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UNIVERSIDADE D
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Joana Batista Fernandes

**STAKEHOLDERS' PERSPECTIVES ON
OPPORTUNITIES AND CHALLENGES IN
ENGAGING COMMUNITIES IN FIRE RISK
MANAGEMENT**

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Stakeholders' perspectives on opportunities and challenges in engaging communities in fire risk management

Abstract

Future projections consider that Portugal is extremely vulnerable to climate change, in which its consequences are expected to occur with heightened frequency and intensity, such as rural fires. The present and future scenarios require, unavoidably, a higher level of preparedness and adaptation by communities and individuals for fire risk, by actively engaging in fire risk management. Therefore, the main purpose of this study is to comprehensively ascertain the level of the Portuguese communities' engagement in rural fire management processes, in the perspective of fire risk managers, such as decision-makers, civil protection, nature protection actors and academic experts. This study also aims to broaden the discussion about the opportunities and challenges towards the development of evidence-based strategies, aiming at engaging communities and citizens in fire risk management processes. To access and analyze the perspective of these stakeholders, an exploratory sequential mix-methods research design was conducted. In a first phase, semi-structured interviews were conducted to fire risk managers ($N = 30$), and in-depth content analyzed. Afterwards, a nationwide sample of stakeholders ($N = 135$) enrolled in a web-based survey measuring the latent variables that emerged from stakeholders' narratives. Quantitative data was analyzed, using descriptive statistics and differences tests. The gathered qualitative and quantitative data was further integrated using a merging approach, resulting in a data matrix encompassing the most prominent results. Findings from this study demonstrate that Portuguese communities do not engage in pre-disaster fire risk management (i.e., prevention, preparedness), and do not have a risk culture, which appears to be related with several psychosocial factors (e.g., lack of knowledge, place attachment, ascription of responsibility). A greater communities' engagement in fire risk management may be achieved through capacity building strategies, based on local level and action-based interventions, as well as, formal risk education within schools.

Key Words: Rural fires; Risk management; Rural communities; Risk communication; Capacity building.

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Introduction

European Mediterranean region is especially vulnerable to rural fire phenomenon, being Portugal the most affected and fire prone country from this region (Casau et al., 2022; Pereira et al., 2011). Annually, the rates of burnt area in Portugal are among the highest in the world, with a growing trend in the number of ignitions, fires' severity and their destructive capacity (Bento-Gonçalves, 2021). Altogether, the actual and projected scenarios for fire risk (cf. Lima et al., 2023) come to challenge those communities living in fire prone areas, once the management of rural fires is complex due to the rural traditional socioeconomic systems transformations, allied to changes in land use and land cover (Casau et al., 2022; Pereira et al., 2011). In addition to these factors, the growing severity of rural fires is also exacerbated by climate change, to which Portugal is particularly vulnerable (Cardoso et al., 2019).

As widely acknowledged, rural fires lead to socioeconomic losses, negative consequences at an environmental level, and to cascading risks. Some of these fire consequences include loss of human lives, infrastructures, cultural heritage, and ecosystem services. Such losses made the rural fires an urgent theme for the general public, and for the political and scientific spheres (Casau et al., 2022; Bento-Gonçalves, 2021). The current environmental and social panorama demand that rural communities and general society understand rural fires in their multiple dimensions, causes and consequences (Bento-Gonçalves, 2021) to be better prepared for them, and engage in fire mitigation and adaptation behaviours. This requires a paradigm shift in how communities, particularly the rural ones, look at their routines and ways of living in the interface between the wildland and rural areas. As a result, it will be possible to prevent situations in which people put themselves at risk of life, such as the ones verified in 2017, in the catastrophic fires of Pedrógão Grande.

Considering this societal urgent need, the present study aims to ascertain whether communities are engaged in fire disaster risk management, particularly in mitigation and adaptation processes and if their behaviours reflect high levels of preparedness for rural fires events. Besides that, this investigation pretends to bring to the debate, possible evidence-based strategies to build community's capacity and resilience to fire risk. To achieve the abovementioned goals, an exploratory sequential mix-methods research design was conducted, i.e., a combination of a qualitative study and a quantitative study. Particularly, fire risk managers (e.g., decision-makers, civil protection agents, members of public institutions) were interviewed (qualitative study) and enrolled in a web-based survey (quantitative study), in order to comprehensively ascertain whether communities are engaged in fire risk management, through the perspective of rural fire management stakeholders. Data was finally integrated, using a merging approach, that resulted in a data matrix encompassing the most prominent results, which were discussed towards alternative strategies aiming at building of social and community resilience to fire disaster risk.

I – Conceptual Framework

1.1. Rural fires in Portugal

In the last decades, climate change has generated concerns on a global scale. In this line, the state of “Climate Emergency” was formally established: more than 11000 scientists worldwide had united efforts to warn humanity that the planet Earth is unequivocally facing a climate emergency (Ripple et al., 2022). In light of the accelerated climate crisis, countries have been reuniting in order to establish measures to mitigate the impacts of climate change, through actions at an intergovernmental level (Wallemacq et al., 2018; World Health Organization [WHO], 2019). An example, are the annual Conferences of the Parties [COP], in which all states that take part of the United Nations Framework Convention on Climate Change [UNFCCC], reunite to assess the progress of climate change mitigation (e.g., decarbonization), and to discuss adaptation measures to the countries and communities facing the impacts of climate change (United Nations, 2022).

Indeed, it is undeniable that climate change is significantly increasing the severity and frequency of multiple hazardous processes (e.g., severe to extreme droughts, rural fires, extreme meteorological events), with cascading impacts on society and most vulnerable communities (Glasser, 2020). Between 1998 and 2017, there were more than 4.4 billion people injured, homeless, displaced, or in need of emergency support. Adding to this figure, more than 1.3 million people have died due to climate-related disasters (Wallemacq et al., 2018). In order to illustrate the magnitude of climate change nowadays, its impacts have reached different regions around the world in recent years, for instance: the extreme heatwave over Western North America in 2021, which caused approximately more than 1400 deaths (Cotlier & Jimenez, 2022); the 2022 severe floods in Pakistan that placed one third of the country's landmass under water, have affected more than 33 million citizens, displaced between 6 to 7 million people, and have killed more than 1500 people, including 552 children (Bhutta et al., 2022); the widespread 2022 European compound drought–heatwave, with preoccupying impacts in human health, socio-economic sectors (e.g., agriculture), and ecosystems (Bonaldo et al., 2023; European Commission, 2023) and the record-breaking wildfires in Canada that, to the date (i.e., July 2023), have burned more than 8.8 million hectares of forest area, forced more than 150.000 people to evacuate their homes and its effects on air quality in Europe have been felt (Gkousarov & Parrish, 2023).

Beyond the abovementioned climate-related disasters, large-scale rural fires have been increasing in frequency and severity due to climate change, affecting different regions of Europe, that were not particularly prone to these hazardous processes. Examples account for Sweden, Germany, Poland and Norway that, in 2018, were particularly affected by rural fires (World Wildlife Fund [WWF], 2019), which, according to the European Commission’s Joint Research Centre (San-Miguel-Ayanz et al., 2019) resulted in more than 32.634 hectares of burnt area.

In Europe, the southern European Mediterranean basin countries (e.g., Spain, Greece, France, Italy, and Portugal) are internationally considered Stakeholders’ perspectives on opportunities and challenges in engaging communities in fire risk management

critical, as they face multiple impacts related to climate change, such as large-scale rural fires (Ozturk et al., 2015). Per annum, more than 80% of the burned area in Europe results from the rural fires occurring in southern European Mediterranean countries (Lourenço, 2018; WWF, 2019). According to WWF (2019), in 2017, the Mediterranean countries reported more than 900.000 hectares of burnt area, the highest number recorded since 1985. Still regarding the Mediterranean basin, the Iberian Peninsula was formally identified as one of the hot-spots for climate change impacts almost two decades ago (Diffenbaugh et al., 2007; Giorgi, 2006); being Portugal considered particularly vulnerable to climate change effects, such as extreme weather events, drought phenomenon and rural fires (Camargo et al., 2020).

In Portugal, climate change effects have been increasingly evident – e.g., the 2021-2022 extreme drought (Instituto Português do Mar e da Atmosfera [IPMA], 2022) – making the country extremely prone to rural fires (Asfaw et al., 2022; Beighley & Hyde, 2018; Lourenço, 2018). Unarguably, climate change may be one of the most important predictors of the Portuguese rural fires. However, it is worth mentioning that significant changes have also been occurring over the last several decades that are having an ongoing detrimental effect on the country's rural fires' potential (Beighley & Hyde, 2018).

In particular, structural and sociodemographic changes of the country, such as the 40s and 50s rural exodus, left Portuguese rural areas significantly depopulated (Carvalho, 2018; Lourenço, 2018). Since then, several factors – such as, the impoverishment, ageing, out-migration, depopulation and abandonment of rural areas – have been contributing to a growing fuel load problem (Carvalho, 2018; Beighley & Hyde, 2018). For instance, less flammable vegetation patterns that once existed in these areas due to agricultural practices, are now overgrown with dense highly flammable trees and vegetation. Moreover, forest plantations are increasingly left unmanaged as they are too costly to maintain. Finally, abandoned areas are overtaken by invasive vegetation species making landscapes increasingly uniform in burning characteristics (Carvalho, 2018; Lourenço, 2018; Beighley & Hyde, 2018; Nunes et al., 2019).

According to Bento- Gonçalves (2021), until the 1970s, forest fires with large dimensions were a rare phenomenon. Lourenço (2018) suggests four generations regarding the evolution of rural fires in Portugal. The first generation occurred between 1974 and 1985. In this period, few and small occurrences were reported, with the larger fires consuming areas measuring less than 10.000 hectares. The second generation occurred between 1986 and 2002. This generation is characterized by a greater number of occurrences and affected areas' size. In the second generation, only the rural fires resulting in equal or more than 100 hectares of burnt area have been considered large rural fires. The third generation occurred between 2003 and 2017. In this generation, rural fires have burnt more than 100.000 hectares of land, and the same areas were affected more than one time. The year 2017 marks the beginning of a new generation of fires in Portugal, which corresponds to fires resulting in more than 30.000 hectares of burnt area (Bento- Gonçalves, 2021;

Lourenço, 2018). In this rural fires' generation, it is worth mentioning the occurrence of a major catastrophe that persists in the collective memory of the Portuguese. In particular, the June 2017 rural fires, which devastated Pedrógão Grande, a Portuguese municipality in the center of the country. The Forest Fire Research Centre report (Viegas et al., 2017) estimates that more than 9672 hectares were burned. Sixty-five people died, among them 8 children aged ten or under. More than 200 people were seriously injured. Of the 65 fatalities, 47 died on the EN236-1 road (nowadays known as the "Death Road"), the majority inside their cars (30). Almost 200 people were evicted from their houses (Areia et al., 2021; Viegas et al., 2017). However, the increasing number of occurrences and dimensions of forest fires in Portugal, indicate that it is a phenomenon that shows no signs of slowing down. Last year, i.e., 2022, Portugal was the second European country most affected by rural fires, which resulted in more than 110.000 hectares of burnt area (Divisão de Gestão do Programa de Fogos Rurais, 2022; Rodrigues et al., 2023).

Due to the ecological (e.g., loss of ecosystems), social (e.g., increased number of fatalities and injured) and economic (e.g., instability in local labor markets) impacts of rural fires, this topic of major concern has been getting emphasis between the general public, decision-makers and within the scientific community (Asfaw et al., 2022; Bento-Gonçalves, 2021). It is widely accepted that fire risk management must consist of a collective action, involving not only fire risk managers (e.g., decision-makers, civil protection agents), but also the communities exposed to fire risk and, even, the broader society. However, little is known on how to promote collective action to mitigate fire risk and thus build communities' resilience to rural fires (Charnley et al., 2020; Otero et al., 2018). In the next subtopics, possible factors that enable and constrain collective engagement/participation in fire risk management will be presented, as well as possible strategies to enhance communities' engagement in rural fires mitigation and adaptation actions.

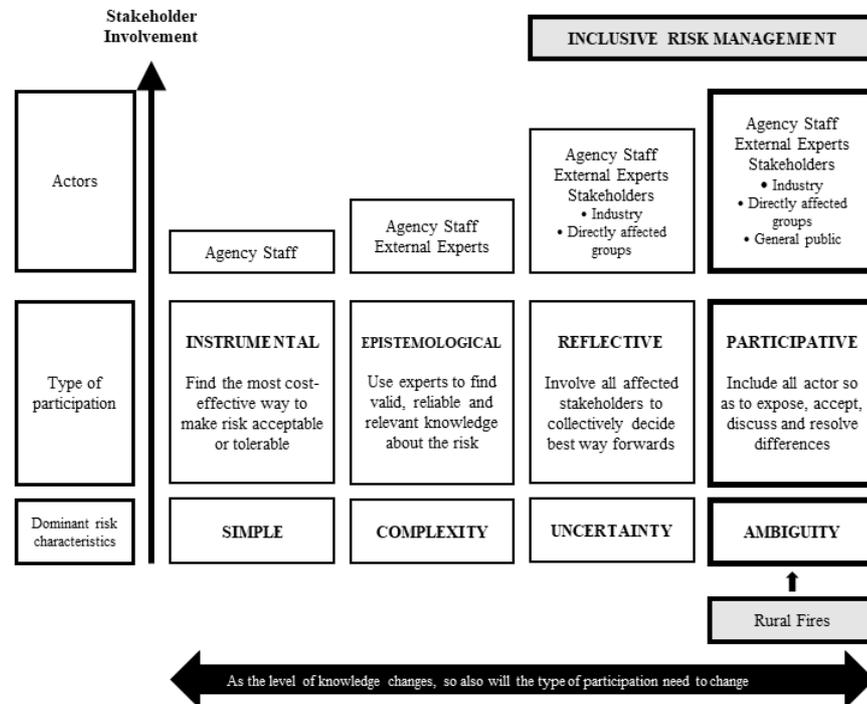
1.2. Fire disaster risk management

Risk is a complex construct defined as a combination of the probability of an event (considering the hazard's specificities, exposure, vulnerability and capacity) and its negative consequences (e.g., economic, human, environmental losses) (United Nations Office for Disaster Risk Reduction, 2023). As argued by Beck (2009, p. 6), "*incalculable risks (...) resulting from the triumphs of modernity*" mark the human condition in the 21st Century. Beyond a reasonable doubt – and as one may witness with the surge of more frequent, intense and destructing climate-related disasters – the confrontation with catastrophic risks is inevitable, as the humanity is facing "*the new historical character of the world risk society*", in which environmental hazards (in part produced by the modern civilization) threatens humanity (Beck, 2009).

According to Renn (2015), risk can be characterized by a mixture of complexity, uncertainty, and ambiguity. Depending on the combination of the abovementioned characteristics of the risk, different levels of stakeholder participation are required to efficiently manage risks (Renn, 2015), as given Stakeholders' perspectives on opportunities and challenges in engaging communities in fire risk management

in Figure 1.

Figure 1. The risk management escalator and stakeholder involvement (adapted from Renn, [2015])



For each different type of risk, there is a different form of participation in risk management, with a different group of actors who are expected to be involved: a) the simple risk is noncontroversial, so it is expected an instrumental participation by private and public actors to find the way to make risk tolerable in the most cost-effective way; b) when complexity is the dominant characteristic of risk, the participation should be epistemic, resorting to scientists and researchers to found valid knowledge about risk in collaboration with private and public actors; c) uncertain risk requires reflective participation involving the affected stakeholders, researchers and private and public actors to collectively take the best decisions; d) when a risk is mainly characterized by ambiguity requires the participation from all already mentioned actors and from the affected communities and the broader civil society, through a participatory involvement, in order to discuss divergent arguments, beliefs, and values in risk debates (Renn, 2015). Rural fires risk management generate different inputs or outcomes by the diverse actors and stakeholders affected by the fire risk. Indeed, research has been demonstrating that the relationship between fire management agencies (i.e., civil protection) and communities and their inhabitants is frequently confounded by politics, competing values or different understandings of fire risk (Morehouse & O'Brien, 2008). For example, fire risk prevention requires surveillance from the security forces to confirm that the measures implemented by the governments are actually applied by the communities'

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residents. In turn, community residents may not properly comprehend those measures and thus not massively engage in such fire risk prevention measures. For instance, when it comes to implement controlled burning of debris, community residents (especially the older ones) may be more resistant to engage with such measure, as they may have a different understandings of the fire risk, considering their long-standing practices of using fire. Based on this example, one may argue that fire risk is mainly characterized by high ambiguity, as plural knowledge from different stakeholders (e.g., decision-makers, civil protection, communities) and value inputs are difficult to reconcile. Therefore, its management would strongly benefit from a participatory management (Renn, 2015).

Despite the scientific community's calls for an integrated, inclusive and adaptive fire disaster risk management (Bacciu et al., 2022; Schweizer & Renn, 2019), rural fire risk management is traditionally based in simplistic approaches, in which only instrumental and technical questions of the probability of event occurrence are taken into account. This kind of simplistic risk management do not consider the specificities of the context (e.g., rural fires' drivers and impacts) and communities' dynamics (e.g., distributions of power, community values). Therefore, these approaches fail to incorporate and account for the diversity of human actors (e.g., community members, civil protection) affected by rural fires, including the varied experiences and concerns that influence communities' adaptation and resilience (Essen et al., 2022). For that reason, several scholars argue that there is an urgent need to shift the paradigm towards an approach that considers the complexity and ambiguity of contemporary rural fire risk, considering an inclusive risk management (Essen et al., 2022; Renn, 2015; Renn et al., 2020). In this sense, it would be valuable that the society and, especially, exposed/vulnerable communities to fire risk, actively participate in fire risk management processes, in order to find a consensus about ambiguity; by comparing risks and benefits, pros and cons, towards the development of a strategies aiming at building communities' resilience to fire risk, throughout the entire fire disaster risk management cycle (Renn, 2015; Renn et al., 2020).

The disaster risk management cycle interconnects different phases of the catastrophe cycle, in a constant exercise of planning: prevention, preparedness, response and post-disaster recovery (Lourenço & Almeida, 2018; Patrão, 2020). Prevention requires actions that seek to mitigate the risk of occurrence of a fire event or the potential consequences. To achieve this, the risk factors and causes of fire are investigated in order to avoid unplanned ignitions, and measures are created to mitigate the identified risk factors. Besides that, actions like education, community engagement, engineering, land use planning and law enforcement are necessary in the prevention phase. Other measures may regard to pre-response, once that can be important for the suppression of fire (e.g. construction of water points). Preparedness corresponds to a pre-disaster phase, where intervenient actors, including government, communities, and other stakeholders, get prepared for the next phases of the cycle. Actions such as fire education, resources, and training programs are implemented in the preparedness phase. Response regards the

actions implemented during or immediately following a rural fire and has the aim of controlling and extinguishing a fire. Recovery is the phase of the cycle that concerns to the effective rehabilitation of post-fire damages. The main objective is to return to a state of equilibrium and functionality. Measures to rebuild the affected areas and social care and support may be implemented during the recovery phase. This phase has the objective of creating greater security conditions and reducing existing vulnerabilities (Lourenço & Almeida, 2018; Patrão, 2020).

1.3. Participatory approaches to fire risk management: Challenges and opportunities

Worldwide, the last three decades have been marked by extreme rural fire events that highlight the need to rethink how to plan fire management, in order to efficiently respond to the novel environmental and societal challenges (Bacciu et al., 2022). Gradually, in some countries, fire risk management has been privileging more proactive and collaborative approaches, rather than the traditional reactive approach, i.e., the suppression-oriented strategy (e.g., Thompson et al., 2022), which tends to be highly structured, bureaucratic, rule-based, and usually based on ‘command-and-control’ approaches that, unsurprisingly, provide little scope for community participation (Haynes et al., 2020; Neal & Phillips, 1995). In this novel approaches of fire risk management, all components of risk are expected to be considered: communities; institutions; land use and landscape planning; and the design of policies tackling urban, agriculture, and rural development (Bacciu et al., 2022). Moreover, challenges are assessed at a regional and local level, considering each territories idiosyncrasies (e.g., cultural values) and vulnerabilities (Charnley et al., 2020; Gonçalves et al., 2022). Not surprisingly, these approaches consider communities as an integral part of risk management processes. For that reason, community participation is considered a key principle of disaster risk reduction and disaster risk management, and essential for community’s resilience building (Haynes et al., 2020).

Community participation is described by Patrão (2020) as a collaborative relationship between communities and their inhabitants with the stakeholders and public authorities involved in rural fire management. As widely argued, a real participatory fire risk management englobes all these interested parts as equal partners, whilst fostering local knowledge about fire risk and thus enhancing a sense of ownership among local residents about the problem (Patrão, 2020; Haynes et al., 2020). Indeed, it is well established in literature that involving the community in fire management processes creates opportunities for social transformations and fosters the sharing of knowledge and expertise among researchers, decision-makers, civil protection, and the communities’ inhabitants, which would be of utmost importance, in order to build community resilience and thus capacity to properly respond in an event of a fire emergency (Bier, 2001; Haynes et al., 2020; Morehouse & O’Brien, 2008; Patrão, 2020).

However, the reality and research demonstrate that communities are not actively involved in fire risk management (Areia et al., 2021), which may Stakeholders’ perspectives on opportunities and challenges in engaging communities in fire risk management

come with catastrophic consequences (e.g., avoidable fatalities). For instance, Górriz-Mifsuda et al., (2019) found that those communities living in fire-prone areas in Mediterranean basin, especially in Portugal, Spain and Greece, demonstrate residual levels of preparedness to respond to a rural fire and cope with its consequences. As argued by the authors, the lack of these communities' preparedness may well be related to the fire management *praxis* adopted in these countries, that do not privilege the implementation of participatory or community-based processes of fire risk management. Instead, these countries' governments greatly invest on the implementation of reactive measures, focused on the suppression and firefighting professionalization. As a consequence, communities demonstrate a false sense of safety, which leads to the tendency of not getting involved in fire risk management, which may lead to increased damage and, even, avoidable casualties (Górriz-Mifsuda et al., 2019).

Beyond the institutional barriers to community participation in fire risk management processes, other factors are pointed out as influencing communities' and individuals' engagement in fire risk management. The lack of knowledge about fire risk and its causes and consequences, is considered a major barrier to communities' engagement in fire management (Eckerberg & Buizer, 2017; Reid et al., 2020). Other studies demonstrate that, despite the individuals' awareness of fire risk, the lack of expertise to implement fire management plans and the lack of financial capacity are critical barriers to community active participation in fire risk management (Copes-Gerbitz et al., 2022; Haynes et al., 2020). Other factors defying individuals' participation in fire risk management are their values, identities, and perceptions of risk (Copes-Gerbitz et al., 2022). For instance, people tend to engage in fire mitigation measures if those measures do not interfere with their values or with the forest landscape surrounding their home (McCaffrey et al., 2013; McFarlane et al., 2011). Community characteristics, such as cultural values or population size, may also influence engagement in fire risk management. For instance, individuals may be resistant to engage in fire management approaches that do not reflect their cultural values (Paveglio et al., 2015). In contrast, other studies have demonstrated that rural and resource-dependent communities with lower populations tend to have a strong place attachment and sense of community that predicts individuals' engagement in participatory processes of fire risk management (Christianson et al., 2012). Moreover, individuals with a heightened sense of shared responsibility regarding fire risk management are more likely to actively engage in risk reduction and management actions, whilst collaborating with local governments (McCaffrey, 2015). Finally, when it comes to individuals' risk perception, the literature is not consistent regarding the influence of this variable on community engagement in fire management. While some authors consider that risk perception is strongly related with individuals' engagement in risk management best practices (McCaffrey et al., 2013), recent research demonstrate that risk perception is not a predictor of individuals' engagement in fire risk management processes *per se*, as other variables demonstrated to

play a significant mediator role (e.g., financial capacity) (Copes-Gerbitz et al., 2022).

On the basis of the existing barriers of people's engagement in fire risk reduction and management, it is essential to develop evidence-based strategies in order to build community capacity to become actively involved in fire risk management processes. In a systematic literature review, Ryan et al. (2020) highlight some strategies that aimed to build community resilience to fire risk, whilst fostering individuals' engagement in participatory risk management, such as: information campaigns/delivery, drills/exercises, community coalitions, seminars, community champions, home visits, collaborative workshops and gamification. The authors concluded that the more efficient intervention were the collaborative workshops, once these communication instruments improve knowledge, whilst have the potential to enhance community capacity, build relationships, and foster individuals' commitment to action. Furthermore, drills and practical exercises, and community coalition (i.e., group of individuals with a common interest who agree to collaboratively work toward a common goal, in this case, to enhance community resilience towards fire risk) techniques also demonstrated to be successful at enhancing community engagement (Ryan et al., 2020). Other studies suggest that community education is essential to raise individuals' levels of fire risk perception (McLennan et al., 2019), in which action-based education strategies are strongly suggested (Areia et al., 2021). Finally, McLennan et al. (2019) ascertained that in Portugal, community involvement in shared-responsibility policies and practice should pass by educating as early as possible through programs about mitigation, preparation, and response, as well as about risk and fuel management.

The implementation of community-based fire risk management approaches is challenging, but offers substantial advantages to inform the development of tailored public policies, that reflect the real needs and concerns of the communities and diverse stakeholder groups, thus enhancing public support and acceptability of fire risk management programs (Palsa et al., 2022). In addition, the participation of communities and stakeholders as social capital is necessary to promote the implementation of fire risk management plans, to improve the performance of risk managers to respond with efficacy to fire emergencies and to the societal needs through public policies and to build community resilience (Palsa et al., 2022; Renn, 2015).

Fire risk managers – such as policymakers, first responders and academic experts – may provide valuable insights about the ways communities and individuals cope with fire risk and to what extent they are actively engaged in fire risk management processes. Therefore, acknowledging the perspective of these stakeholders can be relevant to understanding how to encourage fire-prone communities and the general public to embrace strategies to adapt to fire risk and its related adversities; particularly through strategies aiming at building communities', families' and individuals' resilience to fire risk and fire crisis, through the engagement in fire risk management and the adoption of adaptation measures (i.e., preparedness, prevention, response, and recovery).

II - Objectives

The main purpose of this study is to comprehensively determine the level of the Portuguese communities' engagement in rural fire management processes, in the perspective of the stakeholders directly involved in fire risk management, such as decision-makers, civil protection, nature protection actors and academic experts. Based on the gathered results, this study also aims to broaden the discussion about the development of evidence-based strategies aiming at engaging communities and citizens in fire risk management processes. To achieve the abovementioned goals, the following specific objectives were defined:

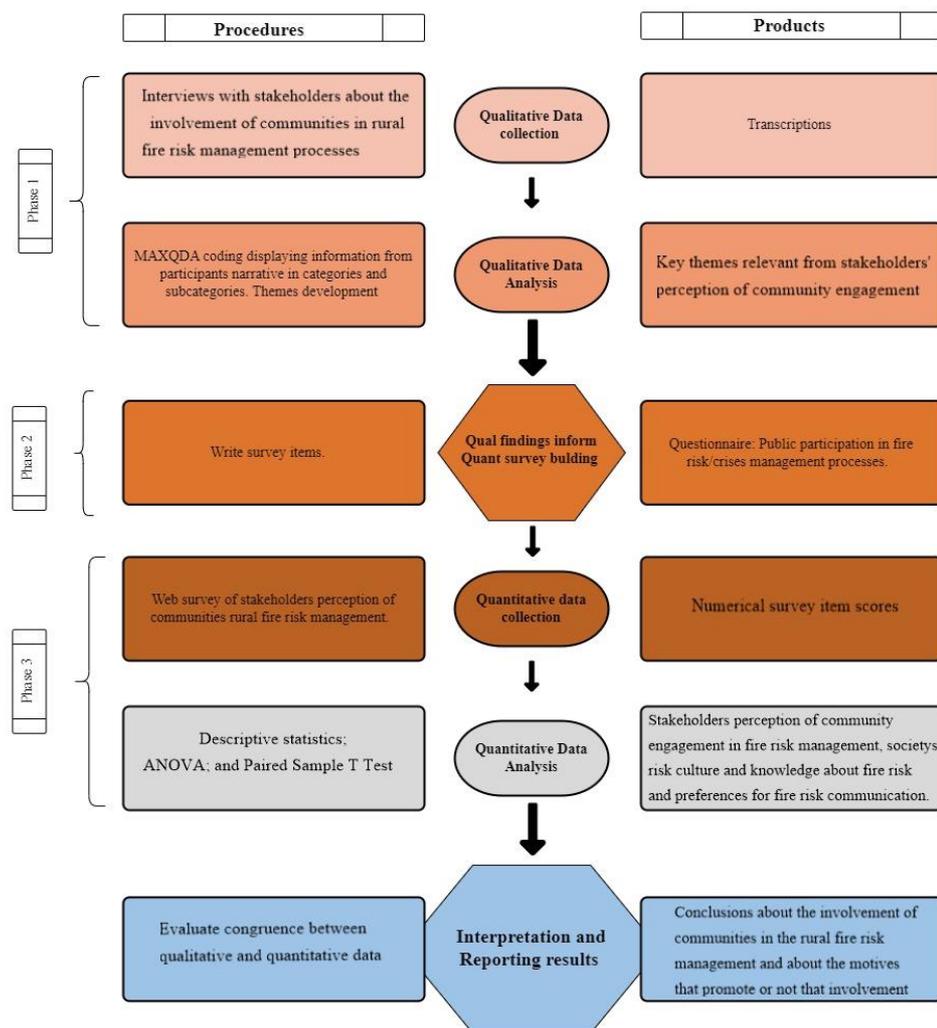
- (a) To ascertain whether communities, families and individuals have high levels of awareness and risk perception regarding rural fires.
- (b) To comprehensively determine if communities, families and individuals are actively engaged in fire risk management.
- (c) To ascertain possible strategies/tools that may enhance communities', families' and individuals' engagement in fire risk management.

III – Methodology

3.1. Study design

The present study follows an exploratory sequential mix-methods research design, i.e. a combination of a qualitative and a quantitative research component. This sequential mixed-method design consists of applying the quantitative study followed by the qualitative (Onwuegbuzie et al., 2009). This research design has the potential to expand the results of qualitative data, by ascertaining if the quantitative results are congruent with the findings of the interviews and, thus, enhance the validity and reliability of those findings. To achieve this, the quantitative questionnaire was developed based on the gathered data from the interviews (Schoonenboom & Johnson, 2017). Finally, the gathered evidence was integrated, as this process has the potential to “*dramatically enhance the value of mixed methods research*” (Fetters et al., 2013, p. 2135). For this study, data integration followed a merging method, according to the principles and practices developed by Fetters et al. (2013). Specifically, integration through merging of the gathered data occurs when the two databases are brought together for analysis and for comparison (Fetters et al., 2013). In this study, it was used a joint display approach. This is, the findings were integrated by bringing the data together through a visual means, in order to draw out new insights beyond the obtained information from the separate quantitative and qualitative results (Fetters et al., 2013). For this purpose, a matrix of data mixing (cf. Discussion section) was developed, in order to comprehensively interpret the gathered findings from both qualitative and quantitative studies and to develop novel insights regarding citizens' and communities' engagement in fire risk management processes. Figure 2 displays the research methodological design applied for this study, considering the main procedures and its products.

Figure 2. Research methodological design



3.2. Qualitative Study

3.2.1. Data collection and interview guide

Qualitative data was collected between November 2022 and January 2023, using a convenience sampling method. The inclusion criteria considered for the study were as follows: (1) being 18 years of age or over, (2) being part of one of the following groups related to fire risk management: civil protection, public institutions, public security forces, policymakers, and scientific community and, (3) having given informed consent to participate in the study.

The semi-structured interview guide was built to meet the objectives of the study and covered the general topics: levels of community's awareness and fire risk perception; community engagement in fire risk management; and strategies to enhance communities' engagement in risk management processes (cf. Appendix 1).

Interviews were conducted in an online environment, using Google Meet™ meetings' platform. Interviews lasted between 30 minutes to one hour and were audio-recorded, after obtaining participant's informed consent, to further be transcribed *verbatim*. Interviews continued until data saturation, this is, when no new categories were identified in the gathered data.

3.2.2. Participants

The qualitative sample consisted of Portuguese stakeholders involved in the management of rural fires, invited by phone and e-mail to participate. The qualitative sample consists of 30 participants: Professional firefighters ($n = 3$), Volunteer firefighters ($n = 5$), District operational commanders ($n = 2$), Local and Municipal Policymakers ($n = 6$), Public Institutions members ($n = 6$), Public Security Authorities ($n = 2$) and Scientific community members ($n = 6$). Most of them are men ($n = 20$; 66,6 %) with a mean age of ≈ 47 , and 10 women (33,3 %) with a mean age of ≈ 41 . The detailed sample characteristics for the participants of the qualitative study is given in Table 1.

Table 1. Sample characteristics for the participants of the qualitative study, $N = 30$

ID	Age	Sex	Residency/ Working Zone ¹	Role	Institution
P01	42	Male	Central Region	Professional firefighter	ANEPC
P02	23	Female	North Region	Volunteer firefighter	ANEPC
P03	52	Male	North Region	Volunteer firefighter	ANEPC
P04	44	Male	Central Region	Professional firefighter	ANEPC
P05	41	Male	Central Region	Professional firefighter	ANEPC
P06	50	Male	Central Region	CODIS ²	ANEPC
P07	52	Male	Central Region	President	Parish council
P08	47	Male	Central Region	Engineer	ICNF
P09	46	Female	Central Region	Engineer	ICNF
P10	49	Male	Central Region	President	Municipality
P11	40	Female	Central Region	Researcher	Research Centre
P12	51	Male	North Region	CODIS ²	ANEPC
P13	47	Female	Central Region	President	Parish council
P14	49	Male	Central Region	Engineer	ICNF
P15	72	Male	Central Region	Professor and researcher	Research Centre
P16	58	Male	North Region	Engineer	GTF
P17	48	Female	Central Region	Professor and researcher	University
P18	48	Male	Central Region	City councillor	Municipality
P19	44	Female	Central Region	Volunteer firefighter	ANEPC
P20	41	Male	Central Region	Engineer	ICNF
P21	48	Female	Central Region	Volunteer firefighter	ANEPC

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P22	24	Female	Central Region	Volunteer firefighter	ANEPC
P23	33	Male	Central Region	Researcher	Research Centre
P24	46	Male	Lisbon Metropolitan Area	Researcher	IPMA
P25	44	Female	Central Region	Vice-president	Municipality
P26	51	Male	Lisbon Metropolitan Area	Professor and researcher	University
P27	49	Female	Central Region	Professor and researcher	University
P28	39	Male	Central Region	GNR	ANEPC
P29	37	Male	Central Region	Engineer	ICNF
P30	41	Male	Central Region	PSP	ANEPC

Notes:

¹ According to NUTS II

² District Operational Commander: this designation precedes the reformulation of ANEPC, which took place after the interviews, in January 2023.

ANEPC- Portuguese National Authority for Emergency and Civil Protection; ICNF- Institute for the Conservation of Nature and Forests; GTF- Forest Technical Office (municipal entity); GNR- Republican National Guard; PSP- Public Security Police; IPMA- Portuguese Institute of the Sea and Atmosphere.

3.2.3. Data analysis

Qualitative data was analysed using MAXQDA 2020, and consisted of an in-depth content analysis, in order to identify, analyse and report the content of interviews to correspond to the initial study goals (Bardin, 1977). According to Bardin (1977), this analysis was conducted considering the following steps: (1) transcription of interviews: this step consisted of the preparation of interviews, i.e., listening to the records and doing the respective transcription *verbatim*; (2) immersion and familiarization with the content: on this phase, the objective was to know the content of interviews and do the interconnection with literature about the topic; (3) generation of codes: after the familiarization with data, codes were created to display the obtained information, in different categories and subcategories, depending on the problem/message conveyed by participants' narratives; (4) themes definition: with the purpose of organizing information of the data analyses, themes were created to incorporate the different codes; and (5) development of the categorical tree-map: this tool pretended to give a clear and summarized vision of the analysed content. The qualitative data analysis and its subsequent results' description was conducted based on the Consolidated Criteria for Reporting Qualitative Research (COREQ) standards (Tong et al., 2007).

3.3. Quantitative Study

3.3.1. Data collection and measurement tools

Quantitative data was collected between March and May 2023, using a convenience sampling method, targeting fire risk managers, through a web-based survey. The survey was developed based on the categories that emerged from the qualitative data analysis, gathered through the interviews. The inclusion criteria considered for the study were as follows: (1) being 18 years of age or over, (2) being part of one of the following groups related to fire risk

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management: civil protection, public institutions, public security forces, policymakers, scientific community, non-governmental organizations [NGO] and environmental associations and, (3) having given informed consent to participate in the study.

The survey questionnaire consisted of a sociodemographic questionnaire and measured latent variables related to: (1) perceived community engagement in rural fire risk management; (2) perceived society's risk culture and knowledge about rural fire risk and (3) perception and preferences for fire risk communication and capacity building strategies. The Portuguese version of the survey questionnaire is given in Appendix 2.

(1) 'Perceived community engagement in rural fire risk management' was assessed through four dichotomous questions, i.e., yes/no, (e.g., "In your opinion, does society know the broader consequences of fires [e.g., impact on the surface water quality, air, soil]?"), to which stakeholders were asked to rate based on their judgment on the given subject. One question regarded the actual community engagement in fire risk management and whether community should participate in decision-making processes regarding fire risk management. Moreover, four questions aimed to assess stakeholders' perception of communities' engagement in fire risk management specific cycles, such as prevention, preparedness, response and recovery.

(2) 'Perceived society's risk culture and knowledge about rural fire risk' was assessed through four dichotomous questions, i.e., yes/no, (e.g., "In your opinion, does society know the broader consequences of fires [e.g., impact on the surface water quality, air, soil]?"), to which stakeholders were asked to rate based on their judgment on the given subject. One question aimed to ascertain whether stakeholders perceive if there is a Risk Culture among the Portuguese society. The remaining three questions related to society's specific knowledge on fire risk factors and fire cascading impacts and individual best practices to manage fire risk.

(3) 'Perception and preferences for fire risk communication and capacity building strategies' was measured in a 5-point Likert scale (1= Totally disagree; 5 = Totally agree), in which participants were asked to indicate to what extent they agreed with each given affirmation. Statements regard the perceived efficacy of the extant fire risk communication *praxis*, perceived efficacy of alternative capacity building strategies (i.e., formal risk education at a school level, action-based risk communication/interventions and local-level risk communication/interventions), and targeted audiences (i.e., inhabitants of fire prone rural areas, visitors from those areas).

3.3.2. Participants

A total of 135 stakeholders with an active role in fire risk management enrolled in the quantitative study, by filling the survey questionnaire. From these, the majority are men ($n = 92$, 68.1%) and have a mean age of ≈ 46 years old ($SD = 9.82$). Most participants have a bachelor's degree ($n = 46$, 34.1%). Regarding participants' residency and/or working zone, almost half are from Portugal central region ($n = 59$, 43%) or from Lisbon Metropolitan Area ($n = 31$, 23.0%). Finally, for the purpose of this study, stakeholders' groups were established based on the framework proposed by Lecina-Diaz et al. (2023), as Stakeholders' perspectives on opportunities and challenges in engaging communities in fire risk management

follows: Civil Protection, Government, Nature Conservation, and Research. Specifically, ‘Civil Protection’ actors consist of those belonging to the Portuguese National Authority for Emergency and Civil Protection and Public Security Authority ($n = 47$, 34.8%). These stakeholders are usually directly involved in the implementation of rural fires' prevention and suppression measures and have a very high relevance in fire management (Lecina-Diaz et al., 2023). Actors from ‘Government’ ($n = 46$, 34.1%) are those belonging to the central government, municipal councils, local parish councils and public institutions. According to Lecina-Diaz et al. (2023) these stakeholders have a very high relevance in fire management, as they share the responsibility for fire management plans design and implementation at different administrative levels. ‘Nature Conservation’ ($n = 16$, 11.9%) stakeholders consist of those actors belonging to Non-Governmental Association or non-profit Environmental Associations. These stakeholders’ objectives are usually related to biodiversity and nature conservation. Their relevance for fire management is medium/low, as they are only sporadically involved in fire risk management, although their role in fire risk reduction at the landscape level is high (Lecina-Diaz et al., 2023). Finally, the ‘Research’ ($n = 26$, 19.3%) group of stakeholders consist of researchers with scientific background on fire-related fields (e.g., fire dynamics). According to Lecina-Diaz et al. (2023) these stakeholders have a low relevance in fire management. Despite being responsible for research, innovation, and transfer of technology activities, these actors are rarely involved in (in)formal training of fire management personnel. The detailed sample characteristics for the participants of the qualitative study is given in Table 2.

Table 2. Sample characteristics for the participants of the quantitative study, $N = 135$

	<i>n</i>	%
Sex		
Female	43	31.9
Male	92	68.1
Age*	46.13(9.82)	
Education		
Primary education (\geq 3rd cycle) ^{1,2}	1	.7
Secondary education ¹	30	22.2
Bachelor's degree	46	34.1
Master's degree	30	22.2
Doctoral degree	28	20.7
Residency/Working Zone³		
Central Region	59	43.7
Lisbon Metropolitan Area	31	23.0
North Region	23	17.0
Alentejo	11	8.1
Algarve	5	3.7
Autonomous Region of the Azores	5	3.7
Autonomous Region of the Madeira	1	.7
Stakeholder Group		
Civil Protection	47	34.8

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Government	46	34.1
Nature Conservation	16	19.3
Research	26	19.3

Notes:

* Mean (SD)

¹ Based on the Education System levels in Portugal

² In Portugal, primary education includes three cycles: 1st Cycle (1st, 2nd, 3rd and 4th years), 2nd Cycle (5th and 6th years) and 3rd Cycle (7th, 8th and 9th years)

³ According to NUTS II

3.3.3. Data analysis

The quantitative data analyses consisted mainly in descriptive statistics, particularly the computation of central tendency measures and frequency distribution, in order to describe stakeholders' perception of community engagement in rural fire risk management, and of society's risk culture and knowledge about rural fire risk. To gain a deeper understanding of stakeholders' preferences for fire risk communication and capacity building strategies, it was computed a repeated measures analysis of variance (ANOVA) with Bonferroni correction. To ascertain whether there were differences between stakeholders' preferences for risk communication target groups, a *T* test for paired samples was employed. The quantitative analysis was performed using IBM SPSS Statistics, version 26.

3.4. Ethics

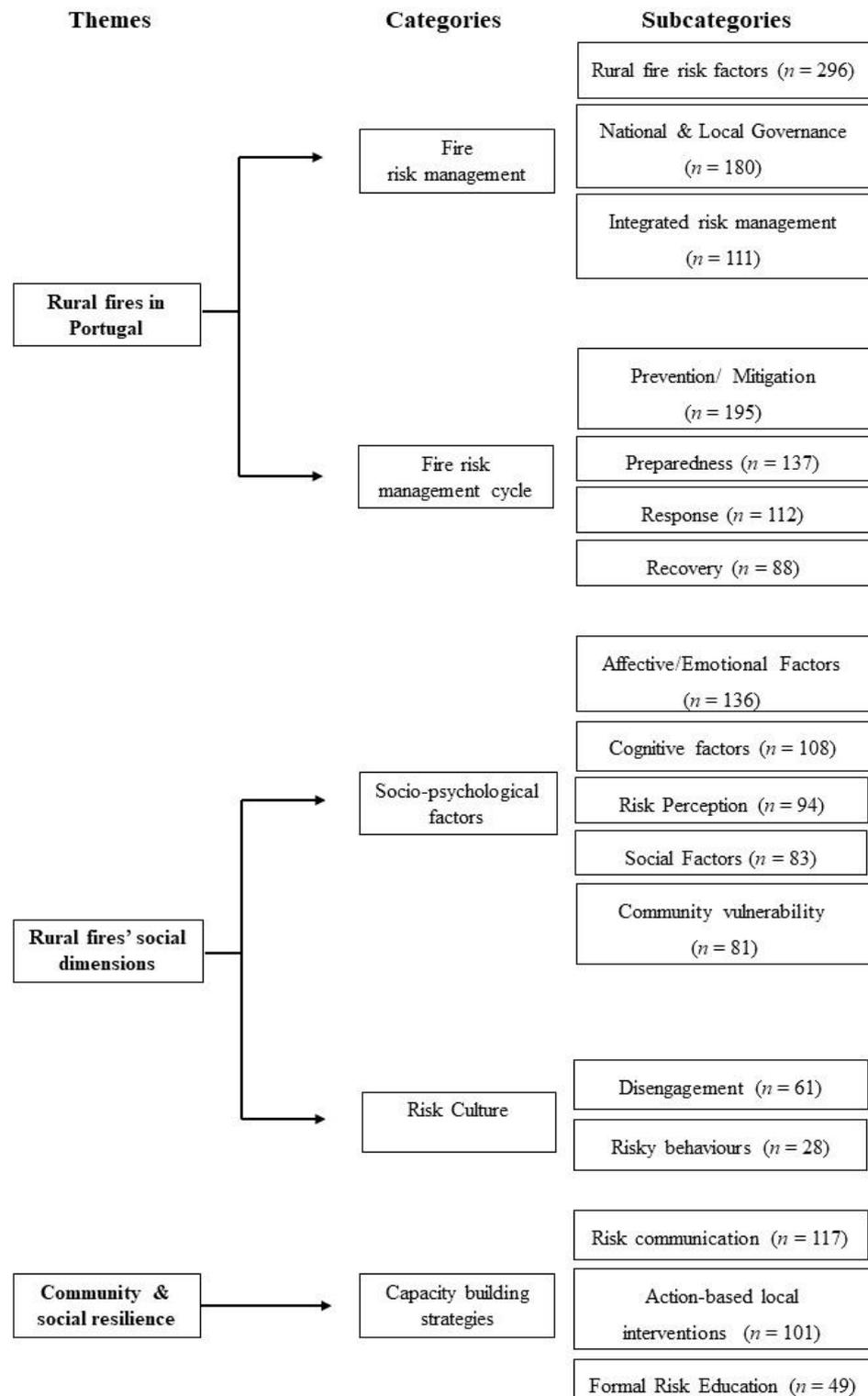
This study was developed in accordance with the international ethical and methodological guidelines for research with human beings (American Psychological Association, 2017) in online environments (Roberts & Allen, 2015). With regard to the qualitative study, before starting the interviews, the study's objectives and respective ethical guidelines were explained to the participants. The interviews only proceeded after participants give informed consent, and the respective permission to record the audio for later transcription. In order to guarantee anonymity and data confidentiality a code was assigned to participants consisting of a "P" for the participant and the respective interview order number (e.g., P05). With regard to the quantitative study, an information sheet as the first page of the online survey was presented to the participants, with general information on the purposes of the research and procedures adopted for ensuring data protection, confidentiality and privacy. The informed consent for participation was obtained at the beginning of the survey, with participants required to check a box to indicate consent before getting into the survey.

IV - Results

4.1) Results from the qualitative study

From the interviews, three main themes emerged: 'Rural fires in Portugal', 'Rural fire social dimensions' and 'Community and social resilience'. All these themes resulted in several categories, each one comprising specific subcategories. The categorical tree map is displayed in Figure 3.

Figure 3. Categorical tree map



Rural Fires in Portugal

With regard to the theme ‘Rural fires in Portugal’, two categories emerged. Specifically, ‘Fire risk management’, and ‘Fire risk management cycle’.

Fire risk management

Concerning ‘Fire risk management’, ‘**Rural fire risk factors**’ ($n = 296$) was the subcategory that most frequently emerged from stakeholders’ narratives. The main risk factors pointed out by participants were an inadequate spatial planning; and demographic factors, such as the rural exodus, which comes with greater challenges regarding forest and fuels management, as mentioned by an ICNF engineer:

“Fires are now completely different. First, because of the abandonment of rural lands (...) and, consequently, the large amount of fuel that exists. In the past, people cleared the bushes for the animals and, therefore, removed the biomass fuel from the forest space and rural areas (...) this no longer happens.” (P14, Male, ICNF engineer)

Moreover, the effect of climate change on fire behaviour that, nowadays, bring serious resistance to control, was also frequently mentioned by participants.

“The climate has been changing. We have the 2017 example (...), Pedrógão Grande. The fires had extreme behaviours. We were unable to predict the direction they were going to take, what they were going to affect ahead. Who was combating the fires in that year and afterwards, acknowledges that fires are having an extreme violent behaviour, making fire suppression difficult.” (P04, Male, Volunteer Firefighter)

The subcategory ‘**National & Local Governance**’ ($n = 180$) consists of the aspects related to the national and local governance of fires in Portugal. The several legal frameworks developed in order to mitigate the rural fire risk were frequently mentioned, particularly the predicaments of those legal frameworks (e.g., bureaucratization of fire risk management processes, unclear responsibilities of different management parties, absence of local power in fire risk management), which may hinder the success of rural fire risk management. One of the existing predicaments of the Portuguese legal framework for fire risk management was the lack of impact assessment, quality control, monitoring and concrete implementation: *“Lawmakers are always creating legislation (...). The problem is that in practice the laws are not implemented. (...) There are too many laws and any sanctions.”* (P01, Male, Professional Firefighter).

‘Integrated risk management’ ($n = 111$) refers to the participation of diverse stakeholders and communities in fire risk management processes, in a collaborative relationship. Indeed, participants acknowledged that the collaboration between public entities and the communities may be important to build communities’ resilience to rural fires risk.

“When we are talking about fire emergency planning, we need the collaboration from parish councils (...). They [parish councils’ presidents] are the ones that may encourage people to engage in fire risk management, by saying ‘you are going to participate in this emergency planning, because this is the best for you; and if a fire happens, you will know exactly the established plan, which was designed based on our community’s ideas and inputs (...)’.” (P05, Male, Professional Firefighter).

Fire risk management cycle

Within the category ‘Fire risk management cycle’, the most frequently mentioned phase was **‘Prevention/ Mitigation’** ($n = 195$), which involves the forest management and possible actions that citizens (e.g., following local and national regulations, by keeping their lands well-maintained to reduce fuel for fires) can take to mitigate the occurrence of fire risk.

“Although there is this perception [of the consequences of the rural fire], people are still negligent in the preventive approach (...). They tend to do what is strictly legal or what is necessary, only just to avoid paying a fine. In many cases this is what happens! Unfortunately, even with this perception, I think we are very far from what should be required [regarding prevention] (...).” (P23, Male, Researcher)

Also, it was widely stated that the actual measures are not adequate, or even obsolete, and more investment is needed in this area:

“That is a transversal problem [regarding fire prevention] that not only regards spatial planning but relates almost with everything. (...) Sometimes we take too long to take any action that when we actually go to the field, what we thought to be the best prevention practice, no longer is adequate to the circumstances.” (P18, Male, Municipality City councillor)

With regard to **‘Preparedness’** ($n = 137$), two main positions emerged from the participants’ narratives. In one hand, it was commonly reported that communities know some tools (e.g., water tanks that shall be activated by the community as a first response to a fire) and have good practices (e.g., know the community’s emergency evacuation plan and practiced it with the other residents) regarding fire risk preparedness.

“(...) especially if we think about some rural areas that are constantly affected by forest fires (...), people end up having a series of mechanisms that are almost automatic. When the fire happens people mobilize some resources. We're talking about operational resources, such as a water tank (...). There are a number of mechanisms that people already activate spontaneously.” (P11, Female, Researcher)

On the other hand, some participants are critical to the existing fire preparedness programs, by stating that those programs are not sufficient to prepare people for fire risk and thus more investment is required to improve the existing programs or develop new ones.

“The State has launched a program, [name of the program], which seems to me an excellent initiative in terms of purpose, but about which I have been very critical. Because it gives me the idea that it was very badly designed and even worse implemented.” (P15, Male, Professor and researcher)

Interestingly, according to the interviewed, in Portugal, the emergency ‘**Response**’ ($n = 112$) to rural fires has a discrepant State investment in resources comparing to other fire risk management cycle phases, such as prevention or recovery. Indeed, the interviewed stakeholders believe that in this phase there would be fewer expenses if more investment was allocated to prevention and/or community preparedness, to avoid the need for fire combat: *“I think there is a greater focus and a lot investment in fire combat, whilst prevention is kind of neglected.” (P04, Male, Professional firefighter).*

Challenges regarding firefighting also emerged, particularly regarding the role of the community in the emergency response. In one hand few stakeholders reported that the community may be a valuable help in firefighting, by providing support or donating supplies. However, on the other hand, some mentioned that community members unintentionally hinder firefighting efforts through several ways, such as through non-compliance with evacuation orders, interfering with firefighting operations (e.g., disregarding safety perimeters established by the Civil Protection), or even attempt to fight the fire themselves without proper training or equipment which, in turn, forces civil protection agents to divert resources to ensure community residents’ safety.

“Sometimes the time is wasted in an attempt to convince people that we are doing our job the best way we can and they should not interfere. I am not saying that it is not our role, but many times we are surely diverting resources that are needed elsewhere.” (P28, Male, GNR)

In contrast to risk response, and according to the interviewed stakeholders, ‘**Recovery**’ ($n = 88$) from rural fires has the lowest investment and allocation of resources. Some participants mentioned that almost nothing is done regarding environmental rehabilitation, which may include reforestation efforts, implementation of erosion control measures, and habitat restoration of the affected areas. Whereas, when it comes to infrastructure and human losses, a greater emphasis is given to the lack of psychosocial support to the affected community residents which, in turn, makes communities and local actors feeling forgotten.

“(...) there is the technical work from Psychology that must be conducted on the right time. (...) For instance, in Pedrógão, there was only a crisis intervention. People begged for psychological support. Psychologists came, delivered a crisis intervention and then gone away. But at this level, I think it is required a long-term intervention, to give people the time to absorb what happened to themselves. (...). It is normal to feel apathetic, disorientated and unable to come back to their daily routines [after a rural fire event]. (...) But then, we have to somehow come back to the normality (...).” (P25, Female, Municipality Vice-president)

Rural Fires’ social dimensions

With regard to the theme ‘Rural fires’ social dimensions’, two categories emerged. Specifically, ‘Socio-psychological factors’, and ‘Risk Culture’.

Socio-psychological factors

With regard to ‘Socio-Psychological factors, ‘**Affective/Emotional factors**’ ($n = 136$) was the subcategory that emerged most frequently and it refers to the emotional responses during and after a rural fire. During a fire event, according to the interviewed participants, the most challenging affective dimension that firefighters have to deal with, is community residents’ emotional attachment to their homes and belongings. Indeed, it was emphasized that strong emotional attachment to one's home and belongings may make residents hesitant to evacuate during a rural fire event which, in turn, may delay evacuation efforts and put community residents' safety at risk. Moreover, beyond having to combat the fire, firefighters reported that they have to deal with the emotional distress of affected residents that are resistant to evacuation, which affects their ability to focus exclusively on firefighting efforts.

“There are people who really don't want to leave. They'd rather die than leave. Especially the elderly (...) because we are talking about a construction of a lifetime. Their life is there and now [during a fire event] to testify it being lost... The pain of losing their home is greater than the pain of staying there. Therefore, many people make evacuation so difficult; they 'set foot' to stay.” (P02, Female, Volunteer firefighter)

After a rural fire event, participants referred that psychological consequences for community residents who experience them directly or indirectly usually occur. A greater emphasis was given to trauma, anxiety, fear and grief. The latter, was particularly related to the loss of homes, assets and treasured possessions (e.g., farm animals). On this issue, and as abovementioned, the lack of psychological support was underlined, with the local decision-makers and community members playing a fundamental role on supporting those who grieve about their losses.

“It's recurring. There are places where it is always recurrent, there is always a recurring history [referring to rural fire events]. And the people who live there, who have lived there their whole lives, obviously have trauma. If I was in their situation, I would have trauma too, dammit! Isn't it? It's normal.” (P01, Male, Professional firefighter)

“There are still many people today that you can see in their eyes, in their way of living: they are not the same anymore. They are different people, because they were left with nothing. Everything they had in life was left burnt.” (P07, Male, Local parish President)

Another category that emerged within the theme ‘Socio-psychological factors’, was the ‘**Cognitive factors**’ ($n = 108$) related to rural fires, in which the stakeholders identified the citizens’ knowledge about fire risk (e.g., fire behaviour, risk factors). According to the stakeholders, the lack of knowledge about rural fires relates to lower risk perception, which, in turn, leads to increased personal risk (i.e., individuals may underestimate the dangers associated with rural fires and thus put themselves at a higher risk), inadequate preparedness (i.e., without understanding the necessary preventive measures and preparedness strategies, community residents may fail to take appropriate actions to protect themselves, their families, their homes, and their community) and hindered community resilience (i.e., citizens who lack knowledge and awareness about rural fires may struggle to come together, support one another, and implement effective community-based rural fire prevention and preparedness initiatives). Still regarding this issue, stakeholders not only mention the lack of knowledge of community residents,

but also of local visitors/tourists. Moreover, it was given a great emphasis about the fact that the information (e.g., regulatory approaches for rural fires management) may not be adequately conveyed to individuals, making it difficult to be fully understood by rural communities: *“Fires are a complicated topic because they have a great emotional charge (...) because people lose property and there are a lot of problems around that, but I would say that in general, society is misinformed.”* (P24, Male, Researcher)

“They do not know; they do not know what to do in case of fire! (...) the Pedrogão disaster was a clear example of the lack knowledge people have about self-protection in case of fire. If we take a look, most of those people died in an evacuation process, attempting to escape, when they were safer in the village (...). I remember that a whole family died, the parents and the son. They were fleeing from a river beach to go where? To the unknown?” (P29, Male, ICNF engineer)

Fire **‘Risk Perception’** ($n = 94$) consists of how individuals perceive and understand the potential dangers and risks associated with rural fires. It involves their subjective assessment of the likelihood and severity of a fire occurring and its potential impacts on themselves, their property, and their community. According to the interviewed stakeholders, different factors influence on individuals’ risk perception, such as the knowledge and previous experiences with rural fires. Some participants refer that the community residents’ risk perception is lower than decades ago because rural communities have always dealt with the fire and do not expect a different fire behaviour, as they are not duly informed about the reasons (e.g., climate change) for that.

“I think that it turns out to be more dangerous [rural fires], due to local residents’ [lack of knowledge]. (...) They have lost the perception of how the fire behaves, because a few years ago it was completely different. Today it is no longer like it was. And every year is worse than the other [referring to fire behaviour].” (P12, Male, District Operational Commander)

In turn, in most of the interviews, it was highlighted that the 2017 fires were a turning point for social awareness towards rural fires and, thus, people demonstrate a greater perception of the risk and consequences of a rural fire.

“From 2017 until now (...) I think they have been demonstrating a greater awareness for rural fires since then. Unfortunately, it appears that there had to be deaths, there had to be a catastrophe, for people become more aware of fire risk.” (P13, Female, Local parish council President)

This category also contemplates ‘**Social Factors**’ ($n = 83$) that mainly relates with the sense of community and the ascription of responsibility, as ascertained from participants’ narratives. Occasionally, stakeholders mentioned that the sense of community offers several advantages in rural fires risk management, such as: collective action and cooperation (i.e., working together to implement fire risk management good practices, conducting neighbourhood clean-ups and participating in community-based preparedness initiatives); rapid response and support (i.e., community residents assist each other in evacuating, provide shelter to those displaced, and coordinate resources and assistance for those in need) and social cohesion and emotional support (i.e., community members provide emotional support to those who have suffered losses, offer comfort, and provide a support network during the recovery process). However, it was most frequently mentioned the negative effects of the ascription of responsibility that, in participants’ discourse, is still very common in fire risk management. Specifically, community residents disclaim responsibility for their acts or duties, placing these responsibilities on other entities, such as the civil protection or the municipalities, or even on other community members: “*No matter how much we say that we all are civil protection (...) for them it's always the neighbour's fault or the firefighters' fault.*” (P21, Female, Volunteer firefighter).

Another preoccupying psychosocial dimension of rural fires risk management was the ‘**Community vulnerability**’ ($n = 81$). According to the interviewed, the main socioeconomic vulnerabilities are conditions associated with advanced age, economic difficulties, and the depopulation of rural areas, which leads to the isolation of older people. All these vulnerabilities create constraints to the implementation of prevention measures, a smooth emergency response and to recovery processes.

“(...) we are talking about older communities (...) and to make matters worse, living in interior territories. And as they are already elderly and perhaps without great financial capabilities (...), they just neglect it [referring to prevention measures]” (P09, Female, ICNF engineer)

Risk Culture

The ‘**Disengagement**’ ($n = 61$) of communities and individuals in fire risk management processes was widely mentioned by the interviewed stakeholders, in which it is pointed out that individuals fail to recognize the importance of rural fire’s prevention, preparedness, and mitigation measures. According to the interviewed, this disengagement from a fire risk culture is translated into limited awareness about the potential hazards and consequences of rural fires and minimal preparedness efforts. Furthermore, instead of taking a proactive approach to rural fire risk management, a disengagement or lack of risk culture leads to a reactive approach, in which communities may only respond to fires after they occur, relying heavily on emergency civil protection services to handle the situation.

“Beyond any doubt, we haven’t a prevention culture. I’m also talking about prevention from a practical point of view (...). It is implemented in other countries. Why is it no implemented in Portugal? Because we all think it doesn’t have to be done and it won’t ever happen [referring to rural fires].” (P14, Male, ICNF engineer)

Another aspect that comes to reinforce the lack of risk culture in Portugal, is the **‘Risky behaviour’** ($n = 28$) taken by Portuguese citizens. According to the interviewed stakeholders, people usually take actions that increase the risk of rural fire, such as the improper disposal of cigarettes, negligent outdoor burning, even neglecting fire safety practices.

“We have risky behaviors that are sometimes so aberrant. People go on a picnic and make fires that they know they are forbidden to make under specific circumstances (...), fireworks, and a panoply of situations that don’t remind the ‘baby Jesus’. They just don’t care” (P01, Male, Professional firefighter)

What is more, during a rural fire event, it appears that the Portuguese tend to adopt behaviours that pose increased risk to their personal safety. For instance, it appears to not be uncommon that individuals, attracted to rural fires, get closer to them out of curiosity or to get a better view. This behaviour is known as "sightseeing" or "fire tourism", and was particularly criticized by one professional firefighter.

“One of the things we [referring to the Portuguese] like most is the ‘catastrophe tourism’. People go to the fire itself, they go with their cell phone cameras to record and make videos, they take their cars there, as if they were doing tourism. This is really called ‘catastrophe tourism’ – I didn’t invent it now! – it’s really ‘catastrophe tourism’. This is what makes it more difficult for us. It makes the civil protection and police circulation more difficult. The police themselves have to control the traffic with the aggravating factor of controlling people.” (P01, Male, Professional firefighter)

Community & Social Resilience

Regarding the theme ‘Community & Social Resilience’ one category emerged: ‘Capacity building strategies’.

‘Capacity building strategies’

The subcategory that emerged most frequently with regard to ‘Capacity building strategies’, was **‘Risk communication’** ($n = 117$). According to the stakeholders, the way risk communication is conveyed to both communities at heightened risk and to the general public must be strategically rethought, considering the target audience. Indeed, participants

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consider that the current communication strategies are ineffective at engaging communities and individuals in fire risk management and do not motivate people to change maladaptive behaviours. Within risk communication, it was consensual that fire risk communication must be targeted, as different individuals and communities have varying levels of knowledge, understanding, beliefs, and behaviours related to rural fires. As clearly stated by an ICNF engineer “(...) *the country is very heterogeneous. The reality of Viana do Castelo is completely different from the reality of Vila Real de Santo António. For this reason, these national communications campaigns are ineffective (...)*” (P20, Male, ICNF engineer). In this line, most participants advocate that risk communication must be based on a ‘proximity communication’, by privileging local campaigns and tailoring fire risk communication to specific audiences.

“(...) I think it must be simplified [referring to fire risk communication]. We have to know our population, and unfortunately there are still illiterate people in the municipality. There are older people who do not understand very well what is written there [referring to informative leaflets]; there are people with a lot of difficulty, even the younger ones. Therefore, the communication must be conveyed in a simple manner, in order to be easy for people to understand.” (P22, Female, Volunteer firefighter)

Moreover, it was especially stated by local decision-makers that risk communication campaigns targeting tourists or other visitors of rural areas, should be implemented. According to these actors, rural areas’ visitors do not know the territory, the fire risk and the precautionary behaviours they should take. Therefore, risk communication campaigns (e.g., emergency evacuation maps) for these audiences must not be dismissed.

“There is another problem: the tourist villages (...). That is, tourists visit the village to know it. If there is a fire, nobody knows where to go. Therefore, emergency evacuation maps must be available, for people to know where to go in case of fire.” (P17, Female, Professor and researcher)

With the aim of involving communities in risk management processes and building community resilience ‘**Action-based local interventions**’ ($n=101$) were identified as possible valuable tools, by the interviewed. These interventions involve engaging community members in hands-on activities and experiences related to fire prevention, preparedness, and mitigation. Examples of these interventions, pointed out by participants, account for: (1) practical exercises, such as using fire extinguishers, or practicing evacuation drills; (2) establishing volunteer firefighter programs or community emergency response teams that engage residents in fire response and support activities; and (3) establishing community task forces, working groups, or

advisory committees that involve diverse stakeholders in developing local fire management plans, policies, and regulations. As widely emphasized, these actions must be implemented in a context of proximity – *“I think that these actions must occur at a local level. It has to be a closer intervention. Especially in these rural areas.”* (P11, Female, Researcher) – considering the idiosyncrasies of each community and its members and, when possible, led by local agents (e.g., local decision-makers).

“I think that there is no intervention without using local agents. There isn't another way! Local decision-makers must be mobilized (...), so that they can further mobilize the community (...). In rural areas is impossible to work from distance.” (P11, Female, Researcher)

“When working on this, you need to know your population. You need to know the strategy that a given family has to respond in case of fire. You must attempt to understand what will be that family's behaviour, what they have available to help, if they have a way to evacuate.” (P04, Male, Professional firefighter)

In general, participants believe these actions may be well more effective at engaging communities' inhabitants in fire risk management, rather than the conventional communication strategies: *“I think that those actions of being sit one day in a room listening somebody talking about fuel management (...) and what to do in case of fire, don't work very well”* (P09, Female, ICNF engineer). In this line, the interviewees recommended the implementation of demonstrative, practical and collaborative strategies that must be conducted routinely, in order to enhance its positive effects in engaging the community in fire risk management processes.

“We cannot just get there, implement a given program in a certain village and that's it. (...) There is no point in such effort if there aren't more training actions. So, if you don't train again, even once a year, that community's risk culture will be lost.” (P06, Male, District Operational Commander)

“People need to get involved in these planning processes. We need to think together. We may even organize a sort of sessions. But these sessions must not be conducted to deliver lessons. These sessions must aim to talk with people, get to know what the community already does that may well be valuable for Civil Protection (...). This must be kind of a social gathering, in which we ask people (...) ‘what do you already do and what can we [referring to Civil Protection] do in a different manner?’. (...) But this means that we have to go to the villages, meet with people, discuss with them and

think together on solutions. Without their opinion, it will be very difficult to implement a fire emergency planning.” (P11, Female, Researcher)

‘Formal risk education’ ($n = 49$), was another strategy that appeared frequently to promote a risk culture for future generations, within the education curricula.

“The school could have a fundamental role. In fact, I strongly believe that this thing of implementing awareness campaigns in schools must be replaced by a formal integration of risk disciplines and Civil Protection within the formal education curricula. For instance, in a citizenship subject! Considering that we all agree that this work [referring to the construction of a risk culture] takes at least one generation to produce its effects (...) we have to start working in schools to further have more resilient adults, and with heightened fire risk perception (...).” (P12, Male, District Operational Commander)

4.2) Results from the quantitative study

4.2.1) Stakeholders’ perception of community engagement in rural fire risk management

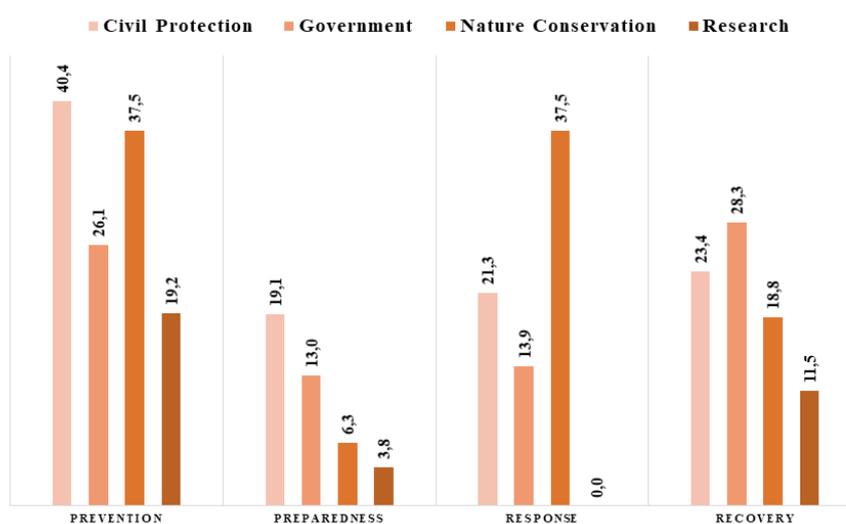
Although the vast majority of the stakeholders consider that communities and citizens must actively participate in integrated rural fire risk management processes ($n = 130$, 93.3%), it was widely acknowledged that, problematically, communities and citizens do not actually engage in fire risk management ($n = 103$, 76.3%).

To gain a deeper comprehension on stakeholders’ understanding on communities’ and citizens’ engagement in fire disaster risk management, frequency analyses were conducted *per* disaster risk management phases (i.e., Prevention, Preparedness, Response, Recovery), taking into account the overall stakeholders’ perceptions, and these perceptions for each stakeholders’ group. The obtained results for each stakeholders’ group is detailed in Figure 4.

With regard to the adoption of rural fire risk prevention and mitigation measures, (i.e., Prevention), more than a half of the stakeholders consider that communities and citizens do not take those measures ($n = 93$, 68.9%). A deeper inspection of the prevalence results *per* stakeholders group, reveal that the Research ($n = 5$, 19.2%) and Government ($n = 12$, 26.1%) stakeholders are among the stakeholders who barely consider that communities and citizens effectively engage in fire preventive measures. Worryingly, almost 90% of the stakeholders consider that communities and citizens are not duly prepared (i.e., Preparedness) for rural fires ($n = 118$, 87.4%), with less than 10% of the Nature Conservation ($n = 1$, 6.3%) and Research ($n = 1$, 3.8%) stakeholders considering that communities and citizens are duly prepared for an event of a rural fire. When it comes to Response, 80% of the stakeholders considers that

communities and citizens do not know the auto-protection measures they shall adopt in case of a rural fire event ($n = 108$, 80.0%). Interestingly, any stakeholders from the Research group consider that individuals are acquainted about the individual response to be taken in an event of a rural fire. Finally, regarding post-fire Recovery, most stakeholders agreed that communities and citizens are not formally supported by public institutions ($n = 105$, 77.8%). However, it is noteworthy, that about 30% of the Government stakeholders ($n = 13$, 28.3%) consider that the affected populations benefit from the proper post-fire support.

Figure 4. Prevalence (%) results of stakeholders perception of communities' engagement in fire disaster risk management cycle



4.2.2) Stakeholders' perception of society's risk culture and knowledge about rural fire risk

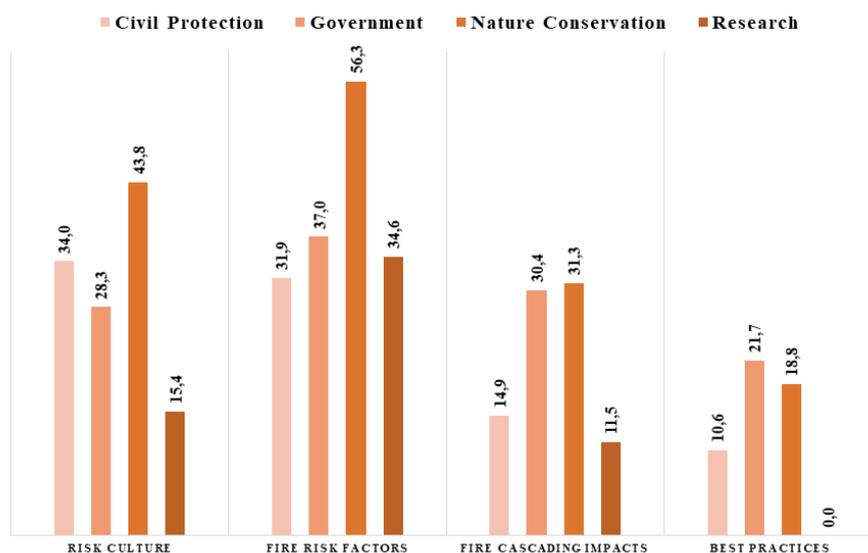
In general, the majority of the stakeholders perceive that the Portuguese population do not have a Risk Culture ($n = 94$, 70.4%). Differently from the remaining stakeholders' tendency, almost half of Nature Conservation stakeholders ($n = 7$, 43.8%) consider that the Portuguese have a Risk Culture. In contrast, about 15% of the Research stakeholders consider that the Portuguese society do not have risk (and its management) embedded in its collective frame of mind ($n = 4$, 15.4%).

With regard to the Portuguese population's knowledge about fire risk factors, 63% of the stakeholders ($n = 85$, 63.0%) agreed that the Portuguese are unaware about these factors. At this level, and once again, the Nature Conservation stakeholders group ($n = 9$, 34.6%) differentiates from the remaining stakeholders, by considering more frequently that the Portuguese know the fire risk factors. Almost 80% of the stakeholders ($n = 106$, 78.5%), consider that the Portuguese population do not know the broader consequences and the cascading effects of rural fires. This evidence was specially verified between the Civil Protection ($n = 7$, 14.9%) and Research

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($n = 3$, 11.5%) stakeholders that hardly considered that the general society is aware of the cascading effects of rural fires, such as the heightened risk of landslides or augmented soil erosion. Finally, nearly 90% ($n = 117$, 86.7%) of the stakeholders consider that the general population does not know the individual best practices to manage fire risk (i.e., prevention, mitigation, preparedness, response and recovery measures). Regarding the latter, it is worth mentioning that any stakeholders from the Research group considered that the Portuguese are determinedly aware about the individual measures to be taken under fire risk management. The obtained results for each stakeholders' group is detailed in Figure 5.

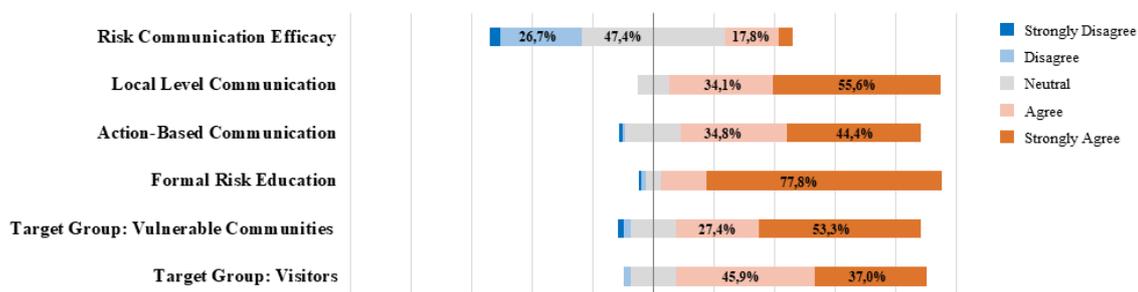
Figure 5. Prevalence (%) results of stakeholders perception of society's risk culture and knowledge about rural fire risk



4.2.3) Stakeholders perception and preferences for fire risk communication and capacity building strategies

Prevalence results for stakeholders' perception and preferences for fire risk communication and capacity building strategies are illustrated in Figure 6. Conventionally, only the highest frequencies (%) are detailed.

Figure 6. Prevalence (%) results of stakeholders' perception and preferences for fire risk communication and capacity building strategies



With regard to the current fire risk communication strategies, it appears that the surveyed stakeholders consider that those strategies are moderately ineffective ($M = 2.93$, $SD = .88$). When it comes to alternative strategies for fire risk communication and community capacity building strategies, the repeated measures ANOVA demonstrate that there are significant differences regarding stakeholders' preferences for risk communication strategies, $F(2, 268) = 8.35$, $p = .005$. *Post hoc* comparisons using *Bonferroni* correction presented statistical differences between stakeholders' preferences for formal risk education with local-level communication strategies, $p = .02$, and action-based communication, $p = .01$. Similarly, statistical differences were identified between stakeholders' preferences for school-level formal risk education with local-level communication strategies, $p = .02$. In general, one may argue that stakeholders consider that fire risk education should be integrated in school curricula, in order to effectively raise awareness and engage individuals in fire risk management. The detailed results of the repeated measures analysis of variance are displayed in Table 3.

Table 3. Stakeholders' preferences for fire risk communication strategies.

	Fire risk communication strategies			$F(2, 268)$
	Formal education	Local-level communication	Action-based communication	
Perceived efficacy	Mean (SD) 4.67 (.71)	Mean (SD) 4.45 (.67)	Mean (SD) 4.20 (.87)	8.35**

** $p < .01$

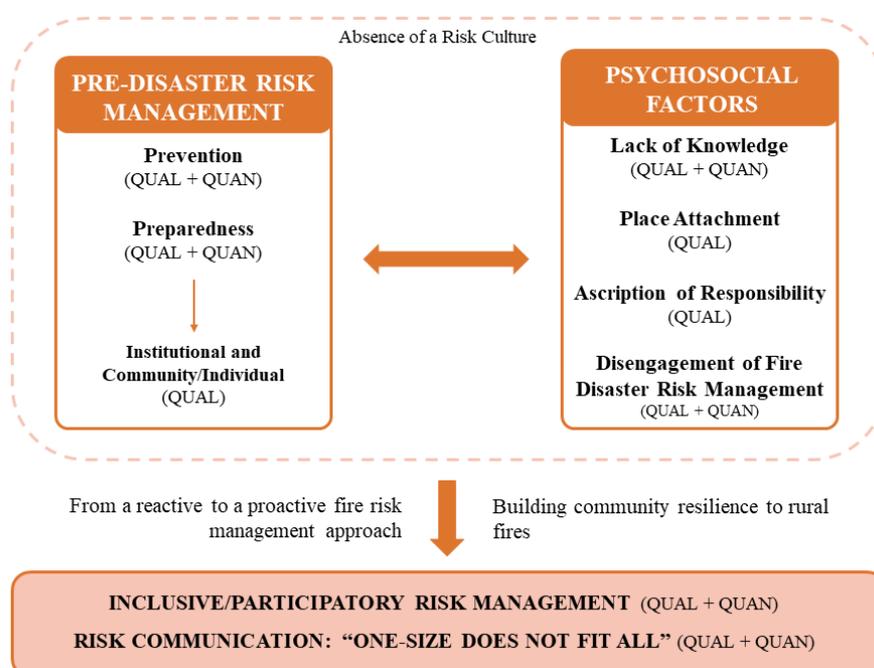
Concerning the preferred targeted audiences for fire risk communication, it seems that stakeholders consider that risk communication should be tailored to both communities exposed to heightened fire risk ($M = 4.27$, $SD = .95$) and to the visitors of those communities ($M = 4.18$, $SD = .76$), as it was not found significant differences between stakeholders' preferences for both audiences, $t(134) = 1.16$, $p = .25$.

V – Discussion

Portugal is located in a region formally identified as a climate change “hotspot” (Lima et al., 2023). Preoccupying future projections consider that Portugal is extremely vulnerable to climate change (Cardoso et al., 2019), in which extreme climate-related events (e.g., heatwaves, rural fires) are expected to occur with heightened frequency and intensity, *due to both the severity of climate projections and the limited adaptation preparedness* (Lima et al., 2023, p. 2). Such projections require a higher level of preparedness and adaptation by communities and individuals for climate-related hazardous processes, such as rural fires (Nunes et al., 2023). This acknowledgement was the starting point for the present study, which had the ambition of comprehensively ascertain the level of communities’ awareness, preparedness and engagement in fire risk management processes, through the perspective of fire management stakeholders (e.g., decision-makers, public authorities), using an exploratory sequential mix-methods research.

Following Fetters et al. (2014) guidelines, findings from the quantitative (i.e., QUAN) and qualitative (i.e., QUAL) studies were integrated through merging and using a joint display, which resulted in a matrix of the most prominent results, as displayed in Figure 7. Four core themes emerged from the quantitative and qualitative results’ triangulation (i.e., Pre-disaster risk management; Psychosocial factors; Inclusive/participatory risk management; and Risk communication: “one size does not fit all”), whose discussion will be centred on the most prominent evidence.

Figure 7. Matrix of data mixing for community engagement in fire risk management



5.1) Pre-disaster risk management and psychosocial factors: Two sides of the same coin?

Results from this study point out that the individual psychosocial dimensions may well be related to citizens' engagement in fire risk management, particularly in prevention and preparedness. Worryingly, the vast majority of the interviewed stakeholders and participants in the survey questionnaire, report that communities' and citizens' tend to do not engage in prevention (e.g., clear the vegetation around their properties) and preparedness (e.g., elaborate households' emergency plans to implement in case of a fire event) best practices. To begin with, the lack of a risk culture in Portugal was widely considered a major factor contributing to both individuals' and institutions' poor involvement in pre-disaster fire management, thus relying mainly in reactive approaches to fire events. Even though this is still the dominant approach to manage fires worldwide (Castellnou et al., 2019), with projected climate change scenarios indicating that vulnerability to catastrophic fires is very likely to get worse, several authors have been arguing that is urgent to move away from reactive towards proactive approaches of managing fires, through a muscularly implementation of preventive and preparedness campaigns (Cassidy et al., 2022; Thacker et al., 2023; Wollstein et al., 2022). However, and despite the scientific calls to shift the paradigm towards a proactive fire risk management (Cassidy et al., 2022; Thacker et al., 2023; Wollstein et al., 2022), it appears that in Portugal preventive and preparedness actions are, somehow, deprioritized, which, according to Wollstein et al. (2022), limits the promotion of long-term ecosystem and community resilience on fire-prone areas.

A dramatic example of the poor society's knowledge, and thus, preparedness for rural fires was given by an interviewed participant, who recalled a family that thriving to escape from the 2017 Pedrógão Grande rural fires, flee from a relatively safe area (i.e., river beach) to end up dying in the Death Road (i.e., EN236-1) trapped by the fire. Regrettably, this was not the single example of community's and individuals' lack of knowledge about fire and its related dimensions (e.g., risk factors, cascading effects, fire management best practices) given by the interviewed stakeholders. It was indeed consensual, among participants in the qualitative and quantitative study, that the Portuguese have limited knowledge of fire risk management. In turn, this may be influential on individuals' lack of awareness and risk perception regarding fire risk (Fernandez et al., 2018; McCaffrey, 2015), which may lead to an overall disregard of the good practices to be adopted pre-, during and a post-fire disaster (McCaffrey, 2015), or even to a false sense of confidence in their capabilities to act in case of an emergency event (Karemaker et al., 2021). The latter (i.e., false sense of confidence) was especially problematized by the interviewed stakeholders with concern to the sociodemographic characteristics of those living in rural communities on fire-prone areas.

With this regard, from the stakeholders' narratives, one may ascertain that in these rural communities (mainly due to the rural exodus) inhabit a significant proportion of socially vulnerable groups, such as elderly people

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Joana Batista Fernandes (e-mail: joana.bfernandes2@gmail.com) 2023

that are, in most cases, economically strained and/or have significant impairments in physical and mental health. According to a study conducted by Karemaker et al. (2021), elderly people usually lack detailed knowledge of fire risk factors, which was also ascertained from the interviewed stakeholders' narratives. In fact, it was widely pointed out that elderly people are particularly challenging in fire risk management, as they usually demonstrate a limited understanding of the actual fire risk factors, fire dynamics and, as a consequence, of the adequate protective behaviours. Actually, fire was traditionally used as an agricultural and pasture practice by rural communities for decades, who used to know well the fire behaviour and how to properly manage it (Leite et al., 2013). Therefore, nowadays, it appears to be challenging for rural communities' inhabitants – especially to the older ones – to comprehend that those traditional practices are no longer safe and expose them to heightened fire risk. What is more, as these individuals were used to deal with fire, they tend to demonstrate – as also verified in previous research (cf. Karemaker et al., 2021) – a false overconfidence in their abilities to respond in case of a fire event, thus exposing themselves to the risk of severe consequences. According to the participants in this study, this is especially confirmed in elderly people's resistance to evacuate, when they are ordered to do so.

With regard to fire evacuation, which naturally causes heightened stress and anxiety for evacuees (Asfaw et al., 2019), it appears that not only the elderly people offer resistance to comply with evacuation orders. Results from the qualitative study demonstrate that communities' inhabitants, in general, are usually very reluctant to leave under a mandatory evacuation. Several reasons were pointed out, such as low levels of risk perception, desires to protect property and fight the fire. However, the most common reason that emerged from participants' discourses regard to place attachment. According to Hidalgo and Hernández (2001, p. 274) place attachment consist of the “*interplay of affect and emotions, knowledge and beliefs, and behaviours and actions in reference to a place*”. This bonding of individuals to their homes, lands and community, has been consistently demonstrating to have a negative effect in evacuation operations (Ariccio et al., 2020; Bonaiuto et al., 2016; Donovan et al., 2012). Beyond a reasonable doubt, delaying the decision to evacuate is one of the most dangerous response strategy an individual can engage in when faced with the threat of fire (Walpole et al., 2019). However, research has been demonstrating that a worrying prevalence of individuals (\approx 30 - 60%) demonstrate waiting behaviours or plan to wait and assess the risk when faced with a fire in the future (McCaffrey et al., 2015; McCaffrey et al., 2017). Remarkably, and once again, strategies to overcome the common obstacles to evacuation operations shall be planned in pre-disaster phases (Ariccio et al., 2020), instead of during the emergency response, as it appears to be the *praxis* in the Portuguese context. For instance, considering the provision of information about the dangers of late evacuation, in prevention and preparedness campaigns, may be of utmost importance to facilitate evacuation operations (Walpole et al., 2019). An alternative strategy may be to strategically plan with anticipation an affectively significant evacuation site

(e.g., school, church) considering the community's values and culture (Ariccio et al., 2020); as evidence demonstrates that in case of disaster, people tend to more easily evacuate to places of affective relevance (Wu et al., 2012).

Based on the acknowledgment of the poor Portuguese Risk Culture, as widely reported by participants in both qualitative and quantitative studies, it was not surprising to find that individuals tend to ascribe fire risk management responsibility to public authorities, thus disregarding themselves of engaging in mitigation and adaptation practices. Similar results were found by Gordon et al. (2010), who found that citizens often reject the responsibility for managing fire risk; believing that the mitigation of fire risk is up to public services, such as firefighting. These findings point to several implications for fire risk management and governance. One may argue that government-driven decision making may dismiss individuals from disaster risk management processes which, in turn, leave them more vulnerable to fire risk. Therefore, bringing communities and citizens to decision-making processes may well be an effective strategy to not only make individuals more accountable for fire risk management, but also build community resilience to fire risk.

5.2) Bridging the gap between communities and risk managers towards an inclusive fire risk management

Findings from this study leave no room for doubt when it comes to the need of engaging communities in fire risk management processes. Both the interviewed and the stakeholders that enrolled in the survey questionnaire, agreed that is crucial to implement participatory processes of fire risk management. Indeed, several studies have emphasized the potential of participatory fire risk management to build resilient communities to fire risk (Almstedt & Reed, 2013; Everett & Fuller, 2010; Gazzard et al., 2016). These participatory processes shall incorporate landscape values and community knowledge into operational fire risk management strategies (Otero et al., 2018). Community participation may come in a myriad of forms, such as community-based preparedness (e.g., Stephens et al., 2022), community-based collaborative groups (e.g., Cheng & Sturtevant, 2012) or community committees (e.g., McGee, 2011).

However, since the participants in this study argued that the Portuguese do not have a proper knowledge on fire risk, its causes, cascading effects and management best practices, and that citizens are not actively engaged in fire risk management; one may argue that it would be prolific to take a step back and to “bridge the gap” between communities and risk managers. To achieve so, it appears that it is urgent to change the actual fire risk communication *praxis*, which was considered obsolete and untailored to the communities – as mentioned by the interviewed – and infective – by the participants that enrolled in the survey questionnaire. Findings from this study point into three alternative directions regarding risk communication: fire risk communication must also happen at a local level; action-based communication has a strong potential at engaging local communities in fire risk management; and it shall be promoted a risk culture to the Portuguese population, which may be enabled through risk education targeting young generations.

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First, fire risk communication must also take place at a local level, and be strategically tailored to each community's cultural values, needs, concerns and idiosyncrasies. As argued by Mabon (2020) local-level communication approaches shall respect that local people may have their own lived experience of fire, which inform how they engage with fire risk information services and how they perceive that information. It shall not be expected that local people learn 'technically' about fire, such as the underlying factors explaining burning fire behaviours; instead their own embodied and anecdotal experiences may be used to develop a genuine interest in fire risk management processes, thus triggering an active engagement in such processes, particularly pre-disaster measures. Moreover, in this communication approach, it shall be considered that the person who is a 'trusted' source of information may not be a public authority (e.g., Portuguese Environment Agency, Central Government) or a research expert. Instead, local people may be more open to the parish council president, to the municipal-level civil protection, or even to local associations leaders (Aven & Renn, 2010; Mabon, 2020).

Furthermore, these local level communications would greatly benefit from an action-based format, as stated by some interviewed. Indeed, some stakeholders, especially the local presidents, argued that they found these strategies quite effective to prepare the community to a potential fire emergency. In some parishes these action-based communication strategies have already been implemented (in collaboration with civil protection) – such as training sessions on fire safety and preparedness, drills and demonstrations – which, according to the local presidents, were effective at raising community awareness to fire risk, as well as, to prepare community residents to respond in case of a fire emergency. The local presidents' efficacy perception of this communication approach is corroborated by the literature, that has been demonstrating that these forms of communicating are effective at advancing knowledge about risk and risk reduction options. Moreover, these strategies demonstrate to have the potential of triggering individuals' intention to reduce risk, by taking preventive measures, and preparing themselves for an emergency (Areia et al., 2021; Kuser Olsen et al., 2016).

Finally, integrating risk education into education curriculum (i.e., formal education) was the preferred communication approach among the stakeholders that enrolled in the quantitative study, and widely suggested in the interviews, particularly by civil protection agents. According to the interviewed, although the civil protection routinely collaborates with schools to convey information about fire risk, civil protection agents tend to consider that these raising awareness sessions are not sufficient to develop – as considered by themselves – a much needed risk culture. Instead, it was extensively proposed to formalize risk education. Actually, research demonstrates that risk education has the potential to foster the adoption of risk prevention and precautionary measures at the children's/adolescents' homes. What is more, it appears that risk education enhances risk perception, risk knowledge and problem-solving capacity among young generations (Ronan & Johnston, 2001). Therefore, as stated by Ronan and Johnston (2001, p. 1055) risk education targeting children and adolescents may be "*one gateway*

through which communities can increase their resilience to the effects of a major hazardous events”, such as rural fires.

5.3) Limitations and Future Research

A limitation of this study regards the samples' sociodemographic characteristics, particularly the discrepancy between female and male participants. The fact that the sample in both studies had more men than women may be explained by the higher number of men working on fire risk management (e.g., decision-making, fire suppression). The few participants of non-governmental associations and non-profit environmental associations in the quantitative study is another limitation to point out. In future studies, to reach this public a different sampling strategy should be implemented, such as a probabilistic sampling method (e.g., stratified sampling). This could be important to have a more robust perspective of organisations that are more likely constituted by members of the community.

Another limitation from this study was the inability to calculate the inter-coder reliability, regarding the qualitative content analyses. Whilst the methodological approach adopted (i.e., exploratory sequential mix-methods research design) sought to minimize this predicament, this weakness must not be neglected. Therefore, future research using similar methodological designs (i.e., qualitative approaches, mix-methods approaches) must attempt to provide evidence on the degree of agreement among independent coders of the qualitative data.

In further studies, beyond the perspective of stakeholders, it may be interesting to understand the communities' perception of their own involvement in fire mitigation and adaptation processes. Having data from these two perspectives will contribute to a better understanding of the reasons why communities do not get involved in rural fire management processes, provide information for strategies that can facilitate this involvement and also know the opinion of communities about the actions of stakeholders, thus providing insights towards a better interaction between them. A dimension that can be analysed in order to understand the motives of the communities that do not get involved in the management of rural fires can be the way stakeholders feel about the general panorama of rural fire management, i.e., understand if stakeholders feel motivated to take actions that may lead to citizens' engagement fire risk management processes.

VI - Conclusion

This study aimed to gain a deeper understanding about the Portuguese rural communities' engagement in fire risk management processes, based on risk managers' (e.g., decision-makers, civil protection agents) perceptions, and using a mix-methods research.

Findings from this study reveal that rural communities' and citizens' engagement in fire risk management processes is still challenging, despite the unquestionably vulnerability of the country to these hazardous processes. Particularly, it appears that communities and individuals demonstrate a greater reluctance to engage in pre-disaster risk management, i.e., prevention and preparedness practices. According to the stakeholders, communities' disengagement of fire risk management may well be explained by citizens' lack of knowledge about fire risk and its management, as well as by the tendency to ascribe the responsibility of managing fire risk only to the public authorities. The latter, may be related to the absence of a risk culture in Portugal and, as a result, both citizens and institutions still tend to rely on reactive approaches to manage fire risk, instead of adopting proactive measures.

Therefore, it was widely argued by the stakeholders the need to engage communities in fire risk management processes, through alternative forms of communicating fire risk; such as local level communication strategies and action-based interventions. Finally, and in order to raise social awareness towards fire risk, it was extensively advocated the relevance of integrating risk education at a school level, targeting young generations.

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Appendix

Appendix 1- Interview Guide (Portuguese Version)

• GUIÃO DE ENTREVISTA •

SECÇÃO 1

Perceção do risco das comunidades, famílias e indivíduos, residentes nos meios rurais e fatores relacionados

1.1. Considera que as comunidades, famílias e indivíduos, residentes nos meios rurais, têm consciência dos riscos/perigos dos incêndios florestais? Se sim/não, porquê?

1.2. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, conhecem as causas subjacentes à ocorrência dos incêndios florestais? Se sim/não, porquê?

1.3. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, sentem-se responsáveis pela mitigação do risco de incêndios florestais? Se sim/não, porquê?

SECÇÃO 2

Envolvimento das comunidades, famílias e indivíduos, residentes nos meios rurais nos processos de gestão do risco

2.1. Na sua opinião, considera que o público em geral, e as comunidades rurais em particular, têm o conhecimento ou a consciência de que “*Todos somos proteção civil*”? Se sim/não, porquê?

2.2. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, conhecem e adotam as devidas medidas de prevenção (e.g., evitar a queima de sobrantes agrícolas nos períodos desaconselhados) de ocorrência de incêndios florestais? Se sim/não, porquê?

2.3. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, estão devidamente preparadas para a época de incêndios? Se sim/não, porquê?

2.4. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, conhecem os planos de emergência a implementar em caso de incêndio florestal? Se sim/não, porquê?

2.5. Na sua opinião, as comunidades, famílias e indivíduos, residentes nos meios rurais, expostas ao risco, sabem como proceder em caso de ocorrência de um incêndio florestal? Se sim/não, porquê?

2.6. Como resultado do comportamento dos incêndios atuais (i.e., incêndios de grandes proporções e que facilmente se propagam à interface urbano-floresta), parece que a estratégia de proteção tem vindo a alterar, donde se opta mais frequentemente por evacuações preventivas. Parece-lhe que a implementação de estratégias de evacuação é facilitada ou dificultada pelas populações em risco?

2.7. Quais as sequelas emocionais, nos indivíduos e nas famílias, que um incêndio florestal deixa? Existem programas de suporte aos significativamente afetados por um incêndio florestal? Se não, considera que seriam pertinentes? Porquê?

2.8. Com o aumento da frequência e intensidade dos incêndios florestais em Portugal, parece-lhe que o público em geral, e as comunidades rurais em particular, estão melhor capacitados para não só prevenir o risco, como também responder em cenários de incêndio florestal? Se sim/não, porquê?

SECÇÃO 3

Estratégias de Capacitação

3.1. Na sua opinião, que meios podem ser utilizados para envolver as populações com e na proteção civil?

3.2. Relativamente ao papel das autoridades públicas (i.e., governo centrais/governos locais) na capacitação das comunidades para a gestão do risco de incêndios florestais, qual a sua opinião relativamente às campanhas de informação e medidas aplicadas? Parecem-lhe eficazes? Se sim/não, porquê?

3.3. Na sua opinião, de que modo se podem capacitar as comunidades, famílias e indivíduos para colaborarem com as autoridades competentes na prevenção e combate aos incêndios florestais?

3.4. Se fosse convidado/a a desenvolver um programa de capacitação das comunidades para a gestão dos incêndios florestais, que estratégias privilegiaria/usaria e porquê?

Appendix 2- Consent Form and Survey Questionnaire (Portuguese Version)

Consentimento Informado

O presente estudo tem como objetivo principal **compreender o posicionamento dos stakeholders relativamente ao envolvimento das comunidades e cidadãos nos processos de gestão do risco/crise de incêndios rurais.**

Para o efeito, o presente questionário é especificamente dirigido a:

- Decisores políticos (nacionais, municipais e locais),
- Membros de instituições públicas (e.g., ICNF, APA, AGIF, IPMA),
- Agentes da proteção civil,
- Agentes de segurança pública,
- Membros de ONGs e associações ambientais,
- Membros da comunidade científica.

Dada a importância estratégica das estatísticas sobre a perceção dos peritos e atores relativamente ao tema em estudo, vimos pedir a sua colaboração no preenchimento do presente questionário.

- Os dados recolhidos servem apenas propósitos científicos, não servindo a quaisquer propósitos comerciais e/ou governamentais.
- Não há quaisquer riscos ou custos relacionados com a sua participação no presente estudo.
- Garantimos o seu anonimato e a confidencialidade das suas respostas.
- O tempo de preenchimento do questionário é, em média, 5 minutos.

Antecipadamente agradecemos a sua indispensável colaboração.

P'la equipa de investigação,

Joana Fernandes

Faculdade de Psicologia e de Ciências da Educação na Universidade de Coimbra, joana.bfernandes2@gmail.com

Neide P. Areia

Investigadora no Centro de Estudos Sociais da Universidade de Coimbra, neideareia@ces.uc.pt

Li e compreendi os objetivos do presente estudo, bem como o consentimento informado. Por isto, aceito participar na presente investigação: Sim

QUESTIONÁRIO

• Questionário sociodemográfico e de dados complementares •

(1.1) Sexo

Feminino Masculino Outro

(1.2) Idade *(por favor, indique a sua idade, no espaço que se segue)*

Idade:

(1.3) Escolaridade *(último nível avançado concluído)*

Ensino primário incompleto ou nulo Licenciatura
 Ensino Básico Mestrado
 Ensino Secundário Doutoramento

(1.4) Zona de residência*

Norte Algarve
 Centro Região Autónoma dos Açores
 Área Metropolitana de Lisboa Região Autónoma da Madeira
 Alentejo

(1.5) Relativamente à sua situação profissional, com particular foco no seu contributo à gestão (e investigação) dos incêndios rurais, onde desempenha funções?

Proteção Civil Autoridade de Segurança Pública (i.e., PSP, GNR)
 Instituição Pública, I.P. (e.g., APA, ICNF) ONG e/ou Associação sem fins lucrativos
 Governo Central Instituição Científica (i.e., Universidades, Centros de Investigação)
 Câmara Municipal Outro
 Junta de Freguesia

Se respondeu “outro”, por favor, especifique:

• Participação das comunidades nos processos de gestão •

(2.1) Na sua opinião, as comunidades/indivíduos participam ativamente nos processos de gestão do risco/crise dos incêndios rurais?

Sim Não

(2.2) Na sua opinião, as comunidades/indivíduos devem participar nos processos relacionados com a gestão integrada de incêndios rurais?

Sim Não

(2.3) Na sua opinião, as comunidades/indivíduos conhecem os fatores de risco relacionados com a ocorrência de incêndios rurais?

Stakeholders' perspectives on opportunities and challenges in engaging communities in fire risk management

Sim Não

(2.4) Na sua opinião, as comunidades rurais envolvem-se ativamente nos processos de prevenção/mitigação de incêndios rurais?

Sim Não

(2.5) Na sua opinião, as comunidades rurais estão devidamente preparadas para a potencial ocorrência de um incêndio na sua região?

Sim Não

(2.6) Na sua opinião, os indivíduos conhecem as medidas de autoproteção a adotar em caso de ocorrência de um incêndio na comunidade?

Sim Não

(2.7) Na sua opinião, as comunidades e indivíduos afetados por incêndios rurais são devidamente acompanhados pelas instituições competentes?

Sim Não

• A sociedade e os incêndios rurais •

(3.1) Na sua opinião, existe uma “cultura de risco” em Portugal?

Sim Não

(3.2) Na sua opinião, a sociedade conhece o Plano Nacional de Gestão Integrada de Fogos Rurais?

Sim Não

(3.3) Na sua opinião, a sociedade conhece os fatores de risco relacionados com a ocorrência de incêndios rurais?

Sim Não

(3.4) Na sua opinião, a sociedade conhece as consequências dos incêndios (e.g., impacto na qualidade das águas superficiais, no ar, no solo)?

Sim Não

(3.5) Na sua opinião, a sociedade conhece as boas práticas relacionadas com a gestão da crise de incêndios rurais (i.e., prevenção/mitigação, preparação, resposta e recuperação)?

Sim Não

• Estratégias de capacitação e sensibilização •

Numa escala de 1 a 5, em que 1 significa “discordo totalmente” e 5 significa “concordo totalmente”, indique quão concorda com as seguintes afirmações.

4.1. As atuais ações de sensibilização sobre o risco de incêndios para os cidadãos são eficazes na promoção de boas práticas de prevenção do risco.

1 2 3 4 5

4.2. As ações de sensibilizam que visem a participação dos indivíduos nos processos de gestão do risco/da crise de incêndios devem ser concretizadas a nível local (na comunidade).

1 2 3 4 5

4.3. A educação para o risco deve começar, formalmente, nas escolas.

1 2 3 4 5

4.4. As ações/intervenções baseadas na prática (e.g., simulacros) são eficazes na promoção do envolvimento dos cidadãos nos processos de gestão do risco/crise de incêndios.

1 2 3 4 5

4.5. As ações de sensibilização sobre o risco de incêndios devem ser dirigidas as comunidades mais expostas e vulneráveis ao risco.

1 2 3 4 5