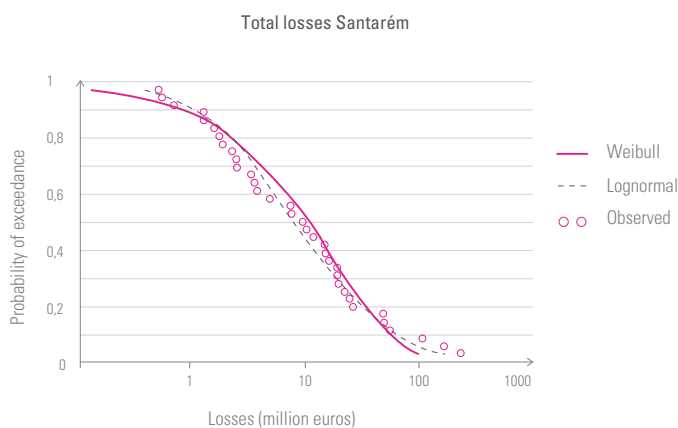
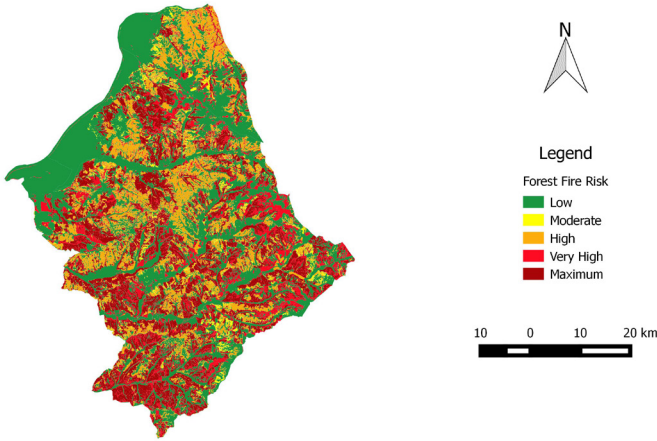


Figure 8.3. Probability-loss curve for wildfires in Portugal.



The wildfire risk is analysed in-depth for both their spatial and temporal component. The **spatial analysis** is developed by the GTF of each municipality, often in a partnership with the Forest Owners' Organisation. The analysis is included in the PMDFCI, combining the susceptibility assessment with the probability of an area to burn (also referred to as 'return period'). The model of wildfire hazard integrates the following variables: land cover (CORINE Land Cover data, the exposed assets), slope (Digital Elevation Module 80m) and past burned areas (historical data of burned areas). The resulting hazard map is then overlaid with the vulnerability and economic value of the elements at risk, to specify the impact for different types of forests ('assets') which have different exposure and economic values (ICNF, 2015). The final spatial risk maps are shown below in **Figure 8.4**.

Forest Fire Risk - CHAMUSCA



Forest Fire Risk - MAÇÃO

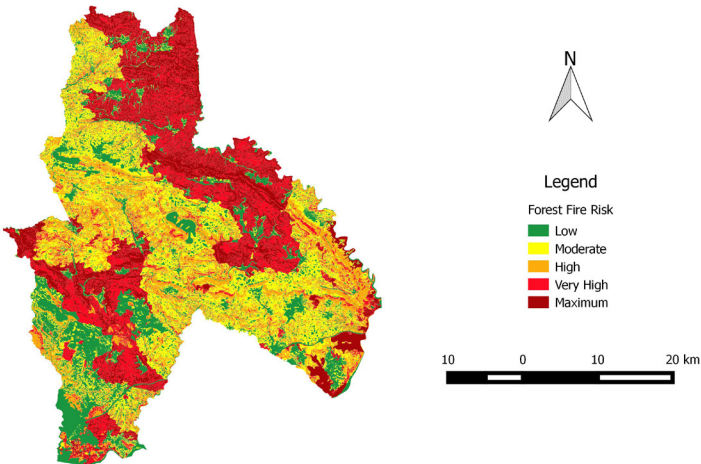
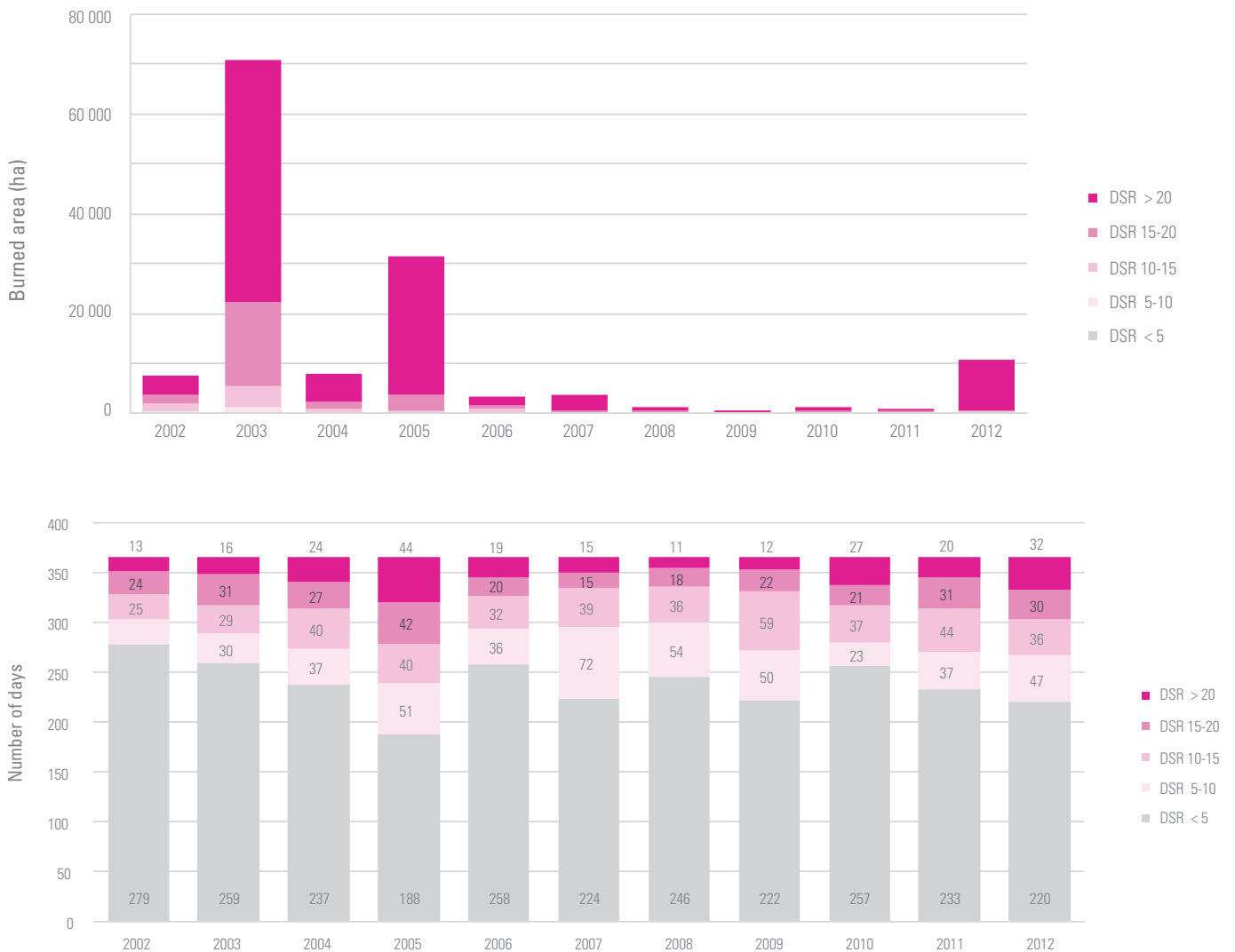


Figure 8.4. Risk Maps produced for the municipalities of Chamusca (top) and Mação (bottom) for the established partnerships in our case study (Source: GTF Mação and GTF Chamusca).

The spatial risk maps were complemented by a dynamic **temporal analysis** using meteorological information (temperature, precipitation, wind, etc.). This information is generally combined in a Fire Weather Index (Van Wagner, 1987). In Portugal, an adaptation of the Canadian Fire Weather Index (FWI) is used, which is a numeric rating of fire intensity (IPMA, 2015). Furthermore, a Daily Severity Rating (DSR) is used, derived from the Canadian Fire Weather System ($DSR = 0,0272 FWI^{1,77}$), to provide

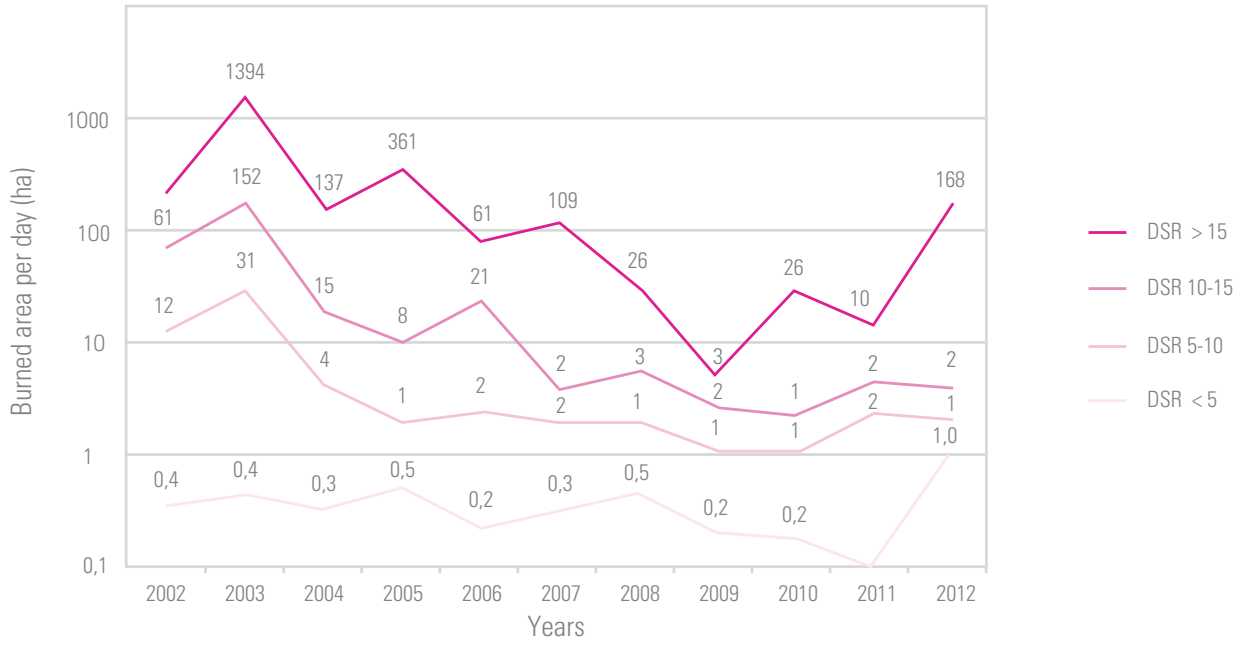
a numeric rating of the difficulty of controlling fires. Analysis of the DSR for the period 2002-2012 shows that large burned areas only occur as a result of wildfire in the few days that the weather is extreme $DSR > 20$ (Figure 8.5). In the period 2002-2012, the number of days per year in which the DSR is extreme (> 20) fluctuated from a minimum of 11 days in 2008 to a maximum of 44 days in 2005 (Figure 8.5).

Figure 8.5. Burned areas per DSR (Daily Severity Rating) class (left graph) and number of days per DSR class (right graph) from the district of Santarém, related to the period of 2002 to 2012.



Analysing the extent of burned area per day and per class of DSR, **Figure 8.6** shows that in extreme years, like in 2003, **it is possible that over one thousand hectares burn in Santarém on days with a very high DSR (> 15)**. Figure 8.6 (NB: the y-axis is in logarithmic scale) shows the **strong dependence of the areas burned on the different weather conditions (DSR)**. This is especially important as extreme weather conditions are expected to occur more frequently in the future according to the current weather scenarios.

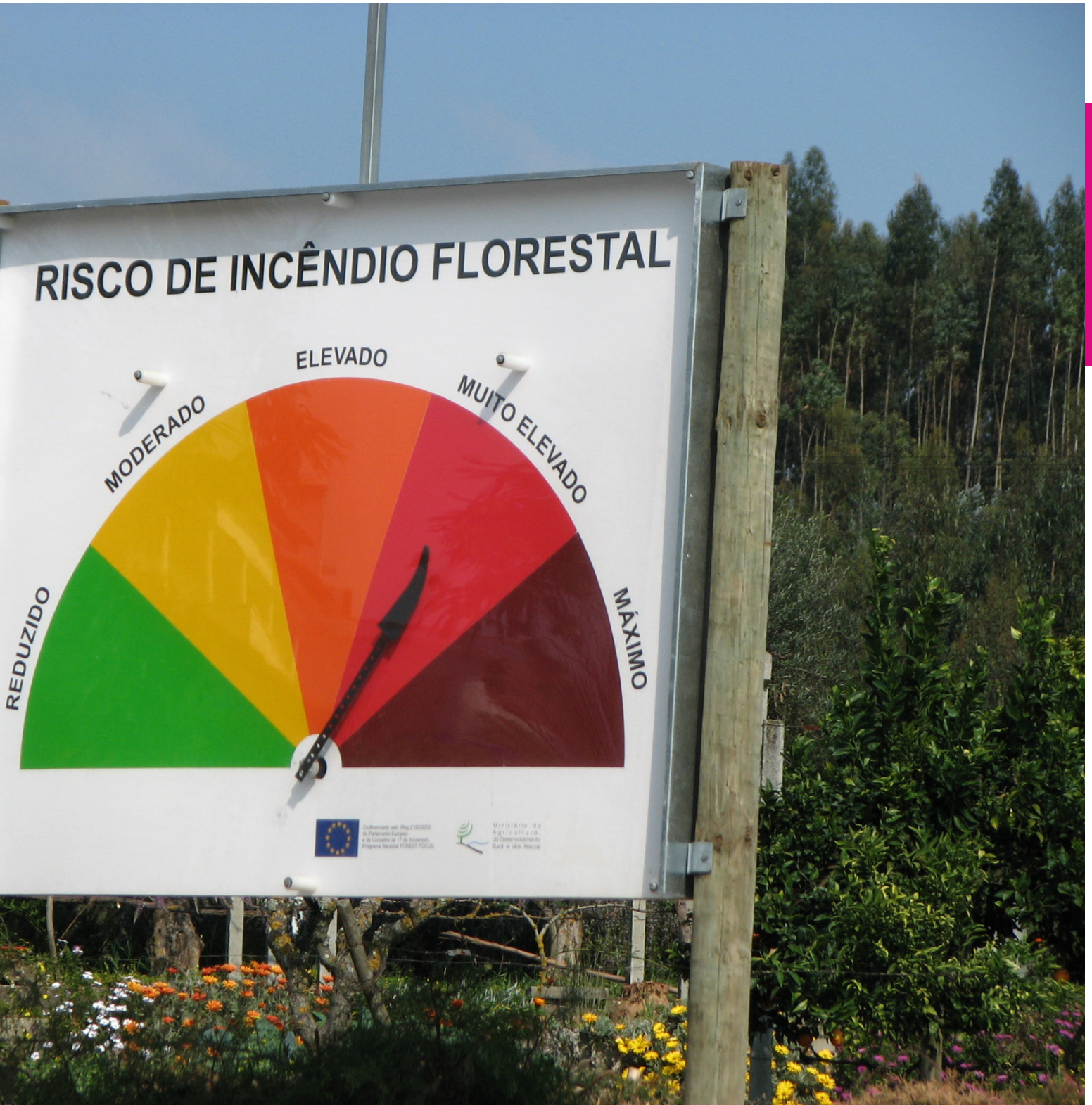
Figure 8.6.
Burned area per day and per DSR class on the period of 2002-2012 in the district of Santarém.



The DSR is considered a suitable indicator for both the length of the fire season, and the difficulty of controlling fires. Pereira et al., (2002) analysed the Daily Severity Rating (DSR) projected for 2080 for Portugal, under climate change conditions. The results show that there will be a significant increase in the number of days with high DSR, which will start much earlier in the year (late spring) and finish later (beginning of autumn).



On days with higher DSR, it is advised to carefully monitor the occurrence of ignitions. When the number of ignitions is very high, which possibly results in large areas burning simultaneously, the country's fire extinction capacity can be overpassed. This potentially results in a collapse of the forest fire defence system, similar to what happened in 2003. Hence, **since DSR numbers will probably increase in the future, fire-fighting capability in these extreme conditions should be clearly enhanced.**





RISCO DE INCÊNDIO FLORESTAL



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 **MINISTÉRIO DA AGRICULTURA**
e do Desenvolvimento Rural e das Pescas

Current and future MSP healthiness and preparedness

To analyse the capacity and potentialities of the MSP for managing forest fires, a **governance assessment** was performed following the five capitals approach (see Chapter 1). For the Portuguese case, the assessment focused on the local scale (municipal level, according to the MSP analysis). The applied methodology focused on semi-directive interviews with key persons, complemented by one focus group for each Commission. Complementing statistics were obtained from the National Institute of Statistics.

The results show that the two Commissions have reasonable capacity to develop Disaster Risk Reduction (DRR) measures to manage forest fire risk. However, both Commissions are limited in terms of financial and environmental capital. In discussion with members of both Commissions, it was concluded that for a regular fire season with a medium risk layer, the MSPs are able to respond to the different events in their territory.

However, the capacity of the MSPs may be limited considering future climate change impacts. This was further evaluated during a few stakeholder workshops and interviews, using climate scenarios taken from the 'Adaptation Strategy to Climate Change for Agriculture and Forestry Sectors'. (MAMAOT, 2013) (Table 8.2).

Furthermore, socio-economic scenarios were used for highlighting possible trends in demographic projections of the National Statistical Institute (INE, 2013) and trends in the valuation and demand of forest products. Socio-economic scenarios were categorised into quadrants, where A and B mean that there is a demand for forest

products and therefore they have a high value, D and C represented the opposite situation. Scenarios A and B assume the existence of adequate forest and fuel management, reduced land abandonment and the creation of a more resilient forest. In the quadrants A and D there is a population decrease and aging, and on the contrary in quadrants B and C the population slightly increases and the aging is less severe. Although the great majority of the participants consider scenario B as the most desirable, scenario A is the more likely scenario to occur.

Concerning the future of the MSP, the participants considered that the current MSP, or a different partnership with the same focus, will continue to exist, but with more political involvement. The participants considered, furthermore, that with less population, the MSPs will have a more important role in the forest and environmental management of the rural areas.

The MSP and the Forest Owners' Organisations will continue to be mediators between the forest owners and the local and central entities. The search for different solutions to increase the forest and society resilience will continue to be one of the main focuses of the MSP.

The participants furthermore indicated that the role of the collective organisations of forest owners for the management of Forest Intervention Zones (ZIF) is likely to be important, and should be enhanced in the future. This is of particular importance in areas where the forest properties are very small. It was also mentioned that, as a result of inheriting land, a new type of forest owner could emerge, such as charities.

Table 8.2.
Climate scenario for 2050 (Source: MAMAOT, 2013).

Scenario for 2050	Impact on Forests
<ul style="list-style-type: none">• 0,5°C temperature increase by decade• More rain in Fall and less in Spring• Increase of frequency and severity of droughts• Heat waves occur more frequent and longer• Longer season (more months) with high meteorological wildfire risk (from Spring to Fall)	<ul style="list-style-type: none">• Wildfire severity increase• Changes on the potential geographic distribution of forest species• Decrease of pine and eucalyptus productivity• Increase of the favourable conditions for pests and diseases on pine, eucalyptus and cork oak

Photo by M. Conceição Colaço.



Potential for new insurance and risk policies

Throughout the project, one of the main conclusions reached by the MSPs was that they operate well in their current form, but only up to a certain level. When dealing with very large wildfire situations that surpass the medium risk layer (Mechler et al, 2014), local MSPs can no longer offer sufficient support in risk management. In such a case, the extreme losses become greater than the capacity of the local MSP to offer financial support in post-fire recovery, limiting risk reduction. This emphasises the need to expand to a regional, national or even international level.

In addition to scaling up, it is important to promote resilience by **reducing the risk directly** (e.g. more efficient fire-fighting in extreme conditions), and by **providing ex-post compensation**. To facilitate increased resilience, a review of possible economic instruments was made for the Santarém MSP (Table 8.3). In the schemes shown in Table 8.3, the partnership would be part of the risk-sharing agreement, where costs and burden are shared between state/district authorities and private owners.

An economic instrument that is already used by the MSP, is the *Permanent Forest Fund* (Portaria nº 77/2015 de 16 de Março), which supports the Forestry Technical Offices and the forest sappers' teams. The PDR2020 (Portaria nº 134/2015, de 18 de Maio), has several policies, which could be interesting for the MSP. However, participants of the workshops mentioned that several applications of these funds were not considered by the evaluators, as they were not in line with the requisites of the National Plan for Forest Fire Defence. Regarding the *European Solidarity Fund* (EC, 2016), the perception is that there are

many resources available after a major disaster, but without the objective of preventing future disasters.

The effectiveness of the funding of the *EEA Grants* (2015) was also discussed for stimulating DRR action in some areas. However, it was indicated that this funding is not applied in the district. Furthermore, The *Portuguese Carbon Fund* (APA, 2015) was not considered to be currently relevant to the Portuguese forest sector.

Insurance schemes covering risks related to wildfire also exist, and were presented. However, they have a very low market penetration and were not considered to be a short-term solution by the workshop participants. Nationwide, only two insurance schemes are in use, but they both have a very small coverage.

Table 8.3.

Potential economic instruments for the Santarém Case Study.

Economic Instrument / Manager	Objective
Rural Development Program PDR2020 / IFAP	<ul style="list-style-type: none"> • Improving resilience and environmental value of forests • Forest prevention against abiotic agents • Forest recovery due to biotic and abiotic agents or by catastrophic events
EEA Grants / National Management Unit	<ul style="list-style-type: none"> • Climate Change and Renewable Energy • Reduced human and ecosystem vulnerability to climate change
PORTUGUESE CARBON FUND – FPC / Portuguese Environment Agency	<ul style="list-style-type: none"> • To contribute to the goals defined by the Portuguese Government in order to achieve the political commitments related to climate change
FOREST PERMANENT FUND – FFP / National Forest Authority	<ul style="list-style-type: none"> • To promote and ensure the continuing investment in the forest management and planning, promoting the ecological, social and cultural functions of forests • To support actions which prevent forest fires • To ensure additional support tools that contribute to the protection and sustainability of Portuguese forests
The European Union Solidarity Fund – EUSF	<ul style="list-style-type: none"> • Set up to respond to major natural disasters and express European solidarity to disaster-stricken regions within Europe
Forest Insurance / Insurance companies	<ul style="list-style-type: none"> • Risk sharing

Recommendations

The MSPs assessed for the Portugal wildfire case study have a good level of response to the different events. However, when dealing with extreme conditions and very large wildfire situations, **risk management is not adequate. In such cases, risk management should be coordinated at regional, national or even international levels.** This premise also applies to the different economic instruments.

Key to enhance resilience with respect to forest fire risk is **risk reduction**. Risk reduction can be stimulated through prevention measures and pre-disaster management incentives, or directly with more efficient fire-fighting in extreme conditions or with more post-disaster financing.

On a local level, the municipalities can apply for the available national or international financial programs. However, it seems that the MSP members are not always fully aware of these funding opportunities. On a local level, the degree of freedom of the municipality to apply for different economic instruments is very low. The Municipal and Intermunicipal Commissions have to follow the national guidelines and documents. Moreover, the final approval of their local plans has to be done at the national level by the National Forest Authority.

For increasing the resilience to wildfires in a local level, we consider it of importance to **involve the national and European institutions**. Together, the MSPs and the national and European institutions can evaluate the effect from different economic instruments to support disaster risk reduction (DRR) efforts by the MSP.

Among the various economical instruments presented, we identified **forest insurance schemes** as an instrument with great potential to establish the linkage between extreme meteorological conditions (as those measured by the Daily Severity Rating - DSR), and the losses caused by wildfires under these extreme conditions. This setup is similar to what is done in the agricultural sector.

As mentioned by some of the stakeholders, the support given by the Government to recover from the direct losses, plus a contribution from the Forest Permanent Fund and from the Portuguese Carbon Fund could contribute to diminish the insurance premiums. Furthermore, they could encourage adequate forest and fuel management and therefore maximise risk reduction.

Finally, together with several stakeholders, we advocate that **a new level of wildfire risk alert (critical level) should be created**. This wildfire risk alert needs to be disseminated to the members of the National Forest Fire Defence System. In response to this wildfire risk alert, the surveillance and dissuasion teams can strive to minimise the number of fires on those critical days. The operational planning for this critical alert level could be expressed in documents written and approved by the Municipal and Intermunicipal Commissions.

Acknowledgements

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Photo by Pedro Palheiro.

