FIRE-RES

Innovative technologies & socio-ecological-economic solutions for fire resilient territories in Europe

D4.7 IA 4.6 brief: Fire-smart risk governance and planning legal frame and tools

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Task Number: 4.2 Inclusive and coherent fire-smart risk governance and planning - Subtask 4.2.2 Fire-smart planning platform and conceptualization tool

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Abstract: Growing wildfire risk makes urgent an effective integration of wildfire risk into spatial and urban planning. This is particularly urgent in Europe, where urban expansion into forested areas has heightened exposures and vulnerabilities. Unlike other hazards, wildfire risks are dynamic and influenced by human activity, requiring tailored approaches. This deliverable presents three tools developed within the FIRE-RES project to enhance fires-smart spatial and urban planning as follow: (1) wildfire risk management resources for professionals into a platform, (2) a guide for land planners and (3) a prototype of application for integrated risk assessment and planning and collaborative governance.

Key words: Spatial and urban planning, land planners, operational tools, integrated risk management and governance.

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Version 1	20/02/2025	Draft	Marta Serra, Eduard Plana, Maria Huertas, Miquel Martí (CTFC) ; Pepa Moran, Giuseppina Verduci, Albert Vich (UPC).
Version 2	30/04/2025	Revision	Jean-Paul Monnet, Sergio Pirone, K. Harald Drager (TIEMS), Luis Fernando Arencibia (Cabildo de Gran Canaria)
Version 3	29/05/2025	Validation	Marta Serra, Pau Brunet, Diana Bolopo (CTFC)

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1. Introduction

The increasing frequency and intensity of wildfires, driven by evolving risk factors and climate and land use changes, present significant challenges for wildfire disaster risk management (DRM). These challenges extend beyond traditional wildfire-prone areas, affecting new and previously unaffected regions across Europe. As climate change exacerbates wildfire risks, there is a growing need to integrate disaster risk reduction (DRR) efforts with broader sectoral policies, including spatial and urban planning as it has the capacity to increase/decrease the exposed elements (e.g., houses, etc.) or increase/decrease the vulnerability (e.g., integrating wildfire mitigation measures in urban developments).

This task is based on the specific context that wildfire risk is evolving within two shifting contexts: first, climate change is driving meteorological variations that extend the wildfire risk season beyond the summer months and introduce fire hazard in previously unaffected areas. Second, spatial and urban developments in Europe, and in the world, has increased in last decades. Added to this, in some EU regions, such as the Mediterranean, have been shaped by a historically unstructured expansion, coupled with the gradual abandonment of agricultural, forestry, and livestock activities. As a result, urban areas have increasingly expanded into forested landscapes, creating a growing wildland-urban interface (WUI) that heightens the vulnerability of these populations to wildfires.

Beyond these territorial dynamics, wildfires—like other natural hazards such as floods and landslides— should serve as a key consideration in spatial and urban planning. Effective planning must account for the incompatibility of urban development in high-risk zones or incorporate mitigation measures to reduce wildfire vulnerability. While the risks associated with floods, avalanches, or landslides are clearly defined in terms of territorial and temporal boundaries, wildfires present a more complex challenge. Wildfires can occur in any area with sufficient fuel accumulation and are often influenced by human activity, necessitating a tailored approach to integrating wildfire risk into spatial planning (Cerdan, 2002; Plana, 2007).

Given the cross-sectoral nature of wildfire risk, a multi-faceted management approach is essential—one that incorporates spatial and urban planning policies. In recent decades, wildfire severity has led to more intense wildfire impacts on urban settlements and infrastructure, making the integration of wildfire risk into planning processes an urgent priority. As planning is regionally or nationally governed (no harmonized conditions or directives are based at EU level), the specific capacity to integrate wildfire risk into planning will depend on each territory and the wildfire knowledge available.

This deliverable presents three tools developed within FIRE-RES project **to enhance and support the integration of wildfire risk into spatial and urban planning** in EU landscapes, as follows:

- FireXplorer platform: A platform that provides citizens and practitioners with accessible knowledge and information related to wildfire risk.

- Guide for planners: A guide outlining methodological steps for integrating wildfire risk management into landscape planning.
- Risk assessment and planning application: A prototype of a computer application designed to support the integration of wildfire risk assessment into planning processes.

According to the task description, the expected Technology Readiness Level (TRL) of the tools is 3 – experimental proof of concept, which was successfully achieved. In the case of the FireXplorer platform and the Guide for planners it is considered that the TRL level is higher, as they are products ready for exploitation. Anyway, further development and validation of the tools would be appropriate to achieve high TRL levels in the future.

2. Specific objectives and methodology

This section outlines the specific objective of the task and details the methodologies applied in the development of the tools.

2.1. FireXplorer platform: 'To Do' section

2.1.1 Specific Objective

The main objective of the FireXplorer platform – To Do section is to **collect and organise the knowledge already available regarding wildfire risk information** which it could serve to spatial and urban planners, among other professionals and practitioners, to better integrate that risk in their job. Thus, the objective is not to create new information but offer, in an organized manner, the existing information.

2.1.2 Methodology

Regarding the methodology, the platform includes three main sections according to different target audience stablished:

(1) 'To Teach', aimed at teachers and educators;

(2) 'To Learn', designed for students and general public; and

(3) 'To Do', intended for professionals (Figure 2). This section focuses on the methodology behind the development of the third section, 'To Do', which targets professional users.

The conceptual inspiration for this section was drawn from the [Flood Hub](), a platform dedicated to support communities in managing flood and coastal risk in United Kingdom.

The structure, content display, filtering options, and overall design of the "To Do" section of the platform were defined in close collaboration with the platform's development team. This collaborative process involved a series of online meetings and an intensive working week held in Portugal. The main outcomes of this co-design process included (Figure 1):

- The establishment of a user-friendly, consistent, and functionally aligned structure that supports the specific objectives of the project.
- The specification of the content types to be included in the 'To Do' section, as well as the design of applicable filters, the amount of information presented on the initial interface, and its integration with the other two platform sections.
- The identification and categorization of stakeholder groups represented in this section ('To Do'), as well as the associated descriptive metadata.
- The definition of final filtering criteria to ensure efficient and targeted access to relevant information.
- The design of a survey, in line with the platform's specifications, aimed at gathering a broad and diverse set of resources to populate the section.

Figure 1. Methodological sequence.

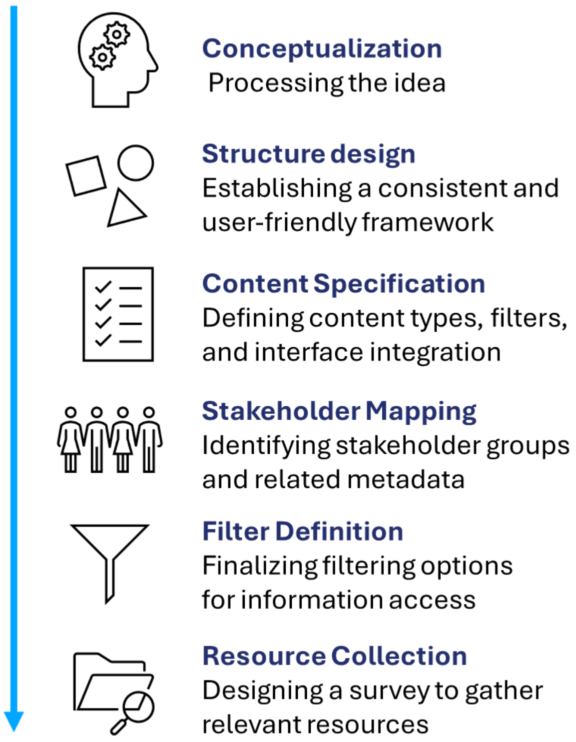
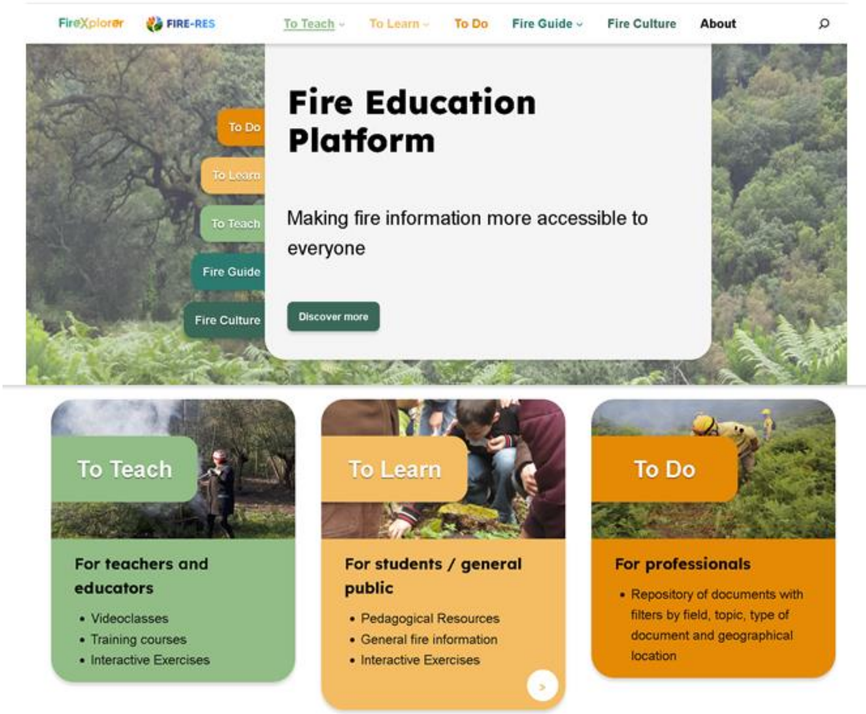


Figure 2. Platform display.



The categorization of the stakeholders' groups was inspired by the Flood Hub, and according to the project and platform objectives, they were defined as follows:

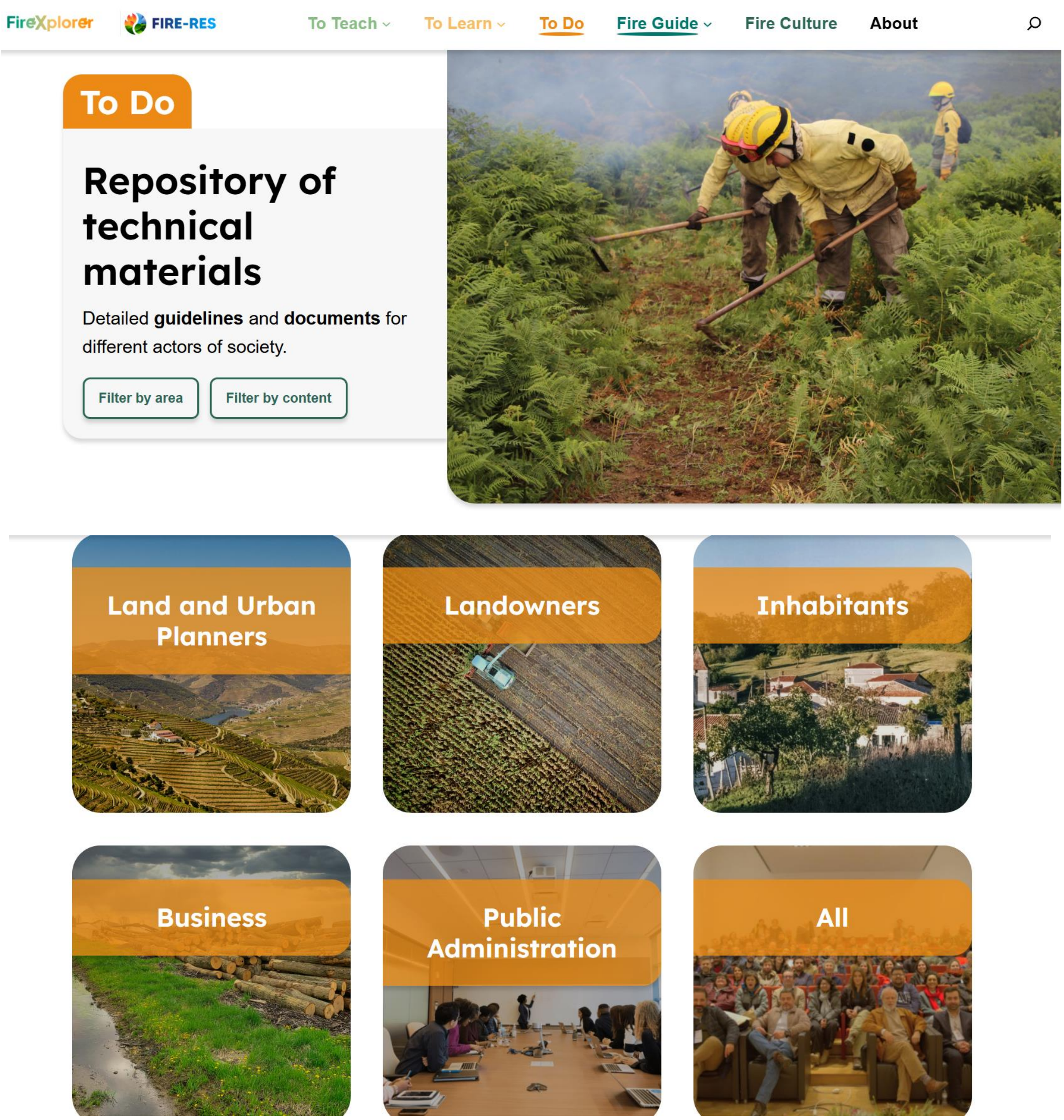
- **Land and urban planners**: Working to create organized and sustainable communities, considering various social, economic, environmental, and aesthetic factors while collaborating with diverse stakeholders to shape the future of land and urban spaces. Specialized in managing and developing rural and/or urban areas focusing on land use planning, infrastructure development, addressing housing, transportation, sustainability, economic growth and/or community engagement.
- **Land and homeowners**: As an individual, entity, or organization, they possess legal rights to a specific piece of land or real estate. These rights typically include ownership, control, and the ability to use, lease, sell, or develop the land in accordance with local laws and regulations. The purpose of their property may vary such as residential, commercial, industrial, agricultural, or recreational. They are responsible for managing and maintaining the land, paying property taxes, and ensuring that the use of the land complies with zoning and land-use regulations established by local authorities.
- **Inhabitants**: As a resident in either a rural or urban area, they may either own a home or rent one, and their residency status could be primary or secondary.

Regardless of their circumstances, they have an important role to play in shaping local policies and the decision-making processes that affect the community. Their needs and priorities include aspects like land-use, infrastructure, and social services, which are often bound to the different characteristics of rural or urban living.

- **Business**: As a stakeholder within the business category, they may represent either an individual or an entity of varying size, with direct or indirect interests in a particular business or enterprise. Besides the core objectives of their business, they have interest in maintaining good corporate governance and ensuring the long-term sustainability and growth of the company. Given that their company or organization operates within a physical environment, this growth and sustainability are intricately tied to the physical landscape. Through their economic weight, their specific interests have an important role to play in shaping local policies and the decision-making processes.
- **Public administration**: As a stakeholder within the public administration category, they may represent a diverse range of actors, including individuals, government agencies, organizations involved in the management and execution of public policies, government functions, or the delivery of essential public services. Whether they act as an individual or on behalf of an entity, their role can involve making critical policy decisions and setting the strategic course for various facets of public administration, thereby playing a pivotal role in governing and providing essential services to citizens. Their interests, responsibilities, and interactions have the capacity to significantly influence both the political and physical landscape across different scales of government.

The stakeholder description available in the platform was shortened. It was agreed not to define more than 5 groups, because the simpler the format, the easier it will be to use for expert and non-expert public. These groups were carefully defined to be distinct enough to avoid confusion, while also broad enough to prevent excessive segmentation and ensure broad applicability.

Figure 3. Stakeholder groups visualization.



The information and resources have been systematically categorized to enhance searchability and user accessibility. Jointly with a professional web designer, the filters were selected to facilitate the search. The classification includes the following criteria:

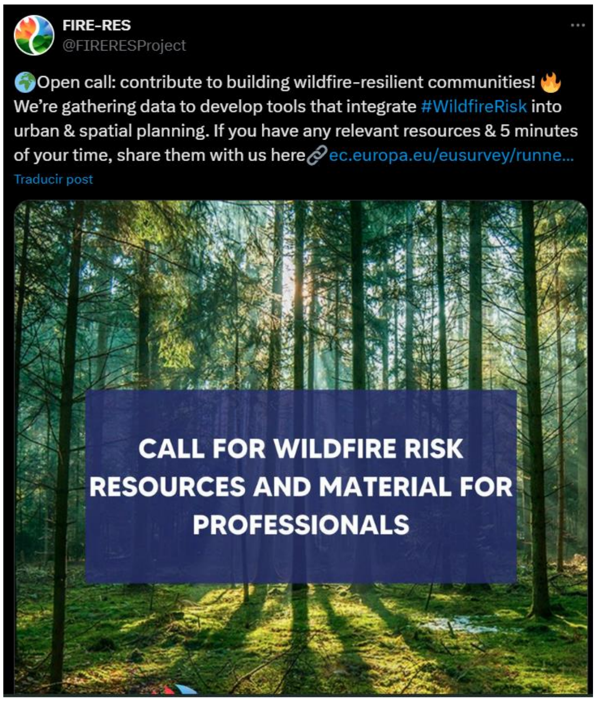
- **Type of material**: Including Guide, Website, Scientific paper, Mobile app, Infographic, Video, Map, Other.
- **Name**: Resource/material name.

- **Target audience**: Including Spatial and urban planners, Land and homeowners, Inhabitants, Business, Public administration.
- **Purpose**: Including Risk prevention, Risk assessment and planning, Risk preparedness, Risk awareness and communication, Risk response, Risk policy and governance, Risk recovery.
- **Scale**: Including Local, Cross-border, Regional, International, National.
- **Country**.
- **Language**.

These filters can be applied individually or in combination to refine search results. For example, users can simultaneously filter for resources focused on Risk policy and governance at the Local scale, allowing for more targeted and relevant information retrieval.

Finally, the collection of material was done through an online survey, which included the fields related to the filters (most of them were multichoice), and where the users could upload the material linked to the task objective. The survey was shared through different networks and channels, including mailing, blog posts, social nets, among others. Below there are some examples of the channels used:

Figure 4. Examples of channels used for sharing the online survey



MedForest

Bioeconomy Ecosystem services Forest management Governance Resilience

Resilience Climate change Wildfires

FIRE-RES calls for wildfire risk resources: help build resilient communities!

The FIRE-RES project is calling on professionals to share wildfire risk resources to help build an online platform designed to enhance resilience in urban and spatial planning. Your input is crucial and you can contribute by completing a brief survey!

By FIRE-RES - October 21, 2024

Photo: FIRE-RES

In response to the growing threat of extreme wildfires in Europe, the H2020 FIRE-RES project is calling on professionals to contribute wildfire risk resources. The project, running from 2021 to 2025, focuses on promoting Integrated Fire Management and providing tools that help communities and landscapes become more resilient to wildfires.

A key objective of FIRE-RES is to develop an online platform that will serve as a central repository for wildfire risk information. This platform is designed to support a wide range of users, from homeowners to land planners and managers, making it easier for them to access and organise relevant data. By doing so, the project hopes to integrate wildfire risk considerations into urban and spatial planning, even for those without specialised knowledge in the field.

FIRE-RES is urging professionals to take part in a brief, five-minute survey to help build a comprehensive wildfire resilience platform. By contributing relevant resources—such as documents, tools, guidelines, or case studies—you can play a vital role in shaping this initiative. Participants are asked to provide key details about the materials they share, including the name, type, target audience, and country of origin. Your input will ensure the platform serves a wide range of users effectively.

To participate, submit your resources here: Wildfire Risk Resources Survey

EVENTS

ThinkForest webinar to explore carbon farming in European forests

EUFORGEN webinar: Mechanisms of natural and anthropogenic selection on trees in...

Join the first ResAlliance "Ask Me Anything" session with Manuel Bertomeu...

Policy forum on landscape resilience in the Mediterranean: barriers and gaps...

PUBLICATIONS

Unraveling oak decline: key drivers in Mediterranean climates

Curious about the factors behind oak decline in Mediterranean regions? This systematic review compiles all published articles on oak decline in these areas up...

Incubating pallet wood samples does not enhance detection of Bursaphelenchus xylophilus

Research highlights potential of Esteya fungi to fight pine wilt disease...

NEWS

FORESTMED: a

ThinkForest webinar to

After different calls for collecting material, resources from EU and non-EU countries are included in the platform. A brief description (one-two sentences) of each material is available in the platform to facilitate content identification.

2.2. Guide for planners

2.2.1 Specific Objective

European practitioners is a growing community that is facing many challenges to the profession, adapting planning to climate change, as well as to new regimes of disruptions such as wildfires.

Landscape planning is an instrument for conservation, remediation and improvement of nature and the man-used landscape, and it can contribute to the construction of resilient landscapes through planning and management. The integration of wildfire assessment into landscape planning is one of the keys to this contribution.

A practical guide is developed to integrate wildfire risk mitigation into planning, addressing the main concepts of hazard, exposure and vulnerability, system resilience and cost-effectiveness, as well as the evaluation of risk mitigation planning and strategic proposals. One of the main objectives is to **provide landscape and urban planning practitioners and end users with a general perspective about wildfire risk management and help to integrate it into assessment, planning and decision-making processes**.

2.2.2 Methodology

The methodology is the result of the academic and research process developed in the Master of Landscape Architecture (MBLandarch) from the DUTP-UPC Urban, Territory and Landscape Department from the ETSAB, (Barcelona Technical School of Architecture) in the UPC, Polytechnical University of Catalonia and the exchange of knowledge with the Catalan wildfire community led by the CTFC and the Catalan Fire and Rescue Service (CFRS) among others throughout the last decade.

Landscape and urban planning have become a key to wildfire prevention policies. Embracing a scope of design and planning strategies that incorporate wildfire risk and vulnerability as a transversal aim in their strategies.

The main adaptation measures towards wildfire prevention are collected and related to landscape-urban planning and regulations, focussing on main objectives to "Integrate wildfire approach in landscape and urban planning".

The guide has been presented along the FIRE-RES project through different events and presentations to the Wildfire Innovation Community of Catalonia, mailing, blog posts, social nets, among others. Table 1 shows some examples of the channels used.

Table 1. Guide for Planners' public presentations.

	Date	Stakeholders	Phase
CWI Catalunya at Can Coll, Barcelona	22nd May 2024	Wildfire Innovation Community Catalonia (WICCat)	Draft guide 1
Online presentation	12th November 2024	Wildfire Innovation Community Catalonia (WICCat)	Draft guide 2
Policy Coherence Workshop	4th December 2024	Wildfire Innovation Community Catalonia (WICCat) And Public and private administration	Final version Guide

2.3. Risk assessment and planning prototype

2.3.1 Specific Objective

The objective of the prototype is to develop a wildfire risk assessment and planning computer application designed **to support practitioners, risks managers and land planners in effectively conducting governance and risk assessment** with the participation of stakeholders.

2.3.2 Methodology

The method focuses on identifying key risk factors, risk mitigation measures and the corresponding planning tools and stakeholders involved. It aimed at assessing and planning risk in a holistic, sequential and systemic way. Ultimately, this will provide a framework in which territorial activities are integrated into the risk management cycle (RMC), promoting a more resilient and better-prepared community to face the impacts of wildfires.

The methodology follows an analytical sequence based on the risk factors comprising the elements of hazard, exposure, and vulnerability (HEV), and the risk management cycle, which includes the phases of prevention, preparedness, response, and recovery. The method includes three steps as follow (Figure 5):

Step 1: Per each value at risk in the territory, the HEV risk factors are identified, considering both physical and social aspects.

Step 2: Accordingly, risk mitigation measures per each identified risk factor, stakeholders involved in each measure, as well as the corresponding sectoral policy and/or planning tool where to fit it are related. Additional timeframe, priority or budget items are included.

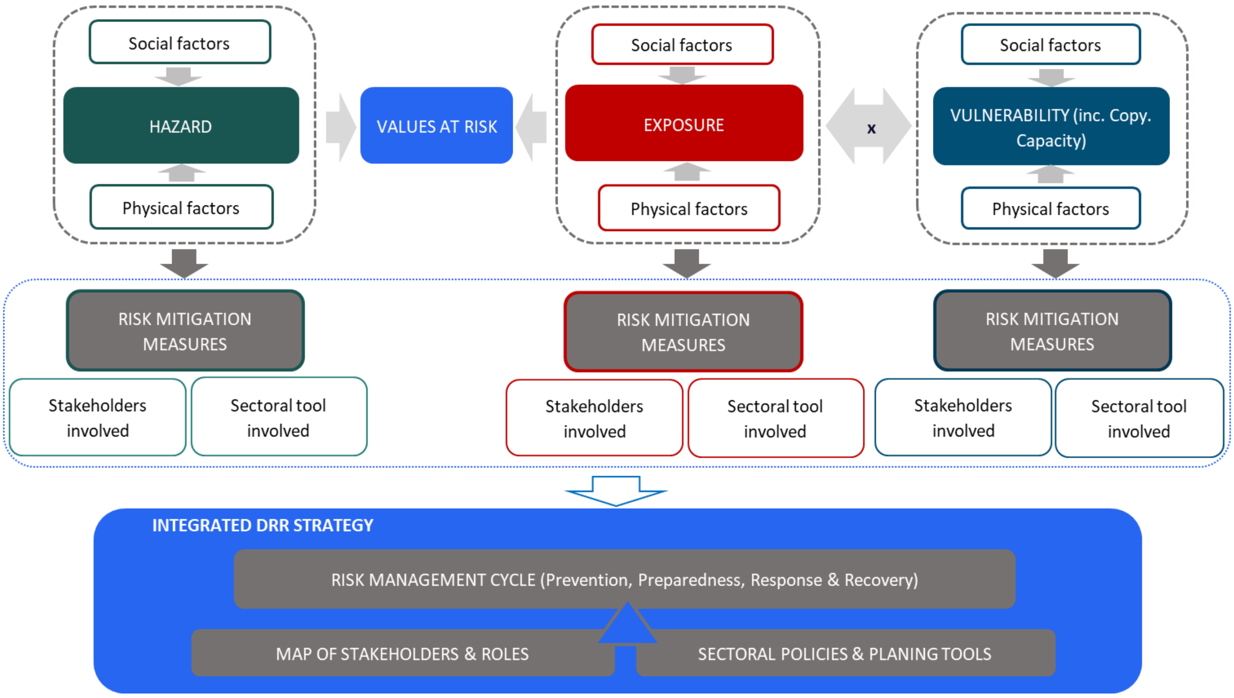
Step 3: Risk mitigation measures are organised within the RMC, conforming an integrated approach where cross-links among prevention-prepardness-response and recovery actions are balanced and synergies are potentiated in a coherent wildfire risk management framework, defining the roles and contributions of stakeholders.

By following these steps, the analytical sequence enables the following:

- Identification and mapping of risk-increasing and risk-reduction factors and measures, considering territorial dynamics and the interactions between wild-land areas and exposed or vulnerable elements.
- Establishment of the relationships among stakeholders in the territory, in relation to both risk-increasing and risk-reduction factors and drivers.

- Analysis of existing risk reduction measures included in various sectoral and/or specific planning instruments.
- Enhancement of current risk reduction strategies based on the identified factors, and proposal of an integrated planning framework across the areas of prevention, preparedness, response, and recovery. This aims to optimize synergies between measures, stakeholders, planning instruments, and actions.

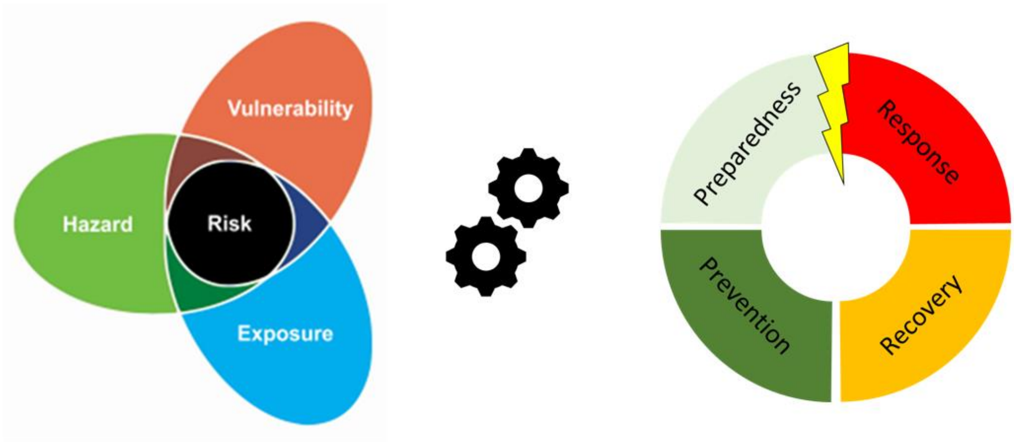
Figure 5. Risk analysis and planning sequence applied in the prototype.



To apply the methodology proposed in the prototype, first is crucial to understand the risk factors and its management cycle. The concepts of hazard, exposure, vulnerability, and the definitions for the stages of prevention, preparedness, response, and recovery considered in this application follow the UNDRR Disaster Risk Reduction Terminology (UNDRR, 2017),

The prototype enables the integration of risk assessment and planning information in a comprehensive manner, structured around two main components: Hazard Elements and Values at Risk, including their associated Exposures and Vulnerabilities. This structure is grounded in the theoretical framework of the risk chain (Badia et al., 2002), which suggests that the presence of a hazard translates into potential impacts on exposed elements. If exposure cannot be mitigated, the associated risk is transferred to vulnerability. In essence, the existence of a hazard is a prerequisite for valuable elements to become either exposed or vulnerable to its effects. The greater the hazard, the higher the potential for exposure and, consequently, vulnerability.

Figure 6. Risk factors and phases of the risk management cycle considered in the computer application.



The interlinkage between the risk factors (hazard, exposure and vulnerability) and the risk management cycle phases (from prevention to recovery) allows to a complete and organized risk assessment, and its consequent planning.

To this end, the prototype is designed to function as a support tool, presenting risk assessment and planning information in an accessible, organized, and sequential manner. It is not necessary for the input data to be exhaustive or fully complete, as the prototype can serve as a reference or starting point for conducting a risk governance exercise. Consequently, the tool's usability can be adapted to suit different user objectives, such as developing a risk assessment, understanding risk planning instruments, or initiating risk governance practices.

Functioning of the application

The computer application can be applied at different scales from local (operational plan, Figure 7) to sub-national/national (strategic plan) levels.

The tool includes the following items that must be filled by the users:

- Risk factors: this field provides a description of each risk factor, which may either be a hazard and the corresponding exposures and vulnerbilities of the value at risk. If the factor is a hazard, it should specify whether it relates to ignition or propagation. Value at risk must be first identified, to proceed with the analysis of exposures and vulnerabilities.
- Risk reduction measure: it defines the risk mitigation measure related to the corresponding element (e.g., protocol of agricultural burning practices on high-

risk days). For values at risk, the measure may target either exposure or vulnerability, depending on its nature and objective.

- Related planning tool: it identifies in which tool the measure has to be included (e.g., Wildfire risk emergency management plan).
- Related stakeholder: it identifies which stakeholder/s is/are linked to the measure and tool previously defined.
- Risk Management Cycle phase: it defines what is the corresponding risk management phase (e.g., from prevention to recovery).
- Timeframe: defines the expected timeframe for implementation (short-medium-long term).
- Priority: indicates the urgency or strategic importance of the measure (low, high, urgent).
- Estimated budget: includes initial implementation cost of the measure and maintenance cost.

There are other optional fields~~,~~ such as geolocation (spatial coordinates, UTM) or constraints (limitations for implementing the measure).

Figure 7. Graphical example of risk reduction measures for reducing the hazard of high-intensity wildfire spread (red), exposed elements (circles) and measures for vulnerability reduction (blue and yellow). This information is collected from the field and inserted directly in the application.

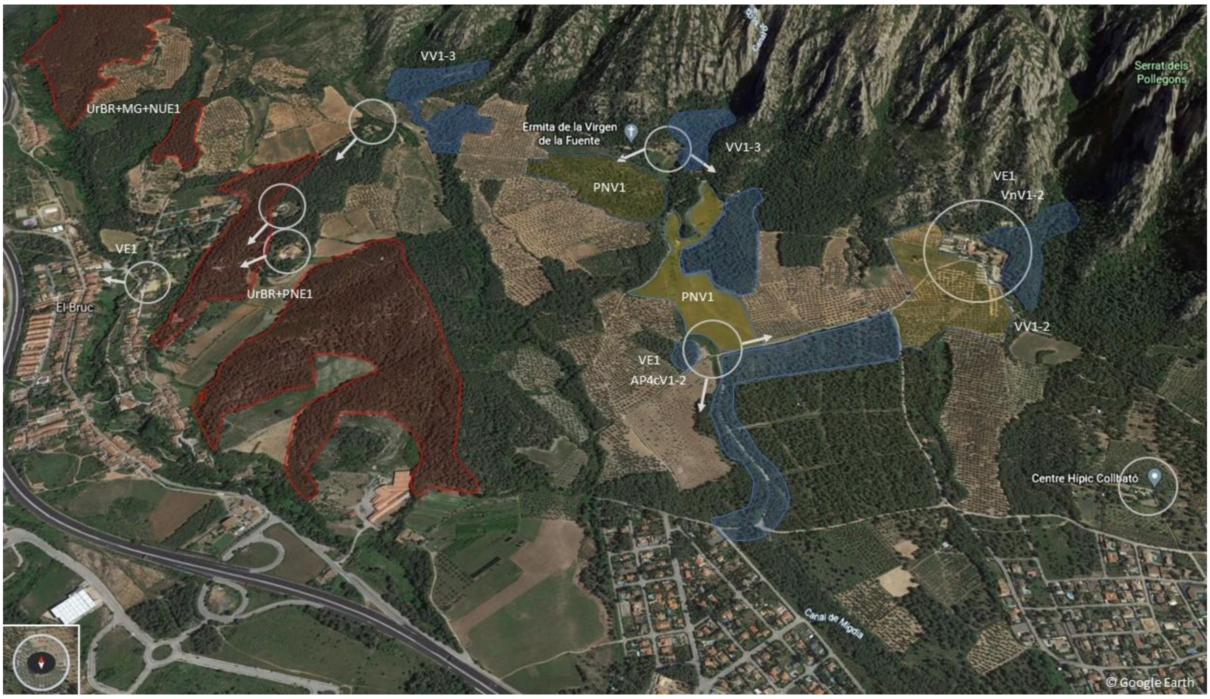
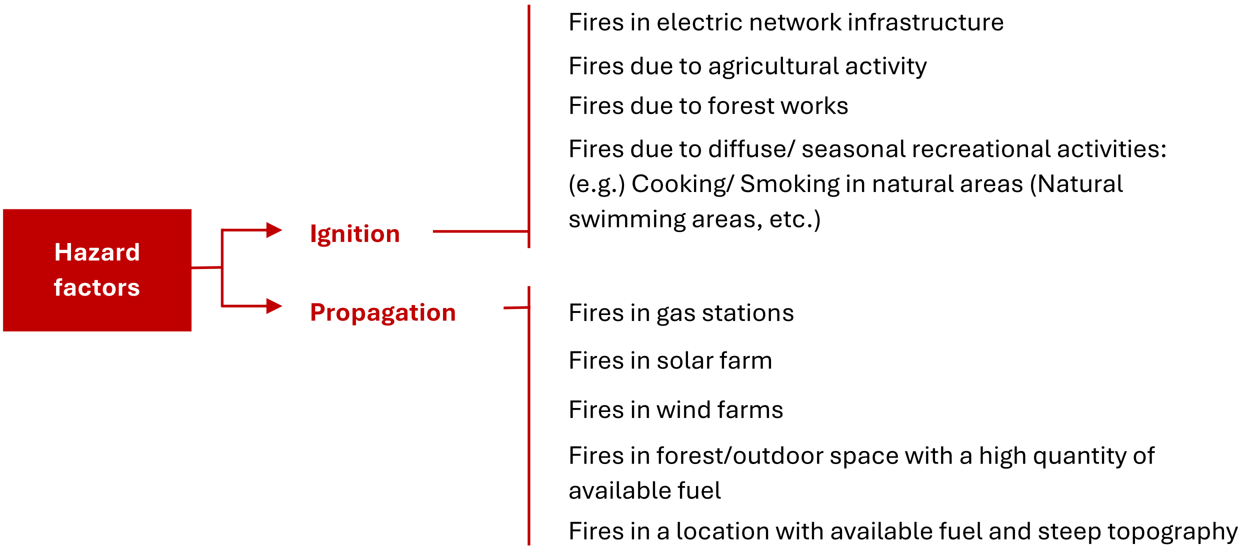


Figure 8. Example of hazard factors.



To test the methodology, all the content was organized in a excel file (Figure 9) to see how it could look like in terms of content organization. After completing and reviewing the content included, the format evolved into an online interface, which is the final result (see section 3.3.).

Figure 9. Screenshot of methodology testing in an excel file.

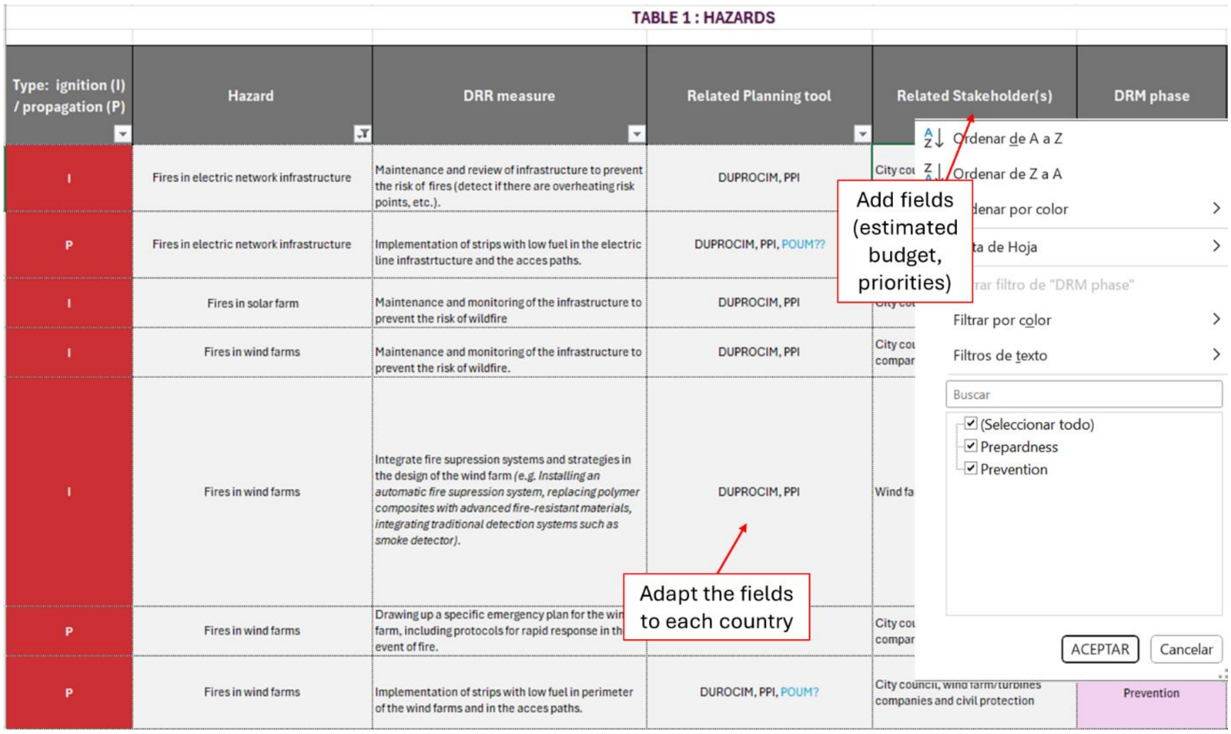


TABLE 1 : HAZARDS

Type: ignition (I) / propagation (P)	Hazard	DRR measure	Related Planning tool	Related Stakeholder(s)	DRM phase
I	Fires in electric network infrastructure	Maintenance and review of infrastructure to prevent the risk of fires (detect if there are overheating risk points, etc.).	DUPROCIM, PPI	City cou	
P	Fires in electric network infrastructure	Implementation of strips with low fuel in the electric line infrastrtucture and the acces paths.	DUPROCIM, PPI, POUM??		
I	Fires in solar farm	Maintenance and monitoring of the infrastructure to prevent the risk of wildfire	DUPROCIM, PPI		
I	Fires in wind farms	Maintenance and monitoring of the infrastructure to prevent the risk of wildfire.	DUPROCIM, PPI	City cou compar	
I	Fires in wind farms	Integrate fire supression systems and strategies in the design of the wind farm (*e.g. Installing an automatic fire supression system, replacing polymer composites with advanced fire-resistant materials, integrating traditional detection systems such as smoke detector).*	DUPROCIM, PPI	Wind fa	
P	Fires in wind farms	Drawing up a specific emergency plan for the win farm, including protocols for rapid response in th event of fire.		City cou compar	
P	Fires in wind farms	Implementation of strips with low fuel in perimeter of the wind farms and in the acces paths.	DUROCIM, PPI, POUM?	City council, wind farm/turbines companies and civil protection	Prevention

For the results edition, the system includes a query option that allows to organise the information by the required items. For instance, the user may ask to the application all DRR measures by Prevention stage, or by Stakeholder group or by combination of items.

Finally, a guide for users is edited indicating the steps to fulfil the information in the application and how to edit de results.

The final version of the prototype (see section 3.3) was tested with 3 practitioners from Central Europe to check its functioning and understanding. This test allows to include some minor modifications to improve the tool understanding.

3.Results

3.1. Fire explorer platform: 'To Do' section

The final and complete results are available in the FireXplorer platform powered by FIRE-RES. The platform is linked to Task 4.1, and it will be permanent available from June 2025 on. To see the test version, please go to https://fireexplorer.instawp.xyz/to-do/ which includes the design and content, but using a not definitive online link. To help understanding the results of this tool, they are described below.

The **purpose** of this section is to offer information, material and other resources to professionals, whether or not they have knowledge about wildfire risk. It acts as a centralized knowledge hub where users can find resources tailored to their role in society.

The page is designed to be interactive and user-friendly, and it can be used as follow:

By user role / target audience

The page organizes content by the type of user. Each category includes a brief description, and it includes relevant documents, guides, and tools:

- Land and urban planners: Planning and designing landscape and urban spaces.
    - ✓ Resources about integrating wildfire resilience into city and regional planning.
- Land and homeowners: Having a property (land, house, etc.).
    - ✓ Guidelines for fuel management, preparedness space, and sustainable land practices.
- Inhabitants: Permanent living in a particular place.
    - ✓ What citizens should do to prepare their homes and families for wildfires.
- Business: Carrying out professional activities.
    - ✓ What enterprises can do for wildfire prevention and ensure continuity.
- Public administration: Managing public programs and policies.

✓ Local, regional or national strategic actions, and coordination resources.

A last category named “All” includes the resources without stakeholder categories.

By content type and area

Users can filter documents based on:

- Type of material: Including Guide, Website, Scientific paper, Mobile app, Infographic, Video, Map, Other.
- Name: of the resource/material.
- Target audience: Including Spatial and urban planners, land and homeowners, Inhabitants, Business, Public administration.
- Purpose: Including Risk prevention, Risk assessment and planning, Risk preparedness, Risk awareness and communication, Risk response, Risk policy and governance, Risk recovery.
- Scale: Including Local, Cross-border, Regional, International, National.
- Country.
- Language.

Different filters can be applied at the same time, that is, it is possible to search for materials related to public administration, at local scale and linked to risk awareness and communication.

Multilingual support

The platform supports multiple languages:

- English
- Spanish
- Portuguese
- French
- Italian
- Greek
- Other

This ensures that users from different countries involved can access it in their native language. Although it is important to highlight that the resources offered are in the original language available.

Accessibility tools

The website includes tools for improved accessibility:

- Adjustable font sizes

- Cursor highlighting and text spacing
- Dark/high contrast modes
- Dyslexia-friendly fonts

These tools make the site usable by people with various visual or cognitive needs.

Application level

According to the variety of resources, the platform can be used by users from different parts of the world, and they can find useful information as long as they can understand the language in which the material is available.

In March 2025, there are a total of 56 material collected from 11 different countries. Some other **quantitative results** about the resources are:

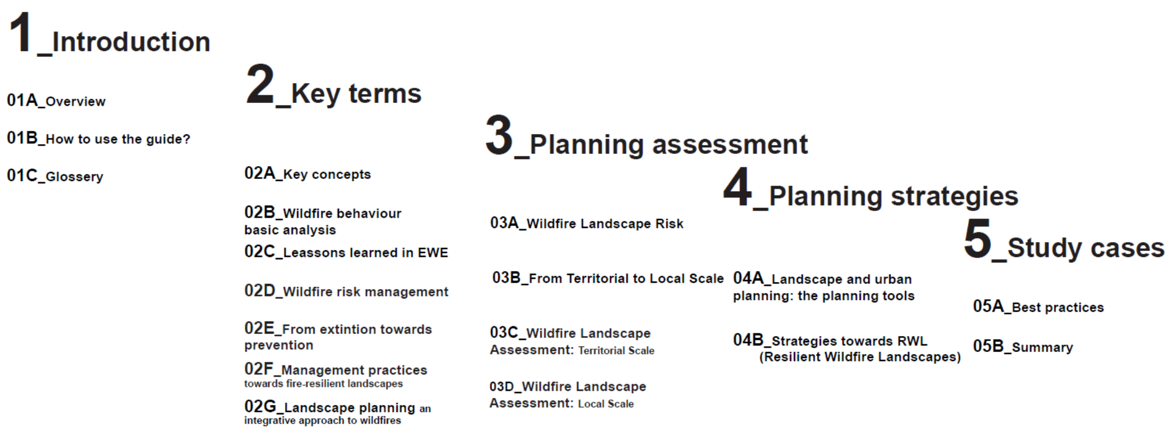
- **Type of material**: 12 Guides, 20 websites, 5 Scientific Papers, 4 Mobile Apps, 5 Infographics, 2 videos, 8 Maps and 9 Other (such as policy instrument or administrative normative).
- **Stakeholder**: 32 resources related to Spatial and urban planners, 30 to Land and homeowners, 23 to Inhabitants, 18 to Business and 39 to Public administration.
- **Purpose**: 45 resources linked to Risk prevention, 32 to Risk preparedness, 15 to Risk Response, 8 to Risk recovery, 37 to Risk assessment and planning, 31 to Risk awareness and communication and 19 to Risk policy and governance.
- **Scale of applicability**: 25 Local scale, 32 Regional, 23 National, 16 International and 7 Cross-border.

The section will have the possibility to upload material from users. By this way, the users can enrich the sample of material collected.

3.2. Guide for planners

The resulting document of the guide is organized in five main sections:

Figure 10. Index from the Guide for planners page



Each section is outlined as follows:

Introduction: The chapter provides context on wildfires and extreme wildfire events in climate change scenario, as well as wildfires interactions with ecosystems dynamics and functions. It focusses the question of resilient landscapes towards wildfires introducing main concepts in Wildfire research as *Fire paradox* term as a consequence of certain suppression policies and Adaptative Management and Landscape Planning contribution as preventive policies and strategies to reduce wildfire vulnerability.

Key terms: This chapter principal aim is to introduce wildfire key concepts to landscape and urban planning professionals and end users to gain a general perspective about this field and integrate into assessment, planning and decision-making processes.

In this chapter, the guide focuses on main key concepts such as: landscape values, resilience, risk, vulnerability among others. Wildfire behaviour main factors are explained, as well as wildfire regimes and typologies. Methodologies to define *Homogeneous Fire regime areas* and *Wildfire Potential Poligons* are described as potential tools to be integrated into landscape and urban planning, paying special attention to Wildland Urban

Interface/Intermix (WUI) and lessons learned in extreme wildfire events and wildfire risk management.

The main adaptation measures towards wildfire prevention are collected and related to landscape-urban planning and regulations, focussing on main objectives to "Integrate wildfire approach in landscape and urban planning".

Figure 11. Wildfire Risk prevention diagram (page 30)

Wildfire Landscape assessment: This chapter exposes main concepts on risk analysis and the methodology to assess vulnerability towards wildfire.

The "Living Lab Cat" icon is used along the guide to introduce specific information related to the Living Lab Catalonia, such as assessment maps, regulations, etc.

Wildfire Landscape assessment methodology is explained through cartographies that are applied to the territory of Catalonia. A sequence of cartography and graphics expose the methodology in two different scales:

- Territorial scale E: 1/1.000.000
- Local scale (Extreme Wildfire Units) E: 1/250.000

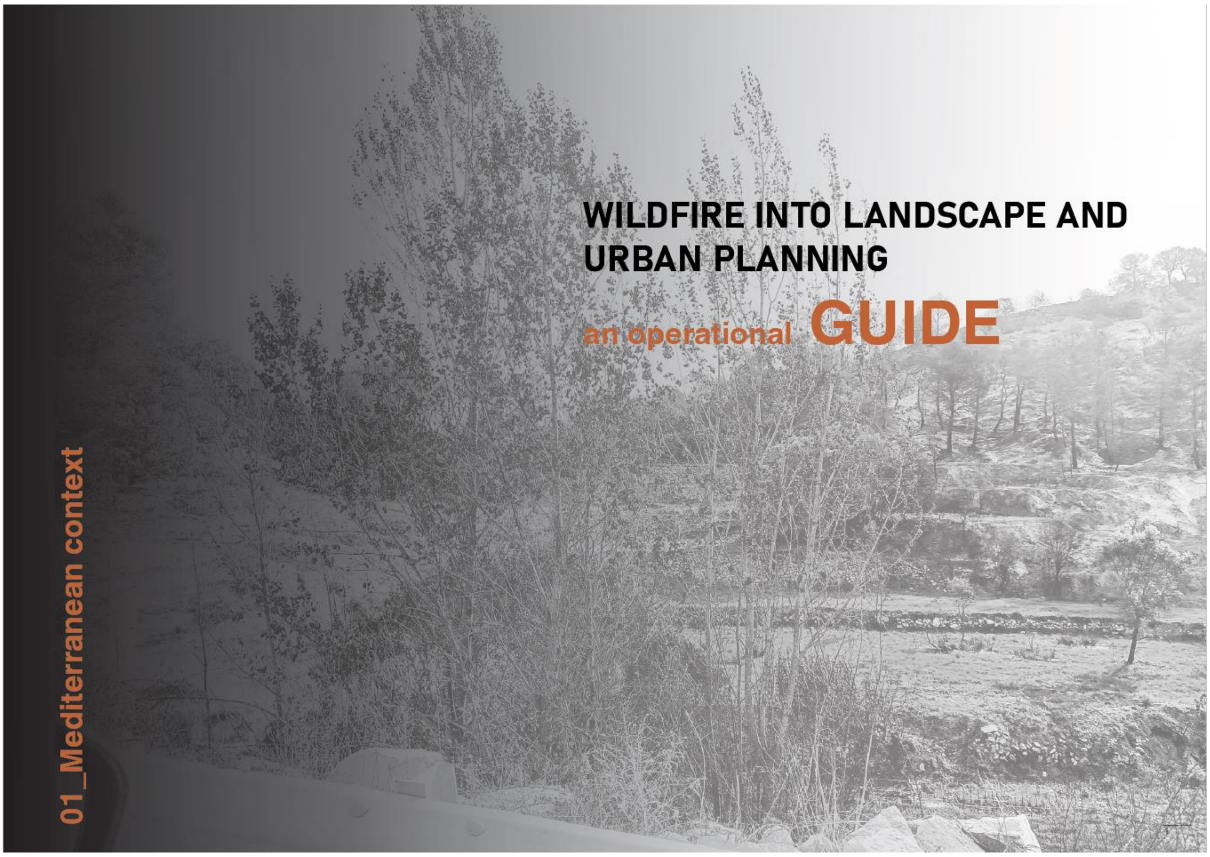
Planning strategies: The wildfire planning framework is exposed in this chapter. It focuses on plans, regulations and public/green infrastructures, which are the main planning tools to contribute to RWL (Resilient Wildfire Landscapes). This chapter highlights a selection of strategies towards Resilient Wildfire Landscapes, as multifunctional infrastructures, self-sufficient communities, urban and housing livability and self-protection.

The strategies are characterized by typologies, their values and benefits and a selection of study cases that develop this specific strategy.

Study cases: The last chapter gathers a selection of twenty best practices and study cases, which are characterized by specific items as the kind of planning tool that represents, the typology of wildfire to which is referred; the scale of the project; the assessment that has been developed in parallel and the strategy and action lines that are integrated in the proposal. A final summary classifies the best practices in four different scales as well as in their specific strategies and action lines.

For further information the Guide is attached to Annex 2 and is available on the FireXplorer platform.

Figure 12. Screenshots illustrating the Guide for planners

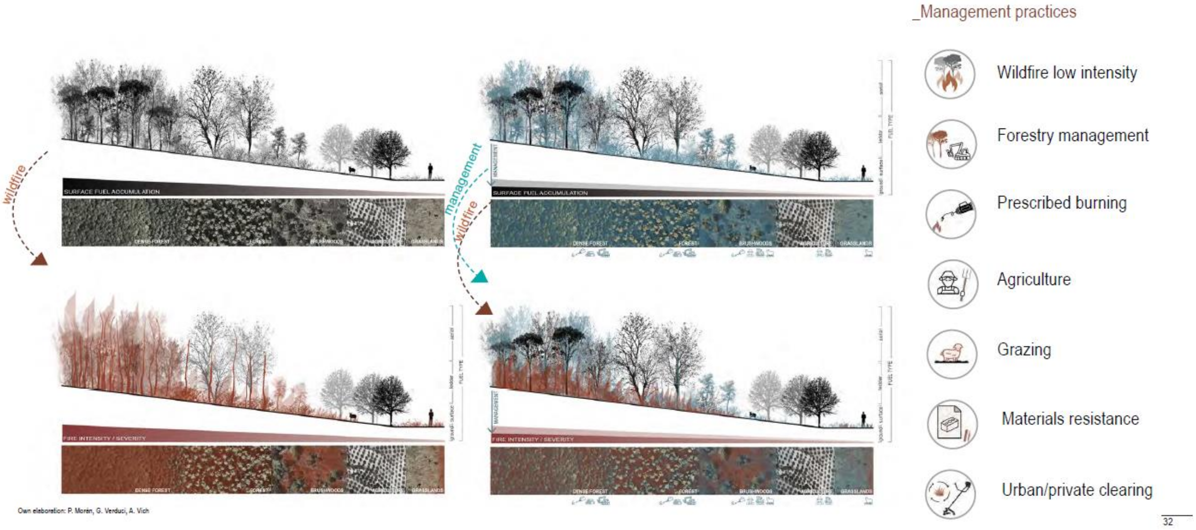


02F_Management practices towards resilient wildfire landscapes

F.1//Management practices

Wildfires primarily affect the forestry and ecosystem service sectors, but agricultural and energy production, public health and tourism may also be impacted, causing damage to property and loss of life.
The challenge is to develop integrated solutions which take into account the objectives of forestry, urban and rural development, agricultural, climate and energy policies to ensure that wildfires are managed in such a way that the safety of people and housing, economic growth and ecosystem ser-vices are maintained or increased. (Forest Fires, Sparking firesmart policies in the EU, 2018).
Forest structures with vertical discontinuity in terms of vegetation layers and horizontal discontinuity in terms of canopy and understory cover are more resistant to fire, making it more difficult to spread and reducing its intensity. (Orgest, 2011) This is demonstrated by studies in which it has been proven that if these continuities are altered through silvicultural treatments, the vulnerability of forest typologies to canopy fire decreases (Fule et al., 2001; Brown et al., 2004; Agee and Skinner, 2005; Johnson et al., 2007).

-Several works are claiming for a retorn of fire indigenous practices to ensure a sustainable way of letting wildfires to burn and eventually reduce fueled landscapes (both as a consequence of fire suppression policies or rural abandonment processes; Schoennagel et al. 2017; Kelly et al. 2020; Moreira et al. 2020).
-Fuel treatments aimed to prevent wildfires and help suppression maneuvers need to strategically count on evidence of their efficiency and on a plan to maintain them economically in the long term (Duane, Castellnou, Brotons, 2021).
-Some countries are considering the promotion of economic value chains of forest products and naturebased solutions as a way to incentivize sustainable forest management (Verkerk et al. 2018), while other regions advocate for an agricultural landscape mosaic and silvopasture practices as a way to reduce the risk of large, intense fires (Moreira et al. 2020).
-Adaptive management seems to be strongly encouraged in an unstable climate context: vegetation needs to readapt to changing climates and we can help ecosystems and species to new conditions in which they will be better adapted and less likely to release massive energy during wildfires (Schoennagel et al. 2017).



Own elaboration: P. Morén, G. Verduci, A. Vich

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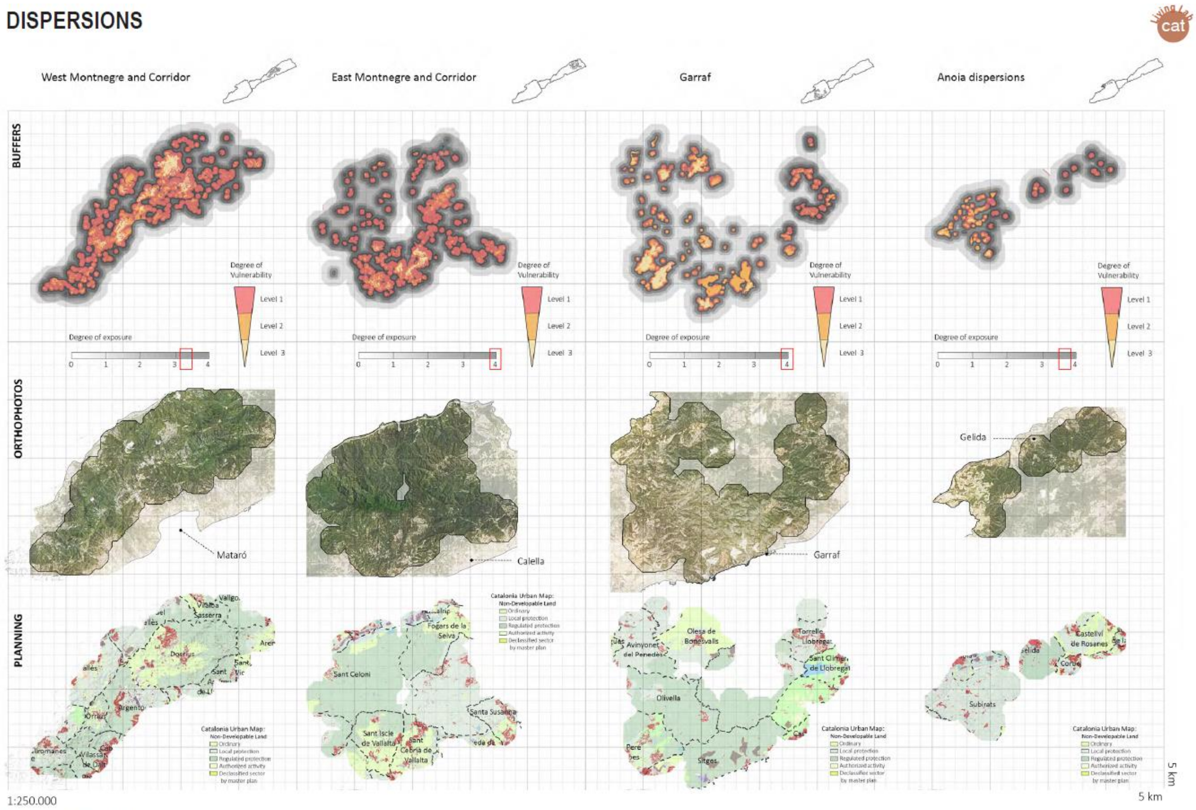
DISPERSIONS



Own elaboration: P. Morén, G. Verduci, A. Vich

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3.3. Risk assessment and planning prototype

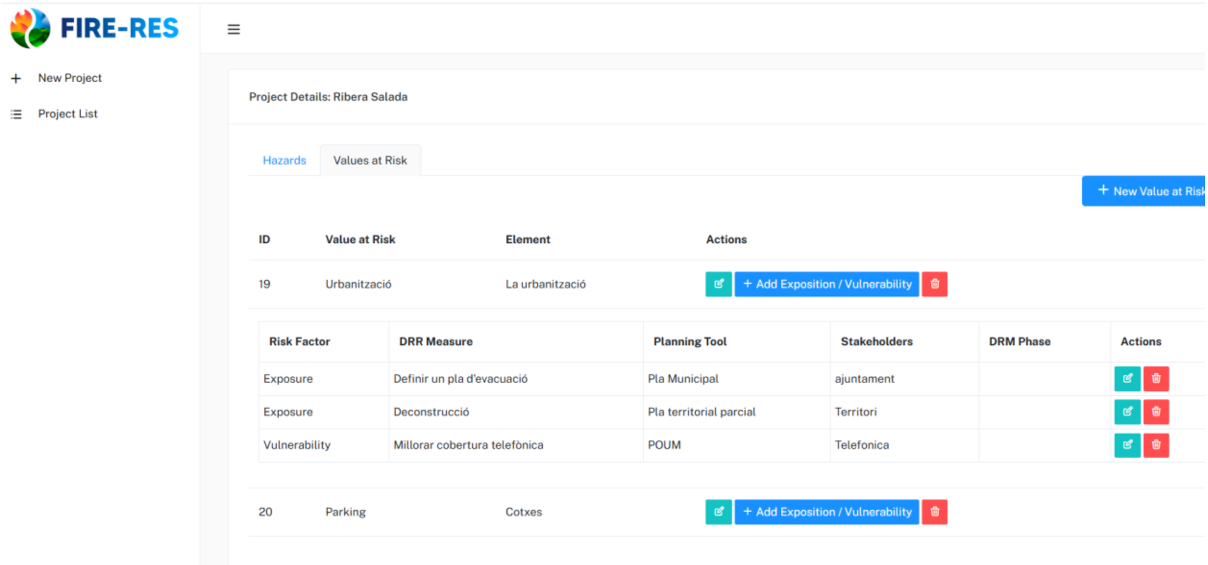
The online version of the computer application of risk assessment and planning is available in https://riskiap.ctfc.cat/. To access, the following provisional credentials must be used:

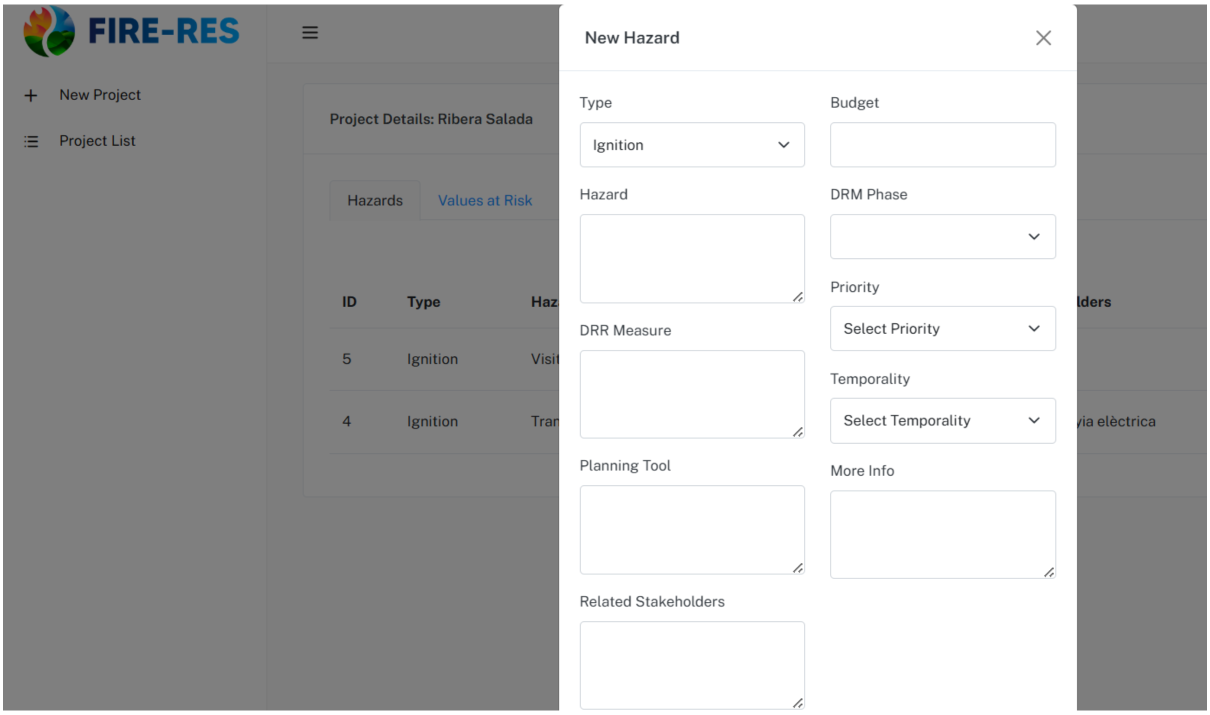
- Provisional Username: riskiap
- Provisional Password: riskiap

The current language is English, and in further versions may be translated to other languages.

To facilitate its use, Annex 1 includes a detailed user guide.

Figure 13. Screenshots illustrating the Risk assessment and planning prototype, RISKIAP





Application level

According to the objective, methodology and FIRE-RES target, the application scale is primarily European, given that the tool was conceived in Catalonia (Spain) with the support of Central Europe experts. Anyway, the prototype can be used by users from different parts of the world, as long as it adapts to their territorial requirements.

Next steps

Several potential areas for future enhancement have been identified. These include the integration of additional accessibility features such as:

- Adjustable font sizes
- Cursor highlighting and text spacing
- Dark/high contrast modes

Additionally, functionality for spatial annotation is proposed. This will enable users to delineate specific areas where measures must be implemented (for example, identifying zones designated for fuel management as a preventive measure against wildfires).

Given that the tool is currently at Technology Readiness Level (TRL) 3 - experimental proof of concept, here is significant scope for further development and refinement. This initial exercise successfully translated a conceptual methodology into a functional software prototype, representing a key step forward in the practical application of a comprehensive and sequential risk assessment and planning approach.

4. References

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Annex 1. Draft of a "Guide for users of RISKIAP, a computer application for integrated wildfire risk assessment and planning (prototype version)"

I.- Introduction

This computer application for wildfire risk assessment and planning (RA&P) aims to address in an integrated and holistic manner the risk reduction measures over existing hazards, exposures and vulnerabilities (HEV) along all the Risk Management Cycle, prevention-preparedness-response-recovery (PPRR).

The method approaches wildfire risk in a systemic way, promoting synergies across agencies and local communities, and to enhance policy coherence on risk reduction from the perspective of landscape resilience.

RISKIAP can be implemented from at local (operational) up to sub-national/national (tactic and strategic) levels.

II.- Functioning

The RA&P method developed conducts a three-step process for addressing integrated wildfire risk management (WFRM):

Step 1: Per each value at risk in the territory, the HEV risk factors are identified, considering both physical and social aspects.

Step 2: Accordingly, risk mitigation measures per each identified risk factor, stakeholders involved in each measure, as well as the corresponding sectoral policy and/or planning tool where to fit it are related. Additional timeframe, priority or budget items are included.

Step 3: Risk mitigation measures are organised within the RMC, conforming and integrated approach where cross-links among prevention-prepardness-response and recovery actions are balanced and synergies are potentiated in a coherent wildfire risk management framework, defining the roles and contributions of stakeholders.

III.- Glossary based on UNDRR Disaster Risk Reduction Terminology

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas. Annotation: Measures of exposure can include the number of people or types of assets in an area. These can be combined with the specific vulnerability and capacity of the exposed elements to any particular hazard to estimate the quantitative risks associated with that hazard in the area of interest.

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards. Annotation: For positive factors which increase the ability of people to cope with hazards, see also the definitions of “Capacity” and “Coping capacity”.

Prevention: Activities and measures to avoid existing and new disaster risks. Annotations: Prevention (i.e., disaster prevention) expresses the concept and intention to completely avoid potential adverse impacts of hazardous events. While certain disaster risks cannot be eliminated, prevention aims at reducing vulnerability and exposure in such contexts where, as a result, the risk of disaster is removed. Examples include dams or embankments that eliminate flood risks, land-use regulations that do not permit any settlement in high-risk zones, seismic engineering designs that ensure the survival and function of a critical building in any likely earthquake and immunization against vaccine-preventable diseases. Prevention measures can also be taken during or after a hazardous event or disaster to prevent secondary hazards or their consequences, such as measures to prevent the contamination of water. Note of the author: according to this definition, ‘resilient landscapes’ can be understood as an example of prevention.

Preparedness: The knowledge and capacities developed by governments, response and recovery organizations, communities and individuals to effectively anticipate, respond to and recover from the impacts of likely, imminent or current disasters. Annotation: Preparedness action is carried out within the context of disaster risk management and aims to build the capacities needed to efficiently manage all types of emergencies and achieve orderly transitions from response to sustained recovery.

Preparedness is based on a sound analysis of disaster risks and good linkages with early warning systems, and includes such activities as contingency planning, the stockpiling of equipment and supplies, the development of arrangements for coordination, evacuation and public information, and associated training and field exercises. These must be supported by formal institutional, legal and budgetary capacities. The related term "readiness" describes the ability to quickly and appropriately respond when required.

Response: Actions taken directly before, during or immediately after a disaster to save lives, reduce health impacts, ensure public safety and meet the basic subsistence needs of the people affected. It is predominantly focused on immediate and short-term needs and is sometimes called disaster relief. Effective, efficient and timely response relies on disaster risk-informed preparedness measures, including the development of the response capacities of individuals, communities, organizations, countries and the international community.

Recovery: The restoring or improving of livelihoods and health, as well as economic, physical, social, cultural and environmental assets, systems and activities, of a disaster-affected community or society, aligning with the principles of sustainable development and "build back better", to avoid or reduce future disaster risk.

Source: United Nations Office for Disaster Risk Reduction (UNDRR). 2017. The Sendai Framework Terminology on Disaster Risk Reduction. "Exposure". Accessed 30 April 2025. https://www.undrr.org/drr-glossary/terminology.

III.- How to fill the information

The steps and how to fill the information is indicated according the following **Sequence**, **Components and Instructions** *(Examples are included)*

Step 1 - Project input and user identification

Upon accessing the application, an initial page should appear to allow for the input of:

User name(s): (the individual(s) responsible for entering the information),

A data entry form is opened

Email address:

Project: Indicate the area under analysis, e.g., Natural Park of Montserrat.

A data entry form is opened

Location: (UTM coordinates where applicable. If not at a local level, this may not be relevant)

Shapefile layer: (if a link to a shapefile delineating the project boundary is available. Again, this is more relevant at the local level)

Step 2.- Identification of hazard factors

The "Hazard" data entry form is opened

Step 2.1 - Ignition hazard factor: Description, e.g., Parking area at Pont del Clop

The relevant data entry fields are then displayed:

Risk reduction measure: Description, e.g., Clear vegetation around the parking area

A data entry form is opened

Related stakeholder(s): Description, e.g., Municipal cleaning staff

Related planning tool: Description, e.g., Municipal Wildfire Prevention Plan

Disaster Risk Management phase: Select one of the following: Prevention, Preparedness, Response, Recovery

Timeframe: Select one of the following: Short-term (1–3 years), Medium-term (3–5 years), Long-term (5–10 years minimum)

Priority: Select one of the following: Urgent, High, Medium, Low

Estimated budget:

Initial implementation cost: Indicate amount. E.g., 30.000€

Maintenance cost and interval: Indicate cost and period, e.g., 2.000€/ha every 5 years

Geolocation (UTM coordinates): Indicate. Ideally, this opens a map (e.g., Google Maps). Again, relevant mainly at the local level.

Additional Information/Constraints: Indicate e.g., Requires authorization from the Directorate General of Biodiversity, as the site is within the PEIN protected area of Ribera Salada.

Note: A single hazard factor may have more than one associated measure. Each will restart the sequence: Stakeholders, Planning tools, etc.

Within a single risk reduction measure, there may be several stakeholders and planning tools. However, the Risk Phase, Budget, etc., will be unique per measure.

A hierarchical and acronym-based numbering system must be implemented to organize the various factors, measures, sub-measures, stakeholders, etc.

Example Output:

Ignition Hazard Factor 1 – Parking Area at Pont del Clop

Measure RR1.1.- Clear vegetation around the parking area

Stakeholders MRR1.1.1.- Municipal staff

Stakeholders MRR1.1.2.- Forest landowners

Planning tool MRR.1.1.1.- Municipal Wildfire Prevention Plan

Planning tool MRR.1.1.1.- Forest Management and Improvement Technical Plan

Disaster Risk Management phase MRR.1.1.1.- Prevention

Etc…

Measure RR 1.2.- Surveillance during high-risk days

Stakeholders MRR1.2.1.- Summer surveillance staff

Planning tool MRR.1.1.1.- Municipal Wildfire Prevention Plan

Disaster Risk Management phase MRR.1.2.1- Preparedness

Etc.,..

Step 2.2- Propagation Hazard factor: Description, e.g., Continuous forest cover from the entrance of Pont de Querol.

Measures could include: MRR1.1- Promotion of extensive grazing in Ribera Salada basin, MRR1.2.- Implementation of Strategic Management Points, MRR1.3.- Promotion of forest management in regular stands, etc. Each measure will follow its corresponding sequence of sub-items.

Step 3. Identification of Values at risk (Exposure and Vulnerability)

The "Values at risk" data entry form is opened

Step 3.1 - Values at risk: Describe, e.g., Swimmers

Following fields are displayed, first for Exposure and then for Vulnerability:

Step 3.1.1 - Exposure reduction measure: Describe, e.g., Restrict access to the swimming area during high-risk days

A data entry form is opened:

Related Stakeholders: Describe, e.g., Forest Rangers

Related planning tool: Describe, e.g., INFOCAT Plan

Disaster Risk Management phase: Select one of the following: Prevention, **Preparedness**, Response, Recovery

Timeframe: Select one of the following: **Short-term (1-3 years)**, Medium-term (3–5 years), Long-term (5–10 years minimum)

Priority: Select one of the following: **Urgent**, High, Medium, Low

Estimated budget:

Initial implementation cost: Indicate, e.g., 0€

Maintenance cost and interval: Indicate, e.g., 0€

Geolocation (UTM coordinates): Indicate. Ideally, this opens a map (e.g., Google Maps). Again, relevant mainly at the local level. For swimmers, indicate the bathing zone.

Additional Information/Constraints: Indicate e.g., Difficult to control access along the entire river section

Related hazard factor: Here it should be possible to select from previously identified hazards, e.g., Ignition Hazard Factor 1 – Parking Area at Pont del Clop or Propagation Hazard Factor 1 – Continuous forest cover from Pont de Querol.

Note: As with hazard factors, multiple exposure reduction measures may be defined for a single value at risk.

Step 3.1.2 - Vulnerability reduction measure: Describe, e.g., Install a siren system and auditory alarms to inform swimmers in the parking area of emergency procedures

A data entry form is opened:

Related Stakeholders: Describe, e.g., Summer surveillance staff

Related planning tool: Describe, e.g., Municipal Wildfire Prevention Plan

Disaster Risk Management phase: Select one of the following: Prevention, Preparedness, **Response**, Recovery

Timeframe: Select one of the following: Short-term (1–3 years), **Medium-term (3-5 years)**, Long-term (5–10 years minimum)

Priority: Select one of the following: Urgent, **High**, Medium, Low

Estimated budget:

Initial implementation cost: Indicate, e.g., 5.000€

Maintenance cost and interval: Indicate, e.g., 200€/year

Geolocation (UTM coordinates): Indicate, e.g., siren installation points, ideally using an integrated map

Additional Information/Constraints: Indicate, e.g., Power supply to sirens must be ensured

Related hazard factor: Here it should be possible to select from previously identified hazard, e.g., Ignition Hazard Factor 1 – Parking Area at Pont del Clop or Propagation Hazard Factor 1 – Continuous forest cover from Pont de Querol.

Note! Again, multiple vulnerability reduction measures may be associated with a single value at risk. Examples: Install evacuation route signage, Adapt an adjacent field as an emergency containment zone, etc. Each will restart the sequence: Stakeholders, Planning tools, etc.

Step 4. Editing results

The following options are presented:

Complete report: All collected information is compiled and displayed in the full sequence, as shown in the example of step 2:

Ignition Hazard Factor 1 – Parking Area at Pont del Clop

Measure RR1.1.- Clear vegetation around the parking area

Stakeholders MRR1.1.1.- Municipal staff

Stakeholders MRR1.1.2.- Forest landowners

Planning tool MRR.1.1.1.- Municipal Wildfire Prevention Plan

Planning tool MRR.1.1.1.- Forest Management and Improvement Technical Plan

Disaster Risk Management phase MRR.1.1.1.- Prevention

Etc…

Measure RR 1.2.- Surveillance during high-risk days

Stakeholders MRR1.2.1.- Summer surveillance staff

Planning tool MRR.1.1.1.- Municipal Wildfire Prevention Plan

Disaster Risk Management phase MRR.1.2.1- Preparedness

Etc.,..

Filter by component

Allows filtering results by specific components, e.g.,

Disaster Risk Management phase

The four phases are displayed (Prevention, Preparedness, Response, Recovery), and selecting one shows relevant data:

Preparedness

Then all the information is displayed following the sequence, as in the example:

For this edition filtered by component it would be provided a Simplified view (only with measures). Example (with "Preparedness" search):

Ignition Hazard Factor 1 – Parking Area at Pont del Clop

Measure RR 1.2.- Surveillance during high-risk days

Ignition Hazard Factor 2.- Electrical Substation at Pla dels Roures

Measure RR 2.1.- Preventive shutdown during high-risk days

Value at risk 1.- Swimmers

Measure RR- Exposure 1.1.- Restrict access during high-risk days

Measure RR- Vulnerability1.1.- Evacuation protocol drills with summer staff and ADFs

Measure RR- Vulnerability 1.2.- Drone surveillance for potential ignitions

Etc…

Value at risk 2.- xxx

And a Complete view with all the fields available:

Ignition Hazard Factor 1 – Parking Area at Pont del Clop

Measure RR 1.2.- Surveillance during high-risk days

Stakeholders MRR1.2.1.- Summer surveillance staff

Planning tool MRR.1.2.1.-Municipal Wildfire Prevention Plan

~~Distater risk management phase MRR1.2.1.- Preparedness~~

Etc.,..

Value at risk 1.-Swimmers

Measure RR- Exposure 1.1.- Restrict access on high-risk days

Stakeholders MRRE 1.1.- Forest Rangers

~~Disaster risk management phase MRRE.1.1.- Preparedness~~

Etc,..

Measure RR- Vulnerability 1.1.- Evacuation protocol drills with summer staff and ADFs

Etc..

Step 5. Exporting results

Can be integrated with Step 4 by providing the option to display results on-screen in Step 4 and export them in Step 5.

Linked to each search query, with export formats such as Word and Excel, either as full reports or component based.