# Wildfire risk planning and prevention

## Innovations in the Mediterranean and beyond


2024

EFI
Diputació Barcelona

**Suggested citation**

Mauri, E., Jankavić, M. 2024. Wildfire risk planning and prevention - Innovations in the Mediterranean and beyond. European Forest Institute. DOI: https://doi.org/10.36333/rs8en

ISBN: 978-952-7426-80-7

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The authors acknowledge the reviewers who provided valuable information to complete the description of the instruments presented in this document.

The production of this publication has received financial support from Diputació de Barcelona.





*Cover photo: Ramy Sakr*

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# INTRODUCTION

While wildfires are a natural part of ecosystem functioning, they are also a major global environmental and socio-economic threat, particularly in the context of climate change, and are devastating to local communities. When a major wildfire occurs, suppression efforts inevitably receive a great deal of attention and, as a result, wildfire management has historically focused on suppression.

However, prevention is increasingly seen as the most important approach to integrated wildfire management. Therefore, wildfire prevention instruments cannot be considered in isolation, but are part of the framework governing wildfire management.

The instruments presented in this document have the ultimate goal of preventing wildfires, but they are not all preventive measures. Instead, they can be usefully considered according to the landscape fire governance continuum set out in the ***Landscape Fire Governance Framework 2023***, launched at the 8th International Wildland Fire Conference, in Porto in May 2023. Some of them provide **fire risk assessment** by assessing fire exposure and vulnerability to further implement appropriate preventive measures. Others are part of integrated fire management **planning**, defining the actions and resources needed to implement programmes and projects that will help achieve fire management objectives. There are examples of **preparedness**, setting up processes linked to planning and implementation to ensure that citizens and organisations are prepared to respond in the event of a fire. And finally, there are indeed some **prevention** instruments, which implement measures to reduce exposure and vulnerability to fire.


*A summarised diagram view of the landscape fire governance continuum. Source: Landscape Fire Governance Framework (2023)*

Because instruments cannot be described in isolation within this framework, some instrument descriptions include elements of adjacent steps in the fire governance continuum.

This document is intended for land managers with wildfire risk management responsibilities. The actions presented here are instruments that have been implemented by local and regional authorities and agencies, research centres or NGOs, at municipal or supra-municipal levels, and have the potential to be replicated elsewhere.

Each instrument is described according to the same structure: the local **context**, the **challenge** addressed, how the instrument has been **implemented technically**, **administratively** and **financially**, and how the instrument meets the four **requisites for success**: how it is integrated with other instruments of the same organisation; how its continuity is ensured; what specialised resources have been needed for its implementation; and what collaboration with third party organisations has been necessary to achieve its full potential.

**Innovations from the Mediterranean and beyond**

- Lebanon
- Turkey
- Greece
- Italy
- France
- Spain
- Portugal
- United States

*The Mediterranean basin and the United States are home to the fire risk management instruments covered in this publication.* Source: EFIMED

# MOBILISING CITIZENS FOR FIRE RISK ASSESSMENT OF BUILDINGS

An NGO and a research institute coordinated volunteers to assess the vulnerability and exposure to wildfire of buildings on a Greek island, and made recommendations to owners on how to reduce risk.

## Background

Kythira, a Greek island with a population of 4,000, experienced a fire in August 2017 that burned 9% of its area and lasted 18 days before being declared extinguished. This fire event prompted local and national authorities to take action to improve prevention and suppression efforts and reduce the probability, severity and impact of future fires. Two methods were used: developing a forest fuel map and simulating the fire using the G-FMIS fire spread simulator, and developing a safe separation distance maps (SSD; distance between potential flames and firefighters). The project also aimed to mobilise people for fire prevention through awareness campaigns, fuel treatment and reforestation activities. What made this project unique, however, was the structural risk assessment of almost all the buildings in the three main settlements on the island.

*Landscape in Kythira island.* Source: @Gorilla Girl / Flickr

**Location**
Kythira island, Greece

**Actors**
Hellenic Society for the Protection of Nature (HSPN), Institute of Mediterranean and Forest Ecosystems (IMFE) of the Hellenic Agricultural Organization "Demeter"

**Pros**
Community involvement in the project.
The importance of prevention became clear.
Community involvement and the achievement of tangible results kept the momentum going for a long time.

**Cons**
Such projects are difficult to plan and implement over large spatial scales. They require the constant presence and impetus of a motivating agent, such as a local volunteer group, a dedicated and knowledgeable prevention officer (e.g. from the Forest Service, local authority or NGO).

## Challenge

Greece has over 200 inhabited islands with limited firefighting capacity. Often located at great distances from the mainland, it takes time for reinforcements to arrive and fires have a greater potential to grow, threatening people, property and the environment. Therefore, these islands need to assess and reduce the vulnerability and exposure of buildings to wildfire. **How is it possible to assess the wildfire vulnerability and exposure of all the buildings in a community of 4,000 people?**

## Solution

Trained volunteers assessed the risk of damage or destruction by wildfire for nearly all 610 buildings in three main settlements on the island. They then communicated the results to the property owners, providing information on how to reduce their vulnerability and exposure to wildfires.

## Technical implementation

The Hellenic Society for the Protection of Nature (HSPN) and the Institute of Mediterranean and Forest Ecosystems (IMFE) have collaborated to create a standard form for evaluating the vulnerability and exposure of buildings to wildfires. The form categorises factors that affect a building's risk, such as characteristics of the surrounding vegetation, topography, building characteristics affecting its vulnerability, ease of access, and nearby fire protection infrastructure. The volunteers training took place over two days with fire experts. It began with theory and continued in the field where participants filled out example forms on various structures under the guidance of the trainers. Once the training completed, volunteers were provided with a satellite image of a settlement and instructed to visit each structure, taking geo-located photographs and completing one form per building. A scoring system was used to evaluate the risk of damage or destruction in the event of a wildfire. To ensure cost-effectiveness and simplicity, geographical information was stored and handled in Google Earth platform. The process (from the training to the production of the individual reports) took nearly two months to complete. The results were double-checked by fire experts and verified by site visits. The risk assessment report was handed out to the building owners.

**610 buildings**
**individually assessed for risk of wildfire damage and destruction**

**Type of measure**
Risk assessment

**Type of economic incentive**
NA

**References**

**Kythira – Innovative action for the prevention of forest fires in Kythira.** 2021. Institute of Mediterranean Forest Ecosystems (in Greek).

**Innovative Action for Forest Fire Prevention in Kythira island, Greece, through Mobilization and Cooperation of the Population: Methodology and Challenges.** 2022. Sustainability.

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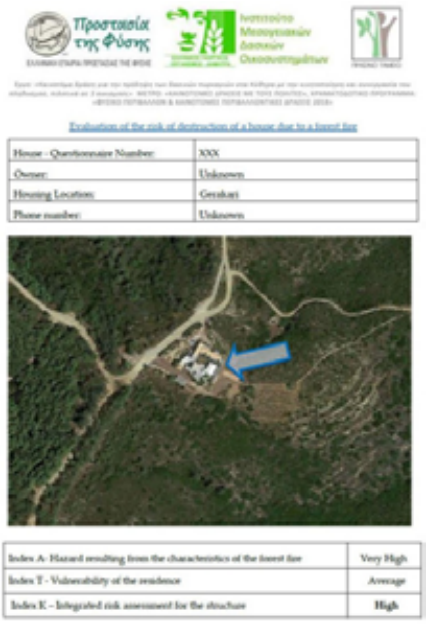
The assessment report identifies risks due to vegetation (exposure) and due to the vulnerability of building elements. Buildings are classified by risk level and marked with corresponding colours, with the highest risk group marked with black circles. To reduce the risk of fire, it is recommended to remove dead flammable material, mow grass, and close windows and doors. The report also included a warning for property owners who may choose to stay and defend their property. It recommends early evacuation for high-risk properties that are difficult to defend. The majority of owners agreed with the assessment report and took steps to protect their homes. The project resulted in a positive reduction in fire risk.



*Summary of a risk assessment report.*
Source: Gavriil Xanthopoulos et al. (2022)

The authorities and the Fire Service were provided with a confidential map showing structures colour-coded by risk. Additional mapping identified areas of exceptionally high risk due to high SSD, concentration of vulnerable properties, and poor road access. Special planning is required for these areas, and early evacuation is advised.

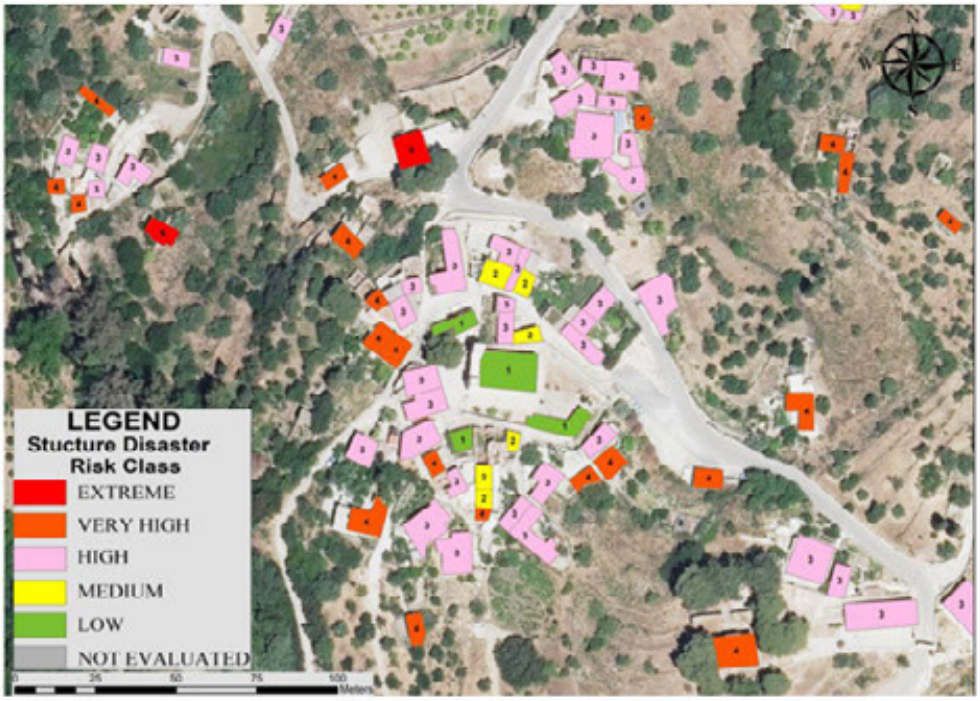
## Administrative implementation

The project began in April 2019 and concluded in October 2021. The HSPN signed a memorandum of cooperation with the Kythira and Antikythira Native Assets Committee and worked with IMFE to implement actions for forest fire prevention and post-fire reconstruction in Kythira. Dr. Gavriil Xanthopoulos (IMFE), a forest engineer specialised in fire issues, coordinated and scientifically supervised the project. Local volunteers participated in project meetings and received training from the IMFE and HSPN scientific team. Official agencies managed the project, tailored to residents' profiles and mentality. Success was achieved through key interactions with citizens, and the mobilization of volunteers on a remote island was partly due to a strong community sense and the memory of the 2017 fire.

The island has a history of emigrants to the United States and Australia who returned to volunteer, having been exposed and participated to volunteerism there. They inspire elementary and high school students through lectures and activities. HSPN members introduced key individuals who became the seed for volunteerism, providing social opportunities and knowledge transfer.

## Financial implementation

These activities were funded by the Green Fund of the Hellenic Ministry of Environment and Energy, under the *Innovative Actions* axis of the *Natural Environment and Innovative Environmental Actions 2018* funding programme. The project, entitled *Innovative action for forest fire prevention in Kythira island Greece through mobilization and cooperation of the population, with pilot in three settlements*, was part of the measure I*nnovative actions with citizens*.




*An example of the building risk map that was created for use by the authorities at Kythira island. Each structure is color-coded in one of five risk classes (low to extreme).* Source: Gavriil Xanthopoulos et al. (2022)

Voluntary organisations in Greece receive funding from state organizations, private companies, local authorities, donations, membership fees, and the sale of advertising items. The project cost €50,000, covering all aspects of the project, which extended beyond the assessment of the risk of structures. In this action, in-kind contributions from the community were important. Cafes and restaurants provided their space free of charge for community meetings.

## Requisites for success

### Integration

The Kythira island Fire Service Chief integrated the wildfire risk assessment of buildings into the Kythira island fire prevention and suppression plan. This was positively received throughout the project. Home risk maps were given to the authorities confidentially to avoid complaints and conflicts. Without official regulation and coverage, homeowners may doubt or even sue for damages if their house is assessed as being at high risk of damage or destruction.

### Continuity

The wildfire risk assessment for buildings should be repeated every 5-8 years. The Ministry of Climate Crisis and Civil Protection is considering including prevention planning at settlement level in its protocols. IMFE has proposed to the government to employ two foresters at each Forest Service office (with appropriate training) to deal exclusively with forest fires, from prevention to post-fire rehabilitation. They would also mobilise and coordinate volunteers to carry out similar prevention tasks. These foresters would be appropriately re-trained and their annual salaries would be equivalent to 5-7 hours of operation of aerial firefighting resources for each Forest Service office. This approach would ensure continuity.

Unfortunately, such local initiatives are not considered in decisions made at the national level. HSPN and IMFE disseminated project outcomes through various events and scientific publications to reach the Fire Service and Civil Protection headquarters.

### Specialisation

HSPN employed an in-house specialist in communication and education and a senior administrator with previous local contacts in Kythira to coordinate the volunteers. Additionally, they employed an external expert in forest fires. IMFE employed a forest fire expert as team leader. In-house researchers and scientific personnel provided support, including GIS analyses, fire modelling, and assistance with organising meetings and seminars on the island. External assistants were also present, including one specialised in photography and video production.

### Collaboration

The collaboration between HSPN (an NGO) with IMFE (a research institute) has been highly productive. The project merged the capabilities and expertise of an NGO that manages volunteers, engages with local contacts, and raises awareness among the general public, with the technical expertise of IMFE in areas such as forest fires and vegetation assessment. IMFE liaised with the Greek Forest Service, which has a limited presence on the island.

During the project, insurance companies were not involved. Generally, insurance companies have limited involvement with forest fire risk in Greece.

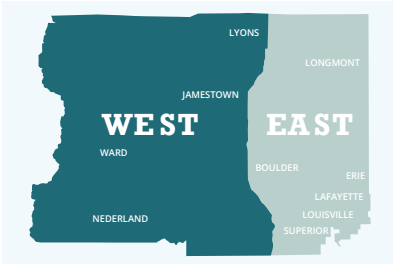
*The island of Kythira and the Attica region of Greece have suffered several catastrophic forest fires.* Source: @Grace Trivino / Flickr

# WILDFIRE RISK HOME ASSESSMENT IN WILDLAND-URBAN INTERFACE

Boulder County launched the Wildfire Partners programme to educate, motivate, and support homeowners in making their dwellings less exposed and vulnerable to wildfires.

## Background

The Colorado State Forest Service reports that half of the 5.5 million people in Colorado (USA) live in fire-prone areas, wildfires happening in every month of the year. Boulder County (Colorado) has a population of over 300,000 and covers 1,900 km². In 1989, the Black Tiger Fire in the foothills of Boulder County became the most destructive wildfire in terms of property loss and damage in Colorado history. By the large number of homes burned in the fire, the fire showed that Boulder County needed fire-resistant building codes and land use regulations.




*Boulder County fire zones division.* Source: Image courtesy of Wildfire Partners

For wildfire management purposes, Boulder County is divided into two fire zones: fire zone 1, covering western half of the county, is mountainous and manly forested, while fire zone 2, the eastern half, is flat and covered by farmland and grasslands. In 1993, wildfire mitigation requirements were introduced into the building and land use codes, applied to new constructions and most building additions in fire zone 1. These requirements mandated ignition resistant building materials and the creation of defensible space around the structures (an area designed and maintained to reduce the fire danger, mainly by managing the vegetation around these structures). When these two conditions are met, they ensure the safety and resilience of homes located in the wildland-urban interface (WUI).

**Location**
Boulder Country (Colorado), United States

**Actors**
Wildfire Partners programme, homeowners and communities in Boulder County (Colorado, USA), forestry works contractors

**Pros**
Individual home assessment free of charge for the owner.
Forestry works subsidised at 50%.
Advantageous access to home insurances.

**Cons**
Individual home assessment and re-certification are not compulsory.

*Houses in the wildland-urban interface in western Boulder County, after a forest fire.* Source: Image courtesy of Wildfire Partners

## Challenge

Living in the WUI in Colorado is characterised by responsibilities and challenges. However, to assume responsibilities and to implement solutions to the challenges one needs to be properly informed about wildfire risks in WUI. **How can homeowners in the WUI be advised to reduce the exposure and vulnerability of their properties to fire?**

## Solution

Wildfire Partners is a recognised programme in Boulder County that assists individual residents and communities in preparing for wildfires. In 2014, in western Boulder County (fire zone 1), they started providing free individual home assessments to eligible homeowners. This programme aimed to increase safety and preserve homes by promoting fire-resistant materials and expert-proposed measures to manage the surrounding vegetation, creating an effective defensible space.

## Technical implementation

The individual home assessment lasts 2 hours and is conducted by a wildfire mitigation specialist in presence of the homeowner to identify vegetation and areas around the house to reduce fire vulnerability and exposure. Together, they examine the exterior elements of the house vulnerable to wildfire as well as the trees and other vegetation in the defensible space zones.

**Type of measure**
Risk assessment

Risk management: preparation and prevention

**Type of economic incentive**
Compliance subsidy

**References**

**Individual Home Assessments.** 2023. Wildfire Partners.

**Wildfire Partners Plains Pilot Project – Project Summary Report.** 2022. Wildfire Partners.

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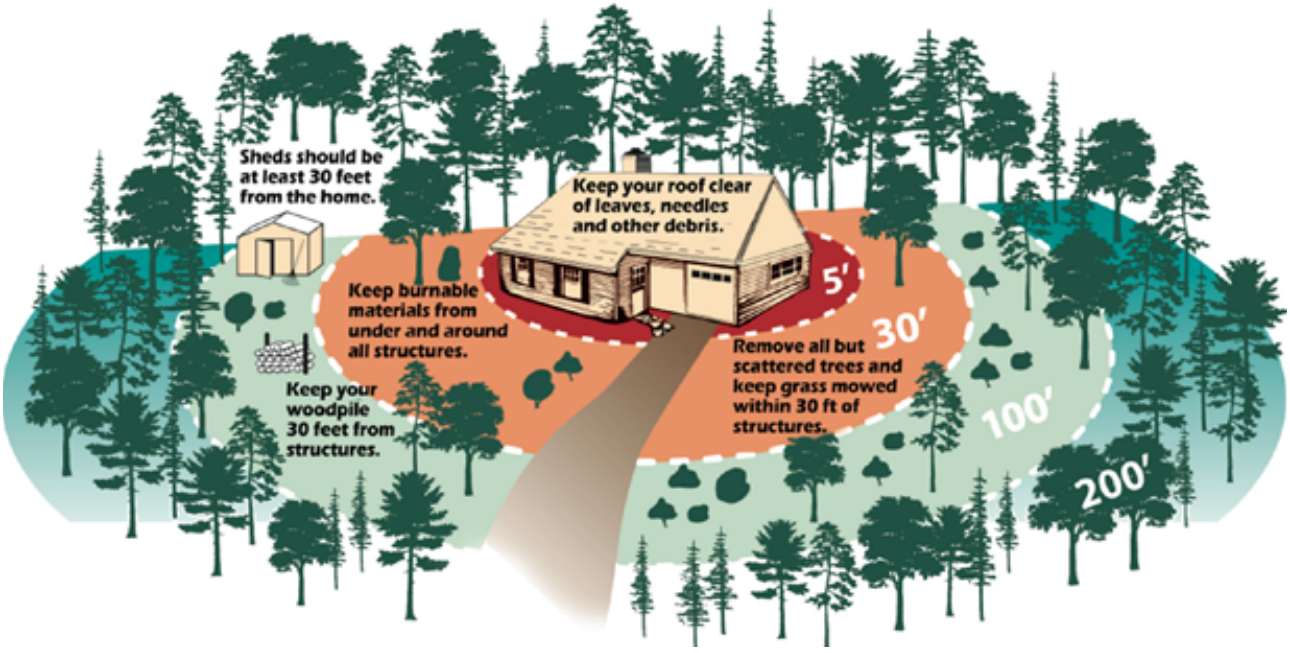


*Defensible space zones 1 and 2.* Source: Oak Hill Fire Safe Council

The specialist marks the vegetation to be removed and takes notes and photos to document the analysis. The specialist and the homeowner also discuss emergency preparedness and planification in case of a wildfire event. Wildfire Partners provides a customised report identifying the weaknesses in the house's defences, the actions requested to reduce the house's vulnerability and exposure to wildfire, photos documenting these actions, a mitigation checklist, recommendations on evacuation and signing up for free emergency alerts from Boulder County Emergency Service.


*Individual home assessment report.*
Source: Wildfire Partners

The requested actions aim at maintaining a functional defensible space by cutting or pruning trees, mowing the grass, installing stone structures around the house, and carefully selecting building materials. Once the actions have been implemented, a one-hour final inspection is done to certify the property. Becoming a certified Wildfire Partner home increases the chances of obtaining and keeping home insurance and of selling the house. Re-certifications are free of charge.

## Administrative implementation

Owners of homes in unincorporated communities (part of a county that is outside any municipality) in western Boulder County are eligible to the individual home assessment (which is not compulsory). Homeowners must be present and participate in the assessment. Renters are not eligible, but they can encourage their residence owner to apply. All the steps of the assessment are conducted by Wildfire Partners.

In addition, homeowners in any unincorporated area of Boulder County who are applying for a building permit for a new home, addition over 18 m², or deck work are subject to wildfire mitigation requirements. Those in west Boulder County have additional vegetation requirements. And homeowners applying for a short-term rental license are required to have completed a Wildfire Partners home assessment before their initial license is issued. To renew the license, they must be re-assessed every two years, at a cost of $100.

## Financial implementation

Wildfire Partners offers financial assistance to cover forestry work costs to manage forest vegetation around assessed houses (new homes built as part of a building permit are not eligible). Standard subsidies cover 50% of forestry contractor costs up to $2,000, and are limited to work performed by an approved contractor. For executed mitigation works, homeowners are eligible to a tax reduction from Colorado state taxes.

From 2013 to 2016, the Wildfire Risk Reduction Grant Program awarded grants ranging from $2,400 to $1,754,298 to various organisations. Wildfire Partners is funded by the Colorado State Forest Service, the Boulder County and the Federal Emergency Management Agency.

## Requisites for success

### Integration

Wildfire Partners also offers, free of charge, services for all communities (incorporated and unincorporated) in Boulder County, including a biomass chipping service, community assessment, and outreach & education activities to raise awareness about wildfire risk mitigation.

### Continuity

Following the 2021 Marshall Fire in fire zone 2 (eastern Boulder County), residents and civic groups in eastern Boulder County contacted Wildfire Partners to protect their homes and communities. In 2022, the Wildfire Partners Plains Pilot Project was implemented in eastern Boulder County to study the adaptation of the individual home assessments already conducted in the western half of the county. Wildfire Partners partnered with homeowners to test a home appraisal, site tour, questionnaire, and reported process for prospective buyers. After 100 applications were accepted, five experts conducted the individual home assessments. A second phase of the Plains Pilot Project is to be conducted in 2023.

*Homes and other structures in Superior town, destroyed by the Marshall Fire (30 December 2021) Boulder Country, Colorado, USA.* Source: Hart Van Denburg/CPR News

### Specialisation

The team for Wildfire Partners includes experts wildfire mitigation, forest and grassland management, forestry works, geographical information systems, project coordination, bilingual outreach & education, leadership, customer service and administrative support.

### Collaboration

Since 2013, many organisations and groups have worked with Boulder County to develop and implement Wildfire Partners. Some of them are Local Fire Protection Districts, Local, State and Federal Government, insurance companies, community groups and non-profit organisations.

# FOREST OWNERS JOIN FORCES FOR FIRE PROTECTION AND SUSTAINABLE MANAGEMENT

Portugal has implemented a forest intervention zone scheme for joint forest management among small-scale forest owners to promote sustainable forest management and protection against extreme fire events.

## Background

Portugal has 308 municipalities, covering an area of 92,225 km², of which around 33,000 km² are forested, and a population of 10.3 million people. Unfortunately, Portugal is prone to frequent and severe forest fires. In 2003, the country experienced its worst fire season on record, with 425,839 hectares of land burnt. This was followed by similarly devastating fires in 2005. However, the record was broken in 2017, when 480 fires burned a staggering 563,532 hectares of land. Forest fires are a common problem in Portugal and pose a growing threat to people, property, and natural resources. Portuguese forests are mainly private. They are owned by more than 500,000 landowners. Private smallholdings make up over 75% of the forested area, with an average plot size of approximately 1 hectare. This fragmentation of tenure, combined with inactive landowners, limits the capacity for forest management to prevent wildfires.

*Forested area in Portugal.* Source: ICNF

**Location**
Portugal

**Actors**
Associations of agricultural and forestry producers, public administration (Institute for Nature Conservation and Forests), local entities, forest industry, NGO

**Pros**
ZIF establishes the legal framework for small-scale private forest owners to take joint action.
Responds to the need for mitigating fire risk at landscape level.
Could potentially increase profitability of managed areas.
Have existing government investment.

**Cons**
ZIFs are heavily reliant on public subsidies, which are primarily used to maintain the ZIF structure rather than to carry out forestry work (including fire prevention actions).
Complexity in assembling many actors together.
In some cases, absence of effective results.

## Challenge

Due to the abandonment of rural areas and the accumulation of fuel caused by a lack of forest management, combined with the effects of climate change, the risk of extreme wildfire events is increasing in Portugal. To mitigate this risk at a landscape level, legal instruments are required to promote and coordinate joint forest management, particularly as most of the forests are owned by small private landowners. **How can a legal instrument coordinate dozens of landowners to achieve coherent wildfire prevention at landscape level through sustainable forest management?**

## Solution

In 2005, the Government of Portugal passed the law on Forest Intervention Zones (ZIF in Portuguese) to address issues caused by land distribution and the large number of small landowners. The law on ZIF promotes the association and joint management, and the protection of forests at the landscape level. The aim is to increase forest resilience to wildfires and reduce the accumulation of fuel, while providing income for owners through professional forest management. The government provides technical and financial support to the ZIF areas.

## Technical implementation

ZIFs are limited areas designated for specific land use purposes. These areas may include private land, common land (*baldios*), and public land. The ZIF approach aims to facilitate cooperation among small landowners of non-industrial private forests. The organisation of ZIFs in private spaces must be a continuous bounded area that meets three requisites:

- cover at least 750 hectares,
- include at least 50 forest owners or producers, and
- include at least 100 forest plots.

Each ZIF must consist mainly of forest, with smaller areas of grassland and shrubland, and agricultural land. The current land uses in ZIFs are 53% forest, 27% grassland and shrubland, and 15% agricultural land.

The main objectives are to promote sustainable forest management in accordance with national and regional guidelines and regulations, mitigate current constraints to forest intervention, such as land structure and size, and

**Type of measure**
Risk management: planning

**Type of economic incentive**
Subsidies

**References**

**Forest Intervention Areas (ZIF): a new approach for forest management in Portugal.** 2013. Silva Lusitana.

**Zonas de Intervenção Florestal**. 2023. Instituto da Conservação da Natureza e das Florestas (in Portuguese).

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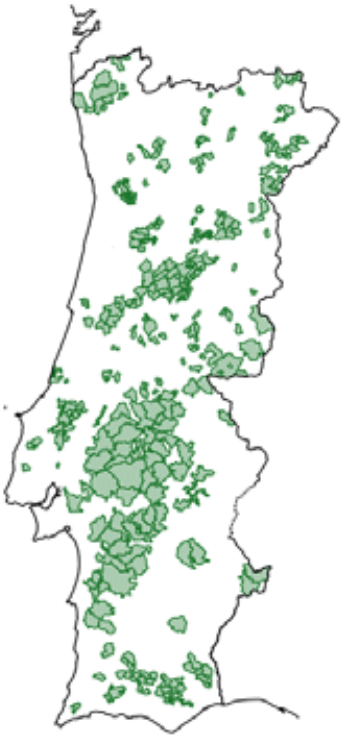

*The area covered by the 272 ZIFs as of June 2023.*
Source: ICNF

develop structural measures for forest protection against fires. The implementation of ZIF is expected to provide significant benefits in terms of intervention on larger spatial scales and ensure a better and more coherent strategic vision for rural areas.

The ZIF process consists of three main stages: the legal stage, the planning stage, and the implementation stage. During the planning phase, the management entity of the ZIF is responsible for creating the necessary plans for managing the ZIF. These plans are a 25-year term forest management plan that outlines the forestry operations and activities within the ZIF area, following the guidelines of the regional forest plan, and a five-year executive plan for forest interventions, defining the actions that protect forests from biotic and abiotic risks. The Institute for Nature Conservation and Forests (ICNF) must approve the plans and supervise their implementation. The process of defining ZIF plans and implementing them is lengthy.

The number and area covered by ZIFs have been progressively increasing since the first one was created in 2006. As of the end of June 2023, there were 272 active ZIFs managed by 85 different entities, covering 1,938,777 hectares of which 1,030,120 hectares are forested. This represents 31% of Portuguese forest land. There are more than 31,000 members. ZIFs are present in all five Portuguese continental regions. Only two ZIFs have been dissolved since 2006 (in 2012 and 2019).

*Most forests in Portugal are owned by small-scale private owners.* Source: Pexels

## Administrative implementation

The law that governs the ZIF was adopted in 2005, and amended in 2009. ICNF, as responsible governmental body for the nature and forest policies, manages the ZIF scheme and serves as the reference point and support for existing and new ZIF. INCF publishes the *Technical Standard*, the *Manual of Procedures to Support the creation of ZIF* and all the forms for the creation and modification of ZIF.

The creation and implementation of the ZIF requires the monitoring and cooperation of forest owners, as well as technical and financial support throughout the process. A core group of forest owners or producers can initiate the process. To do so, they must own at least 5% of the area

within the ZIF that they want to create, and promote local meetings to expand the ZIF community and encourage others to join. The founding group is responsible for preparing all necessary elements to submit formal requests for the creation of ZIF to ICNF.

The landowners can either administer the ZIF themselves or delegate the responsibility to a management entity. This entity can be a non-profit organisation or a forest enterprise approved by the landowners and producers. The management entity will be responsible for the administration of the entire ZIF territory and for defining ZIF plans. Non-industrial private forest owners must actively participate in all stages of ZIF. This includes discussing and negotiating ZIF plans, as well as contributing to the implementation of all activities.

## Financial implementation

The ZIF law mandates the creation of a common fund for each ZIF. This fund is used for the creation of the ZIF and for the execution of the joint planned actions. It may receive financial contributions from forest owners, from revenues generated by forestry activities, from national and European financial instruments, etc. ZIF creation and maintenance costs are often cited by members as a major constraint. Local stakeholders have emphasised that forest owners may lack the financial resources or willingness to invest in ZIF implementation.

## Requisites for success

### Integration

ICNF manages the ZIF schemes and supervises their 25-year term forest management plans and five-year executive plans to ensure compliance with Portuguese forest legislation and the objectives of the ZIF scheme.

### Continuity

The implementation of ZIF has faced several constraints, including high costs, difficulty in obtaining funds, complexity in assembling small-scale holdings and landowners, and social resistance due to landowners' fear of losing their tenure rights.

To ensure transparency, trust, and investment, forest owners must be engaged throughout the entire process. To resolve the deadlock facing ZIF, it is necessary to implement the interventions and actions outlined in the ZIF plans. This requires the timely submission and approval of the plans, the prompt allocation of public funds to priority areas, and the involvement of forest owners in the entire process to secure various forms of support, including financial, labour, and know-how. Despite the challenges, the number of ZIFs continues to increase.

### Specialisation

The management entity of the ZIF must possess the necessary technical capacity to administer the ZIF, including its property area, structure, and activities. Additionally, it should maintain organised accounts and an autonomous cost centre for ZIF. To carry out ZIF planning requires the skills of a forest engineer, who must take into account the requirements of joint forest management and, ideally, be trained in methods and tools used to support group decision-making in collaborative planning for forest management.

## Collaboration

Collaboration between ZIF members and external stakeholders is encouraged. It is necessary to increase the number of actors involved in ZIF, not only gaining in size. This includes the participation of impartial and financially independent companies with technical capacity and coherence, in order to respond to the various challenges of forest management in Portugal. ZIF should also collaborate with insurance companies as the actions implemented by ZIF affect the exposure to fire of the properties within the area.

## Acknowledgements

This text is mostly a synthesis of the following article: Valente, S. *et al*. 2013. *Forest Intervention Areas (ZIF): A New Approach for Non-Industrial Private Forest Management in Portugal*. Silva Lusitana, 21(2): 137-161.

*Pinewoods in the gorges of the Peneda-Gerês Natural Park, Portugal.* Source: Wikimedia Commons

# MAPPING COMPULSORY BRUSH CLEARING ZONES AND STRIPS

French Forest Law requires landowners to clear the forest and understory surrounding their properties. Online maps have been created to indicate to landowners if their properties are affected and where the limits of their responsibility lie.

## Background

Under to the French Forest Law, property owners in departments at high risk of wildfires are required to clear the vegetation surrounding their buildings. Brush clearing involves reducing all types of biomass, such as grass, branches, bushes and trees, to break the vertical and horizontal fuel continuity. This helps to reduce the intensity and spread of fire. Methods of brush clearing may include felling and pruning trees or shrubs, or removing cutting residues such as branches and leaves. In France, this regulation is known as Compulsory Brush Clearing (OLD in French).

Brushing around buildings is compulsory by 1 July each year. This must be done following the technical criteria set by the town council or departmental prefecture, published in the Local Town Planning Scheme.

*Town surrounded by Mediterranean forest in the Provence-Alpes-Côte d'Azur region of south-eastern France.* Source: Wikimedia Commons

**Location**
France

**Actors**
Municipalities and departmental governments, French Government Public Service, National Institute of Geographic and Forestry Information, Géoportail, private companies specialised in geographical information systems

**Pros**
These maps help to track compulsory brushing responsibilities between tenants.
Real estate owners and authorities use the same maps for their respective responsibilities and monitoring purposes.

**Cons**
Converting legal obligations into geographical information systems required specialized resources in spatial data analysis.
The resulting maps need to be constantly updated to reflect the current legislation on brushing regulations.

The clearing must extend up to a depth of 50 meters (strip) from the buildings if they are located in forested land or less than 200 meters from the forest. Owners needing to clear beyond their own land must inform the neighbouring owners and request their permission to enter their property. The neighbouring owners must grant the permit within a month, and if they do not, they will be responsible for the clearing. If the owners are unwilling or unable to clear the surrounding area by themselves, they can hire a forest works company. This expense may be eligible for tax relief. Town councils are responsible for monitoring the execution of the brushing, although they may delegate the task to sworn officials. Controls are carried out without prior notification, and failure to properly implement OLD may result in fines.

## Challenge

Private individuals can contact the town council or the prefecture to learn about the regulations in force in their department regarding OLD. Implementation rules may vary between departments based on local context. However, it can be challenging for individuals to determine if their property is affected and which strip they are responsible for brushing. To monitor the implementation of the measure, town councils also need to know the geographical location of the OLD. **How can landowners and town councils locate the areas subject to Compulsory Brush Clearing?**

## Solution

The online map **OÙDÉBROUSSAILLER.FR** has been created to help French landowners find out if their land is subject to the Compulsory Brush Clearing scheme and to locate the limits of their obligations. Additionally, town councils can use this map to monitor the implementation of the OLD in their municipalities.

## Technical implementation

OÙDÉBROUSSAILLER.FR maps strips affected by the OLD scheme based on the current prefectural decrees and orders. The website eases the access and use of the generated database and cartographic representations. It also aims to aid local authorities in the implementation and monitorisation of the OLD, and to improve communication with the public by reminding them of fire risks. The map displays, over a

**Type of measure**
Risk management: planning

**Type of economic incentive**
Liability fees

**References**

**Zonage informatif des obligations légales de débroussaillement**. 2023. Géoportail (in French).

**Où Débroussailler**. 2023. Optim.aize (in French).

**Dans quel cas le débroussaillage est-il obligatoire ?** 2023. Service Public - Republique Française (in French ).

**Notice d'utilisation du zonage informatif des obligations legales de debroussaillement**. 2023. Ministère de l'Agriculture et de la Souveraineté Alimentaire (in French).

**Contact**

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*OÙDÉBROUSSAILLER.FR logo*

background of aerial photos, the vectorial layers for buildings, cadastral plots, and forest areas. It is important to note that certain wooded areas, which are less than 4 hectares in size, may not be visible on the map even though they are covered by OLD. This is due to difficulties in identifying certain forests, heaths, and thickets from photographic and/or digital data, and the reliability of these areas cannot be guaranteed. It is necessary to update these forested areas as regulations and forest cover evolve.

The map can be accessed using a laptop, tablet or smartphone. If the device has GPS, it can also locate the user's position on the map. Users can browse the map or search for a specific address using the search bar. Clicking on the searched building will notify users if the property is affected by an OLD. If it is affected, the limits of the 50-meter strip and the surface to be treated will be displayed. Additionally, users can view a 100-meter strip. The website provides basic information on OLD that is common across French departments, including legal obligations, methods of brush clearing around buildings and paths, shared responsibilities when the 50-meter strip overlaps with other tenants' land (private or public), and a calendar of possible actions.


*Compulsory Brush Clearing strip (urban plots in yellow, forest land in red) around buildings, as seen in OÙDÉBROUSSAILLER.FR.*
Source: OÙDÉBROUSSAILLER.FR

The map was developed by a private company specializing in geographical information systems (GIS). A GIS processing chain has been developed to identify the precise area of land that requires clearing in a municipality, as well as the spatial separation between the transmitter responsible for clearing and the receiver whose land needs to be cleared.

This data is available for download as open access data in two datasets: a full version with nine attributes and a light version with four. The database lists the 45 French departments currently subject to the OLD scheme. Additionally, the cartography of the OLD can be accessed through Géoportail (**https://www.geoportail.gouv.fr/donnees/debroussaillement**, layer *Informative zoning of Compulsory Brush Clearing*), a comprehensive web mapping service provided by the French government that publishes maps and aerial photographs from over 90 sources for France and its territories. The OLD layer can be combined with any other existing cartography.

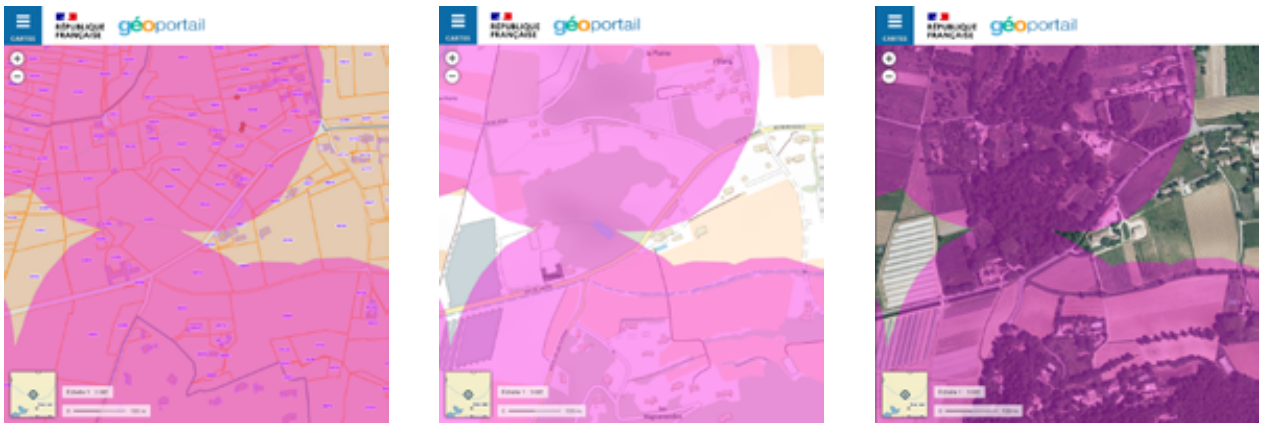
While OÙDÉBROUSSAILLER.FR shows the 50-metre strip around each building affected by an OLD, Géoportail only maps the areas covered by an OLD (without showing the strips). However, by clicking on a point on the map, the Géoportail gives access to the technical clearing criteria in force in that municipality or department, whereas OÙDÉBROUSSAILLER.FR only advises users to contact their municipality or prefecture to find out the technical clearing criteria in force.


*Compulsory Brush Clearing as seen in Géoportail (pink areas indicate zones within an OLD; left) and in OÙDÉBROUSSAILLER.FR (yellow and red areas indicate 50-m strip around a building; right).* Source: Géoportail

## Administrative implementation

The French Forest Law dictates OLD technical brushing criteria (minimal distance between the house and trees, minimal distance between trees, minimal the height of pruning, etc.) for some French departments, while others have their own set of technical criteria. Géoportail differentiates between the two. By clicking on an area covered by an OLD without any departmental criteria, the user is directed to the technical criteria of the French Forest Law. But by clicking on an area of a department with its own technical criteria, the user accesses the website where these are described. OÙDÉBROUSSAILLER.FR does not give access to the departmental technical criteria, only to the national ones.

Departmental prefectures publish their own technical brushing criteria through prefectorial decrees, along with a description of where the OLD should be applied. Magellium, a private company specialized in GIS and cartography, conducted data analysis and generated cartography based on this information, accessible through the website OÙDÉBROUSSAILLER.FR, created by the private company optim.aize. The National Institute of Geographic and Forestry Information hosts and publishes the maps of the areas affected by an OLD in Géoportail.




*In Géoportail, Compulsory Brush Clearing zones can be combined with other cartography (from left to right: cadastral plots, cartographic map, aerial photos).* Source: Géoportail

## Financial implementation

In Géoportail, all ordinary consultations are free of charge. Pricing is introduced for professional, associative or personal use associated with commercial transactions, via the Géoportail API. Géoportail is owned and managed by the National Institute of Geographic and Forestry Information, a public institution under the supervision of the ministries responsible for ecology and forests.

## Requisites for success

### Integration

The two websites provide slightly different services. Géoportail's *Informative zoning of Compulsory Brush Clearing* layer provides links to current departmental technical brushing criteria, while OÙDÉBROUSSAILLER.FR shows the 50-m strip of OLD for each individual property, distinguishing between the user's plot and the neighbours'. Géoportail is more integrated with the legal requirements, while OÙDÉBROUSSAILLER.FR responds to the spatially explicit needs of the users and authorities.

### Continuity

Géoportail, managed by the National Institute of Geographic and Forestry Information and the French Government, ensures long-term maintenance and hosting of the *Informative zoning of Compulsory Brush Clearing* layer.

### Specialisation

Two companies specialized in GIS and cartography were contracted to create the *Informative Zoning of Compulsory Brush Clearing* layer in Géoportail, and the OLD strips mapping and the OÙDÉBROUSSAILLER.FR website.

### Collaboration

The website OÙDÉBROUSSAILLER.FR is gradually adding cadastral information, including the cadastral reference numbers of the plots. This includes the landowner's plot and those of the neighbours affected by the OLD. This will facilitate the traceability of brushing responsibilities between tenants. OÙDÉBROUSSAILLER.FR and the *Informative zoning of Compulsory Brush Clearing* layer in Géoportail are also used by forest managers in integrated fire management plans, as in the **Fontainebleau massif**.

# ARTIFICIAL INTELLIGENCE TO PREDICT IGNITION AND SUPPORT RESPONSE

An ignition probability map is used by decision makers to optimise the allocation of fire suppression resources across a vast territory of Mediterranean Turkey.

## Background

In Turkey, about 230,000 km² of its 783,562 km² of land are covered by forests, which are mainly publicly owned. Unfortunately, a significant portion of them burnt in the Mediterranean region in 2021 in the worst-ever wildfire season in the country's history. Around 80% of the fires are caused by humans due to urban expansion, infrastructures, and recreational activities. As a result, firefighting services are under great strain and require a high level of mobility. During the fire season, firefighters are stationed at fire stations near or within forest areas to extinguish fires as quickly as possible. The Turkish Ministry of Agriculture and Forestry (TMAF) is using a forest fire risk prediction tool based on meteorological parameters. However, experts are aware that meteorological data is not sufficient to assess fire risk if human activities is the main driver of ignitions. Therefore, there was an urgent and fundamental need for a risk map that could take into account static as well as dynamic parameters.

*Houses burned in the devastating forest fires that took place in Marmaris, Turkey in 2021.* Source: IStock

**Location**
South Aegean and West Mediterranean areas, Turkey

**Actors**
General Directorate of Forestry (OGM), Turkish Ministry of Agriculture and Forestry (TMAF), Koç Digital, Deloitte

**Pros**
Optimal and efficient use of fire suppression resources.

**Cons**
An imbalanced dataset is a major bottleneck for algorithm accuracy.
Unpredictable human behaviour is the biggest challenge to predict fire occurrence.
It requires highly specialised resources on IT and computation.

## Challenge

One characteristic of forest fires is the unpredictability of ignitions. Human activity, land and weather conditions affect the chance of a wildfire outbreak. Early detection is crucial, as it is also an initial attack. Initial attack will be faster if the suppression resources are located as close as possible to the potential fire outbreaks. **Can fire ignitions be predicted in order to optimise the distribution of fire suppression resources at a country or sub-country level?**

## Solution

The World Economic Forum's Center for the Fourth Industrial Revolution, Koç Digital, TMAF and Deloitte launched the FireAId initiative in January 2022. The goal of FireAId is to facilitate the use of artificial intelligence (AI), machine learning (ML) and other cutting-edge technological advances in predicting fire outbreaks and optimising the distribution of suppression resources in different territorial compartments for early detection and initial response. This effort is motivated by the need to increase the efficiency and affordability of forest fire fighting operations at country scale.

## Technical implementation

FireAId is an interactive fire risk map developed using Al algorithms and ML, backed by a global community of experts. It provides crucial information for authorities to prepare and respond to fires, with simulation tools processing fire size, predicting progress, and evaluating firefighting tactics.

**Type of measure**

Risk assessment

Risk management: preparation and pre-suppression

**Type of economic incentive**

NA

**References**

**The Next Frontier in Fighting Wildfires: FireAId Pilot and Scaling - Insight report January 2023.** 2023. World Economic Forum.

**The power of AI in wildfire prediction and prevention.** 2023. World Economic Forum.

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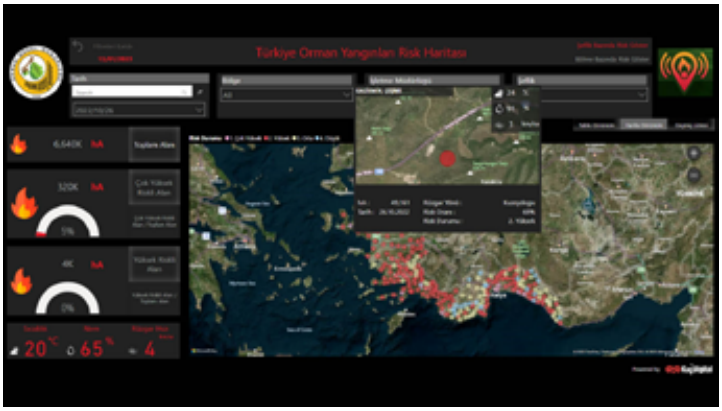
*Devastating forest fires that affected the province of Muğla, Turkey, in summer 2021.* Source: @Felton Davis / Flickr

FireAId has two phases. The first stage is an interactive map where predictive data (dynamic and static wildfire related datasets) are input to generate an ignition probability map. In the second phase, the ignition probability map is used to create an optimal post-ignition resource allocation model to help decision makers direct resources to predicted wildfires and identify potential threats.

FireAId pilot project has been developed for South Aegean and West Mediterranean areas of Turkey, which account for 44,000 km² of land. For the model, the area was divided into 66,394 territorial compartments. Historical data is used to train the models included the location, date, duration and size of any fire in the area since 2010, the means used to extinguish them in relation to different forest and land characteristics (vegetation and land features, land use types, and terrain) and the meteorological conditions before and during the fire (including the daily five-day weather forecast).

The output of the model is the probability of fire occurrence, with four classes of risk per territorial compartment: extremely high, high, medium and low. The model is run twice a day: once in the afternoon using current weather data, and once in the evening using the forecast for the next five days.




*FireAId interactive fire risk map.* Source: Koç Digital

This pilot project in Turkey resulted in an 80% accuracy rate in predicting the ignition of forest fires. In 2023, FireAId is collecting users feedback. Afterwards, the model refinement phase will begin. By continuously improving the FireAId technology's learning techniques, researchers aim to improve its adaptability to the unpredictable nature of wildfires.

## Administrative implementation

KoçDigital developed FireAId for TMAF, which was launched at the World Economic Forum 2023 meeting. The initiative aims to help countries and organisations to model fire behaviour (including ignitions) under different conditions by integrating their fire, land and weather data into the FireAId system. The source codes and algorithms will be made publicly available, increasing the capabilities and impact of the FireAId initiative. The next phase of KoçDigital's FireAId initiative is to expand its solutions to entirely cover Turkey, and KoçDigital's risk maps, resource allocation models and fire statistics will help the TMAF with its annual resource allocation planning.

## Financial implementation

The entire budget of the project was covered by Koç Digital as a social responsibility project. General Directorate of Forestry (OGM) conducts benefit-cost analysis for all projects it carries out and implements. This analysis was also made for this project. Prioritising AI in wildfire prediction and prevention will improve the cost efficiency, effectiveness, and capacity of wildfire mitigation efforts at large scale.

## Requisites for success

### Integration

FireAld is integrated with TMAF, OGM, forest managers, fire services and other government structures by creating a common users network, fire statistics, forest stand maps and meteorological data that can be integrated into FireAId system.

### Continuity

To effectively manage the risk of forest fires and to avoid disasters, it is necessary to empower ministries, strengthen cooperation, incentivise contribution, prepare for long-term efforts. For Koç Digital to ensure the continuity of AI capabilities and to expand its capacities, the goal is to collect and enter as much data as possible into the FireAId system.

### Specialisation

ForestAId required a highly specialised team of project managers, business advisors, business intelligence consultants, ML engineers, data engineers, data scientists and software engineers to ensure that every aspect of the project is covered. And for FireAld to be successfully implemented, there must be constant cooperation with fire experts.

### Collaboration

Forest fire fighting services are not an area that is the focus of high-technology companies, as is the case all over the world. High-energy forest fires that may occur in the future due to climate change will cause great damage to both forests and wildlife. The costs of extinguishing forest fires will increase dramatically. Identifying these negative impacts in advance could create new opportunities for high-technology companies in this area.


*Forest firefighting workers extinguish and control the fire in Bodrum, Turkey, in August 2021.* Source: IStock

# SUBSIDISING FUEL MANAGEMENT IN THE WILDLAND-URBAN INTERFACE

The Barcelona Provincial Council provides municipalities with technical assistance and economic support to implement mandatory perimetral security strips around urban areas.

## Background

The wildland-urban interface (WUI) is the area where human development meets forested landscapes. In the province of Barcelona (in Catalonia, Spain), WUI has significantly increased over the last few decades. As one of the most economically dynamic areas in Spain, the population around Barcelona is continuously growing. Urban development is taking place on agricultural land, while many small agricultural plots are being abandoned and spontaneously turning into unmanaged forest. There are two types of WUI: rural settlements mixing with forests and urban housing extending towards forested areas. WUI areas present multiple challenges: human settlement increases the chance of wildfires due to human ignitions, and WUI fires pose a greater threat to lives and homes. Logically, allowing natural fires to occur in these areas to naturally reduce biomass is not an option.

*Wildland-urban interface in Barcelona province.* Source: Alina Chereches from Pixabay.

**Location**
Barcelona Province, Spain

**Actors**
Barcelona Provincial Council, municipalities, Government of Catalonia

**Pros**
Even municipalities with limited resources can comply with the legal requirements of wildfire prevention in wildland-urban interface.
No legal modifications were required to implement this subsidy.
Raise public awareness of the risk of living in the wildland-urban interface and that prevention requires forestry interventions.

**Cons**
Authorities assume the financial burden to safeguard private assets.
The infrastructure's effectiveness depends on regular maintenance, which should occur at least every two years. However, there are currently no plans to subsidise this maintenance.

In Catalonia, since 2003, communities located in the WUI are required by Catalan law to implement perimetral security strips around buildings and settlements. The municipalities can establish these strips subsidiarily. They must be at least 25 metres wide, adjacent to urban areas, and managed to break horizontal and vertical fuel continuity through tree pruning, clearing understory, and chipping wood residues. Vegetated unbuilt lots within urban areas also pose a problem and must be treated like the security strips. The purpose of these strips is not to prevent fires in the WUI, but to reduce their intensity and provide a chance to safeguard buildings. Regular maintenance is necessary to preserve the vegetation structure under the required conditions.

## Challenge

Although security strips are mandatory, many communities living in the WUI do not implement them. There are several reasons: lack of economic capacity, lack of risk awareness either because of ignorance of the environment in which they live or because of an idyllic vision of the environment that they do not want to alter, or simply the difficulty of organising neighbourhood communities. So, in many cases, implementation is executed and subsidised by municipalities (but they are not obliged to pay for them). However, this does not always happen. There are also several reasons: urban planning problems, lack of technical and economic resources of the municipalities (specially the smaller ones, as the management required for the implementation of the law and the execution and monitoring of the works is complex), it is not always well received by the communities who are not aware of the problems, and applying new fees is not a "popular" measure for the local authorities. **What resources are available to municipalities to comply with Catalan legislation on perimetral security strips?**

## Solution

The Barcelona Provincial Council (DIBA) is a supramunicipal organisation that groups together 311 municipalities, 7,726 km² of land and 5.7 million inhabitants. It provides different technical assistance and economic support to town councils to drive progress and citizens' well-being across the province. In 2004, DIBA established the Programme for the Prevention of Forest Fires in Residential Areas and Population Centres (PPU) following the 2003 Catalan law on perimetral security strips. The PPU provides subsidies to municipalities for their technical design and implementation.

**Type of measure**
Risk management: prevention

**Type of economic incentive**
Subsidy

**References**

**Programa de Prevenció d'incendis forestals en Urbanitzacions i nuclis de població (PPU).** 2023. Diputació de Barcelona (in Catalan).

**Prevenció d'incendis forestals.** 2023. Diputació de Barcelona (in Catalan).

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*Example of a residential area in Barcelona province where a perimetral security strip is applied.* Source: DIBA

## Technical implementation

*Perimetral security strip under execution.* Source: DIBA

The technical assistance of the PPU to town councils consists in two steps. Firstly, DIBA technicians prepare the delimitation map that determines the urban areas, buildings and facilities that must comply with legal security strips. Secondly, they write the Forest Fire Prevention Plan in Residential Areas and Population Centres, which includes the executive project of the interventions required in the 25-meter security strips. It also covers unbuilt plots, municipally-owned plots and green zones in the urban area surrounded by the strip. Next, DIBA finances the forestry works planned in the executive project for the creation of the strips.
This financing includes: the actual execution of the forestry works and the executive project management.

The delimitation map and the executive project have the following basic structure, including technical criteria outlined in the decree on perimetral security strips. The document outlines the layout of low-combustion perimetral strips and lists the impacted properties. It also provides an inventory of strip sections that need to apply certain technical criteria, defining the starting situation for each section based on tree density, shrub cover, land slope, and access to the work area. The inventory process also outlines necessary physical measures for each section, including vegetation treatment methods, service roads, and loaders. The project involves a safety and health study for forestry companies, focusing on occupational accident prevention, occupational illness prevention, and mandatory hygiene and well-being installations. The results are graphically represented, including plans for initial and maintenance actions, and illustrating vegetation treatment methods for each section of the perimetral strip and plot.

## Administrative implementation

The Technical Office of Municipal Prevention of Forest Fires and Agricultural Development (OTPMIDA) of the Barcelona Provincial Council manages the PPU. Town councils must individually request support from the OTPMIDA to access the PPU. Starting in 2024, municipalities can request the grant for up to five residential areas and population centres, an increase from the previous maximum of four.

A forced easement is established in the lands within the 25-meter strip that do not belong to the municipality to allow necessary forestry works. The easement grants the right to compensation, which includes the value of the affected part of the servient estate and the reparation of any damages caused by the passage. If trees are being felled, a forest exploitation communication must be made to ensure compliance with fire prevention regulations. If the works take place between 15 June and 15 September, authorization must be requested for activities that pose a wildfire risk. DIBA provides open access data that is updated with the security strips planned and executed in **gisportal.diba.cat/incendis**.

## Financial implementation

The PPU is entirely funded by DIBA. DIBA subsidises from 80 to 100% of the cost of executing the strips and the project management, depending on the municipality's population size (smaller towns receive higher subsidy rates, the balance is co-funded). The minimum support is set at €2,000. The maintenance of the strips is not covered, but the OPTMIDA provides the city councils with a public price ordinance to raise funds for maintenance. The cost of opening a strip ranges from 3,000 and 6,000 €/ha, while the cost of maintaining it ranges from 300 to 1,000 €/ha. Support is also provided for the preparation of the delimitation maps, which are compulsory by law.

## Requisites for success

### Integration

Beyond the perimetral security strips, the PPU aims to prevent fires, reduce their consequences, and recover affected areas, while assisting town councils in achieving these objectives and fulfilling their legal obligations. The PPU collaborates with OTPMIDA's Forest Restoration and Improvement Section to transfer information on strips locations. This helps to prioritize forestry work adjacent to those areas (such as buffer zones where forest is managed for fire prevention purposes, also promoted by DIBA). Additionally, the PPU collaborates with the Fire Prevention Section to inform town councils about the programme during DIBA staff visits to municipalities. The DIBA Fire Information and Monitoring Programme reports potential fire incidents during fieldwork. The delimitation map contains information that has already been processed by DIBA, such as water points and watchtowers.

### Continuity

There are still many strips to be planned and executed. Town councils often charge their residents or apply for grants from other public administrations to maintain the state of the executed security strips under DIBA support. To ensure this, every time financial aid is granted by DIBA for the opening of strips, the town councils sign a commitment to maintain them at least every two years. In addition, in order to access the financial resources, they must certify the maintenance of all the strips executed with the support of DIBA during the 3 or 4 years prior to the current new application.

### Specialisation

Initially, PPU was managed by only one DIBA staff member. Currently, the team consists of seven forest engineers and one administrative staff member.

### Collaboration

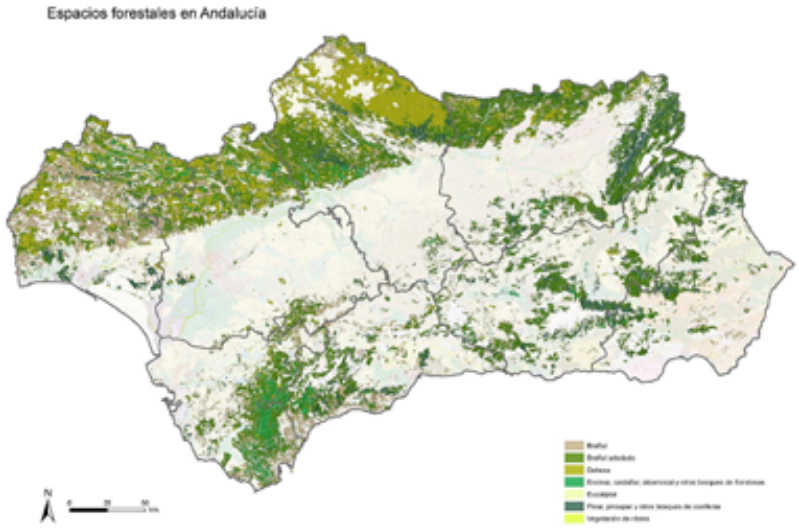
OTPMIDA has partnered with the Research Centre for Ecological and Forest Applications (CREAF) to develop guidelines for perimetral security strips. They also work with the Rural Agents Corps of the Catalan government on raise awareness campaigns and communication materials, and with the Catalan Forest Firefighting Service to standardise the concepts of the delimitation maps across Catalonia. OTPMIDA also collaborates with DIBA's Housing, Urban Planning and Activities Services Department.

# TARGETED GRAZING FOR VEGETATION CONTROL

As a form of payment for ecosystem services, goat and sheep shepherds are compensated for reducing biomass in targeted areas of fire-prone landscapes.

## Background

Andalusia is a vast autonomous region in southern Spain, with a population of 8.5 million people. More than half of the territory in Andalusia is covered by forests, which occupy 4.6 million hectares, a quarter of which is publicly owned. In Andalusia, like many other Mediterranean regions, rural abandonment and successful fire suppression efforts have led to an accumulation of fuel, which increases the risk of future fires. To maintain a fire-resistant vegetation structure, it is necessary to prune and thin trees and clean the understory to reduce the amount of fuel and its continuity. Due to the extensive areas of land that require these treatments, implementing mechanical cleaning throughout these areas would be challenging and too costly, especially in mountainous areas of difficult access. Additionally, rural abandonment and low forest productivity reduce the area of managed forests. Therefore, alternative forest fuel treatments are necessary.




*Forested areas in Andalusia.* Source: Consejería de Medio Ambiente de Andalucía

**Location**
Andalusia, Spain

**Actors**
Andalusian General Directorate of Management of the Natural Environment, Andalusian Public Agency of Environment and Water, local shepherds, School of Shepherds of Andalusia, Superior Council of Scientific Research

**Pros**
Plays a key role in fire prevention in hard-to-reach areas.
Promotes the use of indigenous breeds and the production of quality products.
Contribution to rural development and to keeping people in the area.
Recognises the work of shepherds.
Increases biodiversity through seed dispersal and maintenance of open areas.

**Cons**
Efforts to mobilise the shepherds' community.
A decreasing number of shepherds.

Grazing has a negative image in the Mediterranean region due to land degradation caused by overgrazing and the intentional use of fire for pasture renewal. Targeted grazing has positive effects, such as wildfire prevention, economic savings, and improved land-use effectiveness. However, to make it effective, coordination and support from forest authorities are needed.

## Challenge

Biomass reduction is crucial for preventing wildfires by eliminating fuel continuity and establishing vegetation structure and characteristics that improve the ability to manage wildfires. Therefore, many European countries, including Spain, have turned to livestock grazing as an option to make landscapes more fire-resistant. However, for extensive grazing to be effective at a landscape level, a significant number of shepherds must be engaged, and the grazing activity must be directed towards the most strategic areas. **What steps can be taken to coordinate and reward shepherds for their services in biomass control and fuel break maintenance?**

## Solution

The Andalusian General Directorate of Management of the Natural Environment set up the Network of Grazing-Firebreaks in Andalusia (RAPCA in Spanish). This programme involves targeted grazing to reduce biomass in very specific areas and to maintain an appropriate forest structure for fire prevention. To incentivise shepherds to graze their livestock there, the RAPCA programme provides monetary compensation as part of the payment for ecosystem services (PES).

## Technical implementation

The RAPCA programme was launched in 2005 as a PES scheme in Andalusia. It rewards sheep, goat and cow shepherds for controlling biomass and maintaining existing firebreaks on public forests of Andalusia. The RAPCA programme prioritises grazing in areas with existing infrastructures for fire prevention (e.g., mechanically created firebreaks) and having a high livestock tradition.

This last point is very important, as it avoids having to move herds from distant locations, avoids having to build infrastructure for livestock (such as watering troughs and

**Type of measure**
Risk management: prevention

**Type of economic incentive**
Payment for ecosystem services

**References**

**Red de Áreas Pasto-Cortafuegos de Andalucía (RAPCA). 2023.** Junta de Andalucía (in Spanish).

**Payment for Targeted Grazing: Integrating Local Shepherds into Wildfire Prevention.** 2018. Forest.

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*Goats feeding on understorey vegetation.* Source: Agroinformacion.com

pens), and sustains local economic activity. This allows for livestock to be compatible with the integral management of the mountain.

The shepherds who initially agreed to participate in the programme played a crucial role in engaging their peers and building trust with RAPCA staff. By 2010, the scheme had been fully deployed and comprised 67 shepherds. By 2016, the RAPCA network reached a total surface area of 6,000 ha, grazed with the collaboration of 223 shepherds, belonging to 189 livestock exploitations, with around 90,000 sheep, 20,000 goats and 1,000 cows.

Technicians from the General Directorate of Management of the Natural Environment advise shepherds on the RAPCA programme. Grazing is more intensive during spring and early summer to achieve optimal results before summer (wildfire campaign) season. Livestock farmers decide when and how to graze to achieve the required biomass reduction. This approach reduces transaction costs since it would be costlier to monitor grazing. Shepherds declare the grazed area, which is checked against the EU Common Agricultural Policy (CAP) Land Parcel Information System. The reward for biomass control is based on the area, success rate, and grazing difficulty.

## Administrative implementation

The RAPCA programme is managed by the General Directorate of Management of the Natural Environment and executed by the Andalusian Public Agency of Environment and Water (AMAYA in Spanish). To participate in the RAPCA programme in public forests, priority is given to livestock farms that have grazing agreements on land owned by the Andalusian government or local councils. Shepherds must sign an annual contract in which they take responsibility for vegetation control in a specific area. The RAPCA staff, hired by AMAYA, prepares contracts and coordinates various agents involved in the programme. They identify the areas suitable for grazing and verify herders' tasks through periodic monitoring. RAPCA staff conduct pre-assessments during spring, communicating with shepherds throughout the year. A final assessment of the results is done to ensure final payments.

## Financial implementation

The RAPCA programme provides shepherds in Andalusia with an opportunity to earn additional income. The RAPCA scheme payments shall, at least, compensate for losses resulting from targeted grazing in areas that the shepherds may not prioritise, such as those that are too far from their pens or less productive. It offers a fixed initial bonus of €300 and a variable share ranging from €42/ha to €90/ha based on grazing difficulty. The price calculation takes into account the distance from the sheep pen to the grazing area, the average slope, and the existing vegetation. The herds are contractually obligated to consume a certain amount of annual vegetation growth, specifically 90% of herbaceous plants growth and 75% of bush growth. If the consumption of vegetation annual growth is less

**Targeted grazing saves up to 75% of costs of mechanical vegetation management**

than 50%, the responsible shepherd will not receive any monetary compensation. The RAPCA scheme did not estimate the costs that targeted grazing may impose on farmers in terms of time and extra food supplementation for their flocks. The shepherds have reported that the payments may not fully cover the costs incurred. However, there are other motivations apart from payments that are key drivers for their participation, such as being part of the RAPCA community, improving their relationship with forest administrators, and recognition of their work.

The estimated total cost for the RAPCA programme is €822,000 (2017), representing approximately 1% of the total budget allocated by the Forest Firefighting Plan of Andalusia to fire prevention activities. It is estimated that the scheme saves up to 75% (average 63%) of the costs of mechanically managing vegetation in fuel breaks. After estimating the cost of fuel break mechanical clearance and comparing it with the maximum payments that shepherds could earn, it was found that the latter always falls below 50% of the avoided costs represented by targeted grazing. Transaction costs may arise from monitoring and controlling that the required levels of vegetation consumption are achieved, administering the payments and controlling for contract fulfilments.

## Requisites for success

### Integration

The General Directorate technicians coordinate with the Forest Firefighting Plan of Andalusia (INFOCA in Spanish) to determine the most suitable grazing areas. They select eligible owners of extensive grazing herds based on strict technical criteria. The RAPCA scheme and its expenses are included in the budget of the Forest Firefighting Plan of Andalusia.

### Continuity

Stable high-level political commitment has been crucial for the emergence and consolidation of RAPCA programme. Key intermediaries and sound monitoring practices increased levels of trust amongst involved actors. In addition to wildfire prevention, the RAPCA programme aims to restore and encourage the traditional work of shepherds, which has been in decline in recent decades. The RAPCA programme will be extended to private forests in the future. This will introduce the complexity of multiple land tenants for grazing agreements.

### Specialisation

The General Directorate technicians must have a deep understanding of the way shepherds work, their labour needs and the challenges they face. In addition, they need to have communication skills and empathy to engage shepherds in the RAPCA programme.

### Collaboration

Testing for the RAPCA programme started in 2003, two years before its official launch. Previous experiences were conducted in the Sierra de las Nieves Natural Park in Málaga province, with the cooperation and scientific advice of the Mediterranean Pastures and Silvopastoral Systems group from the Spanish National Research Council. Beneficial side-effects include social recognition of shepherds' activities and reduction of their friction with forest managers.

# INTEGRATING ECONOMIC SUSTAINABILITY INTO WILDFIRE PREVENTION

PRe-FEu – *Fire prevention for wood supply chains* initiative, in the Upper Susa Valley (Italy), created an integrated fire prevention plan which provides for the economic sustainability of planned actions.

## Background

The forest land in the Upper Susa Valley is divided between 14 municipalities (associated under the *Unione Montana Valle Susa*, owning 60% of the land) and private owners (owning the remaining 40%). Private forest plots are mostly abandoned due to extreme fragmentation: in some cases, plots measure less than 0.1 ha. Most of the land was cultivated for local subsistence until the second half of the 20th century. The current situation is characterised by smallholdings of hardly traceable ownership, overgrown with flammable vegetation and without a comprehensive management plan.

In the dry coniferous forests of the inner Alpine valleys, there is a need to respond to the potential for stand-replacing wildfire and to improve the forest's resistance and resilience to fire. In essence, in Susa Valley an integrated fire prevention plan was needed. In parallel, the local timber supply chain needed to be revitalised to support the local timber industry by increasing the value of wood from fire prevention and post-fire treatments in both private and public forests.

*Overview of the intervention area: in the lower part, private, intervention will be implemented in 2024.* Source: University of Turin

**Location**
Susa Valley (Piedmont Region), Italy

**Actors**
Forest Consortium of Upper Susa Valley, the University of Turin, Cooperativa *La Foresta* (private forestry company), *Unione Montana Valle Susa* (association of municipalities)

**Pros**
The project incentives the collaboration between stakeholders (both private and public) as well as the local economy, giving value to a resource often overlooked.
Fuel management as civil protection action, protecting forest functionality, strategic buildings and wildland-urban Interface areas.
Easy replicability in other supramunicipal areas in Italy.

**Cons**
The legal framework may limit the application of some measures in private forests.
Lack of human resources to cover all actions to be done.
Difficulties in keeping forest multifunctionality while ensuring an economic viability of the interventions.

## Challenge

In the Alpine valleys of Italy, land abandonment has increased over the last 70 years. As a result of this abandonment, the area of forest and the amount of biomass have increased significantly, and in some places this has led to a continuous, unmanaged forest cover. As a result of these factors, exacerbated by the effects of the climate crisis, the inner Alpine valleys can experience large forest fires with significant impacts, including the degradation of forest functionality in protecting people from rockfall and landslides. **How preventive measures can include protection of ecosystem services and support for firefighting while being economically sustainable?**

## Solution

The *Fire prevention for wood supply chains* (PRe-FEu) project sustainably manages forest fuel in extensive areas by valorising the wood obtained through preventive silvicultural treatments in short value chains. This wood is transformed into assortments of different qualities destined both for the construction and interior design sectors and for the energy sector. The integrated fire prevention plan of Susa Valley aims to cover fuel management costs over time, while promoting economic, social and environmental sustainability.

## Technical implementation

The PRe-FEu project was launched in 2020 to reduce the impact of large fires in the forests of the Upper Susa Valley. The integrate fire prevention plan covers the forested area of the Upper Susa Valley (about 26,300 ha) and a pilot area in the Lower Susa Valley (about 1,000 ha). The plan integrated these three elements in its interventions: forest ecosystem services, fire-fighting support measures and economic sustainability. It included 35 types of preventive infrastructure such as shaded fuel breaks, strategic fuel management areas, and pyrosilviculture, to increase the resistance of forest stands in large blocks (> 10 ha), and reduce fuel in the wildland-urban interface. Preventive green infrastructure was installed and maintained to reduce flammability by altering fuel levels, structure and connectivity in the understory and canopy through variable retention cutting, prescribed burning and rotational grazing. These treatments have been designed and implemented in areas where fire behaviour can be altered by mountain topography and changes in vegetation flammability.

**Type of measure**
Risk management: prevention and restoration

**Type of economic incentive**
Productive infrastructure

**References**

**PSR 2014-2020: Operazione 16.2.1, Azione 1 Bando 2019 – PRe-FEu (Prevenzione degli incendi per le Filiere del Legno).** 2020. Consorzio Forestale Alta Val di Susa (in Italian, some parts in English and French).

**Dalle ceneri dei boschi della Val Susa nasce un bosco resiliente.** 2023. SorgeniaUP (in Italian).

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*Municipal forest after the preventive intervention.* Source: University of Turin

The economic sustainability of the interventions has been achieved through economies of scale (thanks to joint forest management) and the use of harvested wood for high-value products and bioenergy, securing sustainable local wood supply chains.

*Construction of a mountain hut with pine timber from preventive interventions.* Source: University of Turin

## Administrative implementation

PRe-FEu project was coordinated by the Forest Consortium of Upper Susa Valley (CFAVS in Italian). The main territorial actors in the area of activity (municipalities, associations of forest owners, livestock associations, etc.) participated in the development of the integrate fire prevention plan. The implementation of the plan has significantly increased cooperation between local, regional and national public institutions. The activities of the PRe-FEu project focused on large public properties to plan its interventions, involving private smallholders when the relevance of their plots was high.

The integrate fire prevention plan was subjected to an econometric analysis of fuel management practices and the effectiveness of suppression of extreme wildfire events. The analysis used data collected in representative Mediterranean countries on the types and costs of forest fuel management and treatment, the amount of EU funds invested in fuel management and post-fire rehabilitation, the annual budget allocated to firefighting training, and the official costs of firefighting agencies.

## Financial implementation

PRe-FEu was a project funded by the Rural Development Programme of the Piedmont Region. PRe-FEu had a budget of €374,000, of which €74,800 (20%) were co-funded. The project earmarked 4% of the water charge paid by residents to finance the integrate fire prevention plan through a payment for ecosystem services mechanism. The business plan was the single most relevant aspect of the integrate fire prevention plan in order to obtain fundings, particularly from European Regional Development Fund and private donors.

**60% of salvaged timber was used for high-value products**

PRe-FEu carried out activities to maintain the local timber industry by removing and recovering burnt logs from the forests of the Susa Valley. The salvaged timber was used by the local cooperative *La Foresta di Susa*. 60% was used to produce highly valuable products and 40% for energy production. One of the cooperative's flagship products is a picnic table with benches made of Scots pine salvaged from the 2017 fires. Using the salvaged wood prevented economic losses of the forest interventions and increased the visibility of the project. A marketing campaign was organised to raise awareness of the use of salvaged wood from local fires.

It increased sales of the salvaged wood picnic table tenfold compared to ordinary picnic tables. Another iconic product was a mountain hut built with wood harvested in preventive interventions. Scots pine reclaimed timber was used for the internal structure and external cladding. These uses gave visibility to the project.

## Requisites for success

### Integration

Through PRe-FEu, CFAVS has improved its foresters' understanding of forest fires as a significant risk to local forests and human activities. The organisation is now seeking synergies to implement the integrate fire prevention plan through self-financed timber harvests and public funding. CFAVS staff have been trained in these activities.

### Continuity

CFAVS, with its expertise in forest management since 1953, will ensure the full implementation of the plan in the coming years. PEFC chain of custody certification will maintain the commitment of the project partners. The importance of revenue from timber sales varies from intervention to intervention, depending on the characteristics of the forest and its accessibility. In any case, most of the interventions will need other sources of funding to reach economic break-even. Currently, the main sources are regional/European funding and private crowdfunding companies interested in supporting the plan.

In 2023, the PRe-FEu integrated fire protection plan for the Upper Susa Valley is being tested and it will be replicated in other areas of the Piedmont Region.

### Specialisation

The project involved bibliographic resource activities and testing of innovative silvicultural practices, providing training for foresters to plan preventive interventions without the use of external resources.

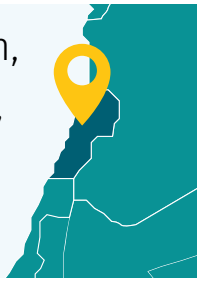
**PRe-FEu integrated fire protection plan to be replicated in other areas of the region**

### Collaboration

PRe-FEu is a collaboration between the CFAVS, municipalities, the fire service, local sawmills and research institutions to improve forest management, prevent fires and safeguard ecosystem functions. It has been funded by the EU Rural Development Programme, LIFE project calls and private investment. Municipalities and the *Unione Montana Valle Susa* are raising awareness of forest fires and implementing local prevention practices. Firefighters were involved in the preparation of the fire prevention plan, specifically supporting the mapping of the available fire suppression resources and infrastructures. Private forest owners with plots located in relevant areas made them available to expand intervention areas. This activity has been very time consuming but very rewarding and has helped to change public attitudes towards forest management for wildfire prevention. Forestry companies were involved both in carrying out the activities (together with CFAVS loggers) and in producing local wood products. Their innovative design enabled the project to reach out to a wider audience and to build consumer and public support for preventive activities.

# NGO SUPPORT FOR COMMUNITY WILDFIRE RESILIENCE

The Association for Forests, Development and Conservation, a Lebanese non-profit and non-governmental organisation, is helping vulnerable communities to build resilience against wildfires.



## Background

West Beqaa district is located in the southern part of the Beqaa Valley, in eastern Lebanon. It is Lebanon's most important farming region. It covers an area of 425 km² and hosts a population of more than 65,000 people. The region is characterised by a landscape intertwined with forests, agricultural lands, cultural sites, and settlements. However, ineffective forest management and human activities have increased the area's vulnerability to forest fires. The local population, many of whom live in poverty-stricken informal settlements near agricultural lands, heavily rely on forest resources like firewood for heating and cooking. This reliance further strains the already pressured natural resources and exacerbates the risk of forest fires. Unfortunately, the situation is expected to worsen in the future, with an increase in the number of fires and the duration of fire seasons.

*A landscape photo of the West Beqaa and the Qaraoun Lake.* Source: Ramy Sakr

**Location**
West Beqaa (Lebanon)

**Actors**
AFDC, international donors, local communities, local authorities, civil defence members.

**Pros**
Adopting participatory approach in developing local forest fire management plan ensures the initiative ownership.
Incorporating forest-based livelihood into the forest fire management plan promotes local community recognition and motivation to protect the natural resources.
Reducing the impact of forest fires on local communities improves the socioeconomic outcomes.

**Cons**
Working in fragile state context can undermine the sustainability of the forest fire management plans.

## Challenge

The West Beqaa district in Lebanon has been identified as a high-risk area for forest fires, which have worsened due to the effects of climate change. The lack of prevention, preparedness, and response measures at the municipal level has further increased the risk of fires. While Lebanon has a national forest fire management strategy in place, community support is crucial to implementing community-based fire management approaches and enhancing resilience to forest fires. **In this context, how can an NGO assist local communities in improving their fire management capabilities?**

*The forest cover after pruning and implementing the fire prevention process.* Source: Ramy Sakr.

## Solution

The AFDC, founded in 1992, is a non-profit non-governmental organisation in Lebanon that promotes sustainable governance of forests and natural resources. Their primary objective is to safeguard these resources and achieve climate and land degradation neutrality. They do this by promoting mitigation practices, creating an environmentally educated society, and advocating for sustainable development practices. AFDC also seeks to conserve natural and cultural heritage while adapting evidence-based practices. One of their achievements is developing a community-based forest fire management plan in West Beqaa, as part of their Nature Conservation programme.

**Type of measure**
Risk management: prevention

**Type of economic incentive**
NA

**References**

**AFDC Lebanon**. 2023. Association for Forest Development and Conservation

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## Technical implementation

AFDC fights wildfires through the Nature Conservation programme by promoting mitigation practices across the country to resist the effects of climate change and land

*Work in progress of cleaning and clearing the forest cover in the West Beqaa district.* Source: Ramy Sakr

degradation. AFDC aims to preserve and sustainably manage Lebanon's forest ecosystems by contributing to the expansion of protected areas and actively participating in achieving land degradation neutrality through enhanced restoration and reforestation efforts. It also aims to create an effective tool for monitoring and evaluating forest projects and initiatives.

In West Beqaa, AFDC adopted a participatory approach with stakeholders to tailor a community-based management plan and to establish a local forest fire risk committee to identify high-risk areas. The members of this committee were local authorities, local public agencies, academia, farmers, women, and the youth. AFDC trained the committee members on fire risk planning and management processes, and received advanced firefighting equipment. This ensured the local ownership of the plans. Since 2019, AFDC has trained over 34 first responder teams to combat local forest fires, supported by the World Food Programme's Food Assistance for Assets.

AFDC has also restored over 85 hectares of abandoned public lands in the Beqaa region, planting native forest species and installing protective fencing against livestock. The success of these seedlings depends on regular maintenance and monitoring. In collaboration with the World Food Programme, AFDC has restored over 294 hectares of arid lands across the Akkar, Baalback/Hermel, and Beqaa governorates since 2018, planting 213,478 seedlings, reforesting abandoned lands and rehabilitating public gardens. Over 7,498 households have received cash-based transfer assistance through previous projects, ensuring food for their tables.

*The forest cover after pruning and implementing the fire prevention process.* Source: Ramy Sakr

## Administrative implementation

AFDC has a general assembly of members from all over Lebanon. This assembly elects a committee that has a mandate of strategic orientation. At the execution level, AFDC adopts a matrix organisational structure including programmes and projects to achieve its mission, under the direction of the director general. Operations are supported by human resources, finance, procurement and monitoring and evaluation departments. At the national level, AFDC works with the Ministries of Environment, Agriculture, Education,

Interior and Municipalities. At the local level, AFDC works closely with local stakeholders in 15 different locations in Mount Lebanon, North and South Lebanon through voluntary units consisting of up to 500 volunteers.

## Financial implementation

Since its initiation in 1992, AFDC has been working on mobilising resources through building partnerships with donors, UN agencies and prominent international environmental organisations. During the last 30 years, AFDC has received funds from 32 partners and donors (including WWF, UNEP, UNESCO, and IUCN). However, the forest fire management plan for West Beqaa was implemented in partnership with the World Food Programme through the *Increase the Resiliency of Empower Lebanese Communities to Withstand Climate Change Impacts* project. Millions of dollars were supported by international donors to be implemented across the country. However, the total amount fluctuates between the years depending on the availability of funds and the number of projects awarded and implemented taking into consideration the economic and social security situations at the national and local levels.

**32**
PARTNERS AND DONORS

## Requisites for success

### Integration

In addition to the Nature Conservation programme, AFDC has four other programmes: Sustainable Development, Environmental Education, Outreach & Communication, and Research. AFDC's five programmes are integrated by aligning and coordinating individual projects to achieve AFDC's overall goal. AFDC ensures that the mission and goals are clear, with overarching aspirations for the programmes. Team members collaborate and communicate effectively by sharing information, resources and expertise to ensure proper integration and maximise performance.

### Continuity

AFDC has delivered quality achievements in natural and human systems for more than 30 years, however, funding levels vary depending on the dynamics of the funding ecosystem and are prone to international economic, financial and political obstacles.

### Specialisation

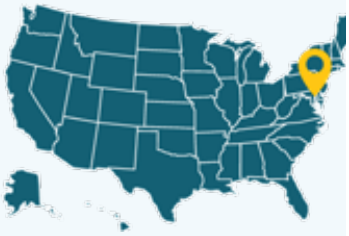
AFDC lacks adequate and sustainable financial support to extend its approach to all fire risk designated areas in Lebanon. Support is needed to provide equipment and restoration activities of the burned sites and preventive forest works such as establishing fire breaks, and thinning, and also to raise awareness.

### Collaboration

AFDC collaborates with different stakeholders at the national, regional, and local levels to join forces, exchange of expertise and best practices with similar entities to ensure the realisation of national strategies and plans.

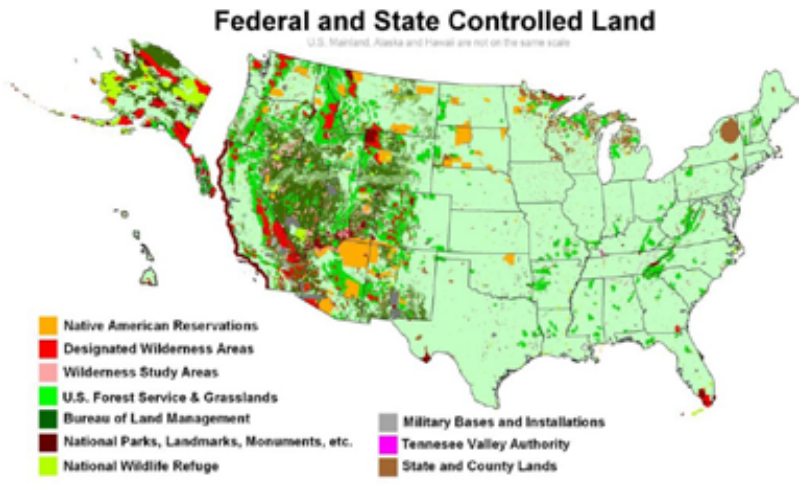
# LANDSCAPE-LEVEL WILDFIRE RISK MANAGEMENT ACROSS JURISDICTIONS

The Joint Chiefs' Landscape Restoration Partnership provides cost-sharing to improve the health and resilience of forests across jurisdictions and across actors.



## Background

There are approximately 3,313,000 km$^2$ of forested land in the United States. Five federal agencies are responsible for planning and responding to wildland fires in 2,735,000 km$^2$ of forest in the United States: the Bureau of Land Management, the Bureau of Indian Affairs, the National Park Service, the United States Fish and Wildlife Service (the four within the U.S. Department of the Interior), and the United States Forest Service (within the U.S. Department of Agriculture). In addition, state, county and local fire risk management organisations are responsible for several hundred thousand hectares of forests in the United States. Publicly owned forests are mostly located in the western half of the country and are usually surrounded by privately owned forests. Is there where average fire season length, number of large fires, and annual area burned are increasing, and increased fuel continuity and conditions resulting from climate change have caused a rise in the extent and frequency of high-severity wildfires.




*Federal and state-owned land in the U.S.* Source: WolrdMap

**Location**
United States

**Actors**
The Natural Resources Conservation Service (NRCS) and the Forest Service of the United States Department of Agriculture (USDA)

**Pros**
It improves environmental governance by working across jurisdictional and organisational boundaries to support collective action and address issues at large ecosystem scales. The requirement to collaborate and infusion of committed, multi-year funding support faster implementation of planned work and increased coordination across jurisdictions and partners.

**Cons**
Previously established collaborative relationships between partners are the most critical factor underlying project success. Limited agency capacity is significantly impeding project success.

## Challenge

The forests of the United States face the challenge of large and frequent wildfires that impact the environment and require enormous suppression efforts. This disturbance occurs at a landscape scale, involving multiple actors and land tenants, and creates a mismatch between large-scale, dynamic ecological processes and the scales at which individual land management agencies have the capacity and authority to operate. **How can environmental governance be improved to work across jurisdictional and organisational boundaries to support collective action and address scale mismatches?**

## Solution

To improve the health and resilience of forests and grasslands on public and private lands, the United States Department of Agriculture (USDA) launched the Joint Chiefs' Landscape Restoration Partnership Initiative (Joint Chiefs' for short) in 2014. The Joint Chiefs' supports and addresses ecological processes, such as wildfire, that require coordination across multiple jurisdictions. It provides cost-shared funding for collective action to reduce wildfire risk through three-year projects on mixed landholdings at the landscape scale.

## Technical implementation

The Joint Chiefs' Landscape Restoration Partnership is an initiative between the National Resources Conservation Service (NRCS) and the Forest Service. It enables these two agencies to invest in collaborative projects with agricultural producers, forest landowners, tribes, and public land managers to conserve and restore forests and grasslands on a scale large enough to make a positive difference in environmental stewardship. Working in partnership, and at this scale, helps reduce wildfire threats to communities, protect water quality and supply, and improve wildlife habitat for endangered species.

Local collaborative groups self-organise and compete for three-year project funding. Project proposals must set out their own goals and objectives, deliverables, timelines and measurable desired outcomes. The Joint Chiefs' programme gives priority to proposals that address wildfire risk reduction in a municipal watershed or the wildland-urban interface.

**Type of measure**
Risk management: prevention and restoration

**Type of economic incentive**
Subsidies (grant and cost-share funding)

**References**

**Joint Chiefs' Landscape Restoration Partnership.** 2023. U.S. Department of Agriculture.

**Policy design to support cross-boundary land management: The example of the Joint Chiefs Landscape Restoration Partnership.** 2019. Land Use Policy.

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*Northern Front Range Joint Chief's Landscape Restoration in Colorado, USA.* Source: USDA

Proposals should increase the forest workforce capacity or forest business infrastructure and development, leverage existing agencies and non-federal funding contributions from partners, support the established state, tribal and regional priorities, and describe how the eligible activities were prioritised across the landscape and the source of the state or regional priorities (e.g., fire area analysis, wildfire risk assessment, state technical committee watershed prioritisation, endangered species recovery plan, state wildlife action plan, etc.). They must also demonstrate a balance between land tenures, prioritise adjacent lands at the public-private boundary, and include education and outreach activities to local communities.

Landowners will work with local USDA experts and partners to apply targeted forest management practices on their land to address the unique forestry challenges in their area. Thanks to the availability of funding, landowners are able to conduct coordinated fuel reduction activities, such as thinning, hazardous fuel treatments, firebreaks, and prescribed burning. Beyond fire-risk mitigation, tree planting under the Joint Chiefs' programme is another valuable post-fire restoration tool and supports the USDA's reforestation priority.

While there is no minimum area or scale requirement for projects, almost every project highlights the value of the Joint Chiefs' for increasing the pace and improving the spatial coordination and extent of activities. The inclusion of work on private lands makes for more contiguous treatment landscapes.

## Administrative implementation

Joint Chiefs' programme is jointly administrated by the NRCS and the Forest Service. Between 2014 and 2022, the initiative has supported 110 projects in 42 states and Puerto Rico, to treat 121,405 hectares of hazardous forest fuels, restore 11,735 hectares in priority watersheds, and enhance 80,937 hectares of wildlife habitat. The NRCS will provide cost sharing for the treatment or restoration of mixed assets larger than 20,000 ha.

Joint Chiefs' project proposals are developed at the local level through consultation between the NRCS, the Forest Service and other partners (non-governmental, state, tribal, and community participants). Local NRCS and Forest Service offices submit the proposals to national agency offices. Proposals are reviewed and vetted at multiple agency levels based on local, state, tribal and regional priorities. Landowners are often required to submit final reports at the end of the project, detailing activities, outcomes, and lessons learned, which helps evaluate the success of the project and contributes to the overall evaluation of the Joint Chiefs' programme.

## Financial implementation

Between 2014 and 2022, USDA has invested $286 million in 110 Joint Chiefs' projects. In 2023, 14 projects were selected, with funding per project ranging from $199,500 to $2,853,032 in fiscal year 2023. Most of the selected projects received between $500,000 and $1,500,000 during the fiscal year 2023, and the total funding for this period was $48.6 million ($17.4 million for the 14 new projects and $31.2 million for the 25 previous projects still in progress).

Once a project has been implemented and verified as meeting NRCS standards, financial compensation is paid for the work.

Private forest landowners can obtain funding from alternative sources to treat additional forest area simultaneously. Joint Chiefs' funding, particularly for the Forest Service, provides an opportunity to continue fuel treatments that were initiated or planned in previous years.

## Requisites for success

### Integration

The significance of the Joint Chiefs' Landscape Restoration Partnership stems from the collaboration between NRCS and the Forest Service. It demonstrates how policy can be designed to support restoration work across boundaries and to support improved approaches to fire management in the U.S. legal and administrative context, by involving or allowing the involvement of non-state actors to coordinate across jurisdictions, build bridges between actors, and leverage capacity. To reduce wildfire risk, the Joint Chiefs' programme provides a model for coordinated action by supporting different types of landowners at the same time and engaging them in a comparable timeframe.

### Continuity

The programme's goal is to authorise $90 million annually for the Joint Chiefs' Landscape Restoration Partnership, to be split between the Forest Service (at least 40%) and the NRCS (at least 40%). The remaining funds may also be used for technical assistance, project development, or local capacity.

### Specialisation

The specialised resources needed to implement the Joint Chiefs' programme are professional experts on forest and fuel management, adequate financial resources, technical equipment (tools for fuel treatment, monitoring equipment, GIS, machinery), as well as social and ecological data.

### Collaboration

In the absence of the Joint Chiefs' programme, large landowners, including public and private corporate landowners, coordinate directly with each other when planning and implementing treatments at the landscape scale. In contrast, family forest owners (usually small tenant farmers) rarely coordinated directly with each other or with large landowners. Instead, they work individually with NRCS partners or foresters to plan treatments on their properties. The Joint Chiefs' programme builds bridges between different landowners, regardless of type or size of property, to achieve coherent and continuous hazard prevention forest management or restoration across the landscape.

Partners in the Joint Chiefs' projects include, but are not limited to: national, state, county and local governments, departments and agencies, public land managers (including the Bureau of Land Management, the Bureau of Indian Affairs, the National Park Service, the Fish and Wildlife Service, and the Forest Service), large corporate landowners as well as small family or individual landowners, private utility companies, non-governmental organisations, tribal governments, foundations, and wildfire protection services.

# INTEGRATED FIRE RISK MANAGEMENT IN THE FONTAINEBLEAU MASSIF

The managers of the Fontainebleau massif have implemented an integrated fire management plan that includes information campaigns, ground and aerial patrols, adaptation of forest composition and infrastructure, and close cooperation with other actors.

## Background

The Fontainebleau massif covers nearly 23,000 hectares and is managed by the Ile-de-France–Est territorial agency of the National Forest Office (ONF in French), being a protected state-owned forest. It is a popular natural landmark in France, attracting 15 million visitors annually, and is renowned for its world-class boulder climbing. The forest grows on a sandy substrate and is home to flammable species such as eagle fern, heather, mullein, and Scots pine. Although the forest has an oceanic climate, it has been affected by wildfires throughout its history. The presence of dense litter often causes ground fires that last for several days after the main fire is extinguished and can cause new fires.

*Wildfire in the Fontainebleau massif.* Source: ONF Fontainebleau territorial unit

**Location**
Seine-et-Marne department (Ile-de-France region), France

**Actors**
Ile-de-France–Est territorial agency of the National Forest Office (ONF), ONF Fontainebleau territorial unit, National Forest Fire Protection Agency (DFCI), Departmental Fire and Rescue Service (SDIS)

**Pros**
An integrated fire management plan covers the entire landscape fire governance continuum and utilizes the capacities of existing agencies involved in forest and fire management.

**Cons**
Staff members must be trained and reminded of their roles and procedures due to the plan's complexity. Exceptional funding is necessary for training and equipment acquisition.

In the early 20th century, forest managers identified tourism as a major cause of wildfires, leading to the installation of lookout towers in 1920. However, the use of mobile phones in the early 2000s made these towers obsolete, with alerts often given by forest users. Ignitions occur every year, but the annual area burned rarely exceeds 10 hectares due to the rapidity of alerts and the responsiveness of local firefighters. However, the effect of repeated dry spells on certain stands, particularly Scots pine, remains significant and could increase its impact rapidly.

## Challenge

The risk of forest fires in the northern half of France is low. In heavily visited forests like Fontainebleau, efforts have been made to minimize the annual rate of fires. **How can public forest managers successfully prevent and provide early alerts in highly tourist areas?**

## Solution

Integrated fire risk management has been progressively developed on the Fontainebleau massif to reduce the number of hectares burned. The ONF Ile-de-France–Est territorial agency's strategy is based on four pillars: providing regular information to citizens about fire risk, conducting ground and aerial patrols, adapting forest infrastructures to firefighting needs, and maintaining a close partnership with the Forest Fire Protection Agency (DFCI in French).

## Technical implementation

The ONF Île-de-France-Est territorial agency works in prevention and regularly provides information to users through various channels, including social media. They established a Facebook group called "Forêt de Fontainebleau" with over 10,500 members, where they share updates, particularly during high wildfire risk periods. Additionally, from April to November, the Fontainebleau territorial unit staff conduct ground patrols. Aerial patrols are conducted using a drone equipped with a thermal camera to detect forest hotspots, particularly campfires, which are often the cause of fires in this area. This tool also assists firefighting services in identifying sleeper and ground fires after the main fire has been extinguished.

In recent years, five 30 m³ underground tanks have been installed to facilitate firefighting operations in the most

**Type of measure**
Integrated landscape fire management plan

**Type of economic incentive**
NA

**References**

**La gestion du risque incendie dans le massif de Fontainebleau.** 2022. Office National des Forêts (in French).

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*Installation of a buried 30 m³ water tank.*
Source: ONF Fontainebleau territorial unit

sensitive areas. These tanks are buried because the Fontainebleau massif is a listed site. Integrating them into the landscape is therefore a priority. Forest roads have been upgraded to provide access for firefighting equipment. The agreement initiated by ONF also allows to restock fire engines at various points along the waterway that flows through the state-owned forest and provides drinking water to Paris.

Since 2023, a team of two forestry workers has been conducting patrols to increase public awareness, detect and intervene in incipient fires. The patrols use pick-up trucks equipped with a removable kit, including a 600 L water tank, motor-driven pump, and hose reel with fire hose. They communicate with the fire brigade by radio. One vehicle was allocated in 2023, and two additional vehicles were allocated in 2024.

## Administrative implementation

The ONF Ile-de-France–Est territorial agency has established a close partnership with the Departmental Fire and Rescue Service (SDIS in French) to enhance their operations in the Fontainebleau Forest. Technical days are held annually to improve mutual understanding of each other's missions, and they regularly participate in SDIS exercises. An emergency vehicle access cartographic atlas of the forest has been created. The agency aims to collaborate with SDIS from the Essonne department to enhance intervention prevention and effectiveness in the nearby Sénart public forest.

Furthermore, the National Forest Fire Protection Agency (DFCI in French) has established a network that includes all territorial actors involved in protecting the forest against fire. The ONF Ile-de-France–Est territorial agency has been granted the authority to implement measures aimed at reducing the risk of wildfires since 2020. These measures are determined based on the wildfire risk level published by the French Weather Agency (Météo-France) and may include restrictions on access or activities in the forest when the risk level is high. The DFCI agency has created a written document outlining the emergency procedures to be followed.

The network of actors involved in forest fire management benefits from technical and regulatory assistance provided by DFCI. This facilitates exchanges with other referral agents, allowing for the sharing of experience and knowledge. Many DFCI agents participate in training sessions on wildfires to improve firefighters' skills. This network structure is being replicated in other departments in northern France with less structured wildfire risk management, helping to address both internal and external forest fire needs. A one-day general training course was held in 2020, followed by three days of training in 2023 on system procedures and brush clearing. Forestry workers responsible for patrols also received three days of training.

## Financial implementation

Some of the actions, such as personnel costs and equipment, are funded by the ONF Ile-de-France–Est territorial agency through a *mission of general interest* received from the French Ministry of Agriculture. This covers information campaigns, both in the field and on social networks, meteorological observation, ground patrols, the improvement of forest roads, and the ONF's cooperation with the authorities, the DFCI and the SDIS. External funding has been required for the following actions:

- the acquisition of a drone and thermal camera, through a sponsorship programme, and the
- the acquisition and installation of five 30 m³ water tanks in the forest, through Ile-de-France region and the Seine-et-Marne department funding.

As a result, the budget allocation for these activities has increased. A drone equipped with a thermal camera is estimated to cost around €25,000 (excluding taxes and pilot training), while an underground tank is estimated to cost between €30,000 and €35,000 (excluding taxes).

*Prescribed bringing in the Fontainebleau massif.* Source: ONF Fontainebleau territorial unit

## Requisites for success

### Integration

The Fontainebleau forest faces a significant tree dieback, posing a risk of increasing dead biomass. To address this issue, species that are better adapted to water deficits, such as pubescent oak (*Quercus pubescens*), Pyrenean oak (*Q. pyrenaica*), and rowan (*Sorbus spp.*) are being planted. Forestry works are limited or prohibited during periods of high fire risk to prevent further hazards.

### Continuity

The ONF territorial agency has an internal procedure that is updated annually. This procedure reminds staff members of the measures to be taken and the roles of everyone involved. Additionally, ONF uses the media to remind forest users of good practices.

## Specialisation

The local ONF teams had already been trained in fire monitoring and policing. Additional training was required to prepare for the aerial patrol. Five ONF staff members from the territorial agency were trained as drone pilots, as these skills were not previously available. Additional staff members have received training on the use of firefighting equipment that will be installed in the pick-up trucks, as well as monitoring the **Compulsory Brush Clearing**. Personnel could receive training in fire cause investigation in the future, although this has not yet been implemented in the area.

## Collaboration

ONF and SDIS collaborate to understand each other's roles in fire situations. This enables forestry technicians to assist the fire brigade in facilitating response and allows the fire brigade to rely on foresters' skills in addressing access, presence of human, fire-sensitive stands, and other particular issues. The network of correspondents is important for the ONF's response to fire risks. It enables the ONF to enhance its skills, knowledge of procedures, and effectiveness in prevention and support for the fire brigade during fires, thereby enhancing the ONF's overall response.

*The oak is a typical species of the Fontainebleau forest landscape..* Source: Manon Genin / ONF

EFI

The European Forest Institute is an international organisation established by European states. EFI conducts research and provides policy advice on forest-related issues. It facilitates and stimulates forest-related networking and promotes the dissemination of unbiased and policy-relevant information on forests and forestry. It also advocates for forest research and for the use of scientifically sound information as a basis for forest policies. EFIMED receives funding from the Spanish Ministry of Science, Innovation and Universities.