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Building Forest Fires Resilience, the Incorporation of Local Knowledge into Disaster Mitigation Strategies

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Abstract: The severity of the socio-economic, political, and ecological damage caused by forest fires each year requires action plans for disaster risk reduction (DRR). Despite efforts made to incorporate participatory mechanisms into risk governance, much of the research on disaster risk reduction in academia is conducted under the deficit model. This paper proposes public engagement as a mechanism for incorporating community-based knowledge, experiences, and practices into DRR plans. Based on the case study of forest fires in Galicia (Spain), developed within the MITIGACT project, we explore, through the analysis of in-depth interviews, how forest fires are defined, how disaster management plans are evaluated and what concrete proposals are considered. The results highlight the need to strengthen social governance at the local level and to balance the resources dedicated to the three phases of prevention, extinction, and recovery, moving from a linear to a circular model.

Keywords: forest fire; resilience; disaster risk reduction; public engagement



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1. Introduction

Natural disasters, such as forest fires, are increasing in frequency, intensity, and extent. Forest fires are currently one of the main environmental threats in southern European countries, not only because of the volume of forest mass destroyed each year, but also because of the disruption of social stability and routine because of preventive evacuations, the cutting of communication routes, or the damage caused to infrastructures, crops, and animals. In the most devastating cases, a high number of fatalities and a loss of housing should be added. In Europe, 2022 was the second worst year in terms of burned areas and the number of fires since 2006. According to the data available in the European Forest Fire Information System (EFFIS), the three largest fires mapped in 2022 across the entire region covered by EFFIS were all in Spain, with a total of 315,705 ha affected in 1490 fires. Moreover, 55 of these fires were classified as Large Forest Fires, burning 82% of the total affected area. Within the national territory of Spain, the regions of the North-West account for the largest forest area destroyed by fire, with 48% of the total. In Galicia, 52,562 ha were burned in 2022, tripling the average area burned during the last decade. These data confirm the need to question whether the existing knowledge of forest fires and their consequences is effectively applied in the design of policies and protocols to mitigate these disasters.

Two decades ago, in academic studies on disaster risk reduction, [White et al. \(2001\)](#) highlighted the paradox that losses from natural hazards have steadily increased despite the growing body of research on environmental risks. This situation translates into a gap between science, policy, and practice. A gap between what is known about natural hazards and disaster mitigation on the one hand, and how research results are translated into disaster risk reduction (DRR) policies and plans on the other ([Weichselgartner and Obersteiner 2002](#)). This raises the question of whether existing knowledge about environmental hazards and their consequences is effectively applied in the design of disaster risk reduction policies

and protocols. Some answers to this question could be that decision-makers use only a fraction of existing information and knowledge when designing disaster risk reduction policies, or that scientists and researchers do not take into account the full complexity of the needs and priorities of potential recipients of risk management and prevention policies and plans when conducting their research (Weichselgartner and Pigeon 2015).

Thus, much of the previous research on disaster risk reduction has been conducted under the deficit model (DM), ignoring the social and cultural dimensions of such adverse events. Owens (2015) defines the deficit model as a set of practices in which the connections between knowledge and policy are seen as linear and unidirectional, and in which science informs a rational and orderly process of policy production. The DM argues that a lack of knowledge leads to poor decision-making. Participation, understood as top-down participation, would be an effective mechanism to reduce the social perception of risk. Participatory exercises become a top-down information transfer. The goal of this kind of participation is to provoke a change in behavior and attitudes toward risk, in what Wynne (2015) calls the double reaffirmation of the DM. The ineffectiveness of this model in reducing disaster risk is partly due to its lack of attention to the social and cultural dimensions of risk and the limitations of one-way information transfer (Allum et al. 2008; Beck 2011; Bucchi 2008; Gross 1994; Hall and Sanders 2013; Kasperson 2014, 2017; Renn 2014; Simis et al. 2016; Sturgis and Allum 2004).

Facing the DM, recent research has demonstrated the power and benefits of building relationships guided by methodologies that employ ‘active listening’. Research by Broockman and Kalla (2016) shows that participatory mechanisms based on respect and autonomy of the participants’ reverse ineffective efforts in one-way information transfer exercises, and result in the entrenchment of more meaningful interactions between experts and the public that can lead to behavioral change that positively impacts disaster risk reduction. As an alternative to the deficit model, Jasanoff (2004) proposed that co-production is the bridge between knowledge and social action. This proposal, applied to the field of natural disaster risk reduction, is based on the premise that knowledge, “what people know”, is co-produced by their values and beliefs in relation to “what people think should be done” in disaster risk situations.

In the field of disaster risk reduction, knowledge considered relevant can be produced by any type of actor—whether academic or not—that provides a specific perspective on a given problem (Weichselgartner and Truffer 2015). According to Davenport and Prusak (1998) knowledge is a fluid mixture of framed experience, contextual information, values and expertise. When defining the concept of knowledge, we can distinguish between two types: explicit knowledge and tacit knowledge (Polanyi 1967; Nonaka and Takeuchi 1995). Explicit knowledge can be easily processed, transmitted to others in formal language, or stored. Tacit knowledge is personal knowledge based on experience and introduces intangible factors, such as personal beliefs, perceptions, and value systems. Tacit knowledge is difficult to codify, formalize, and articulate in formal language. It can be ephemeral, transitory, personal, and context specific. In turn, tacit knowledge has two dimensions: A technical (procedural) one, which encompasses the type of experiences and informal skills, and a cognitive one, which involves beliefs, perceptions, ideals, values, emotions, and mental models. Weichselgartner and Pigeon (2015) alert of the need to incorporate tacit knowledge into DRR research and policy design.

Looking for ways to incorporate community-based knowledge on wildfires into natural disaster prevention policies and plans, this article presents the first results of the MITIGACT project (PID2019-107443RA-I00). This project argues for the need to design new natural disaster management strategies that go beyond the classical nature-culture distinction (van Riet 2021) and pay attention not only to the biophysical characteristics of fires but also to their cultural dimensions (Pyne 2007). The main objective of the MITIGACT project is to build resilience to natural hazards by improving knowledge of the social, political, and technical mechanisms that lead to risk mitigation and facilitate the participatory co-production of disaster risk reduction policies and plans. To achieve its objectives, the

project proposes several case studies in which a qualitative methodology based on in-depth interviews is used to approach local knowledge about natural hazards. Specifically, this article deals with the case of forest fires in Galicia (Spain).

Galicia is an Autonomous Community that is in the northwest of Spain (see Figure 1). According to the Galician Statistics Institute (IGE), with a total population of 2,690,464 inhabitants and an area of 29,576,74 km², it has a density of 91 inhab/km². Most of the population is concentrated in coastal cities (only three cities have more than 100,000 inhabitants and the most populous does not reach 300,000), the interior being less populated. Traditionally, it has been an agricultural and livestock area, with significant forest exploitation, although currently the number of people employed in the service sector is greater (4.38% of the population is employed in agriculture, livestock, hunting, and forestry, compared to 72.54% of people employed in the service sector). The textile, automobile, fishing, naval, and chemical-pharmaceutical industries are noteworthy. It enjoys a mild oceanic-influenced climate, characterized by the existence of several microclimates due to its irregular orography. It is one of the communities with the largest forest mass, with 68.96% of mount and forest, according to data from the fourth national forest map.



Figure 1. Geographical location of Galicia.

Galicia is a very heterogeneous region with diverse examples of forest management and land use. In these fire-prone areas, a new concept of resilience is needed to minimize the effects of future forest fires (Marey-Perez et al. 2021). The definition of the general objectives of the forestry policy on forest fires corresponds to the General State Administration in Spain in collaboration with the Autonomous Communities. Spanish regulations on forest fire management are contained in the document Forestry Code 3, published in 2018 and updated periodically. In Galicia, Law 3/2007 on prevention and defense against forest fires aims to update the legal regime for fighting fires in rural areas, integrating prevention and extinction, in addition to the protection of the population, infrastructures, and agricultural facilities. This Law establishes planning at four levels, autonomic, district, municipal, or infra-municipal, with the aim of ensuring the territorial consistency of the policies and instruments for firefighting and following a logic of collaboration between all the administrations and the population. Planning will be carried out annually through the Forest Fire Prevention and Defense Plan (PLADIGA). The PLADIGA 2023 plan has an investment of almost EUR 200 million and, in total, some 7000 troops dedicated to fighting forest fires. On high-risk days, Galicia has 18 of its own aerial resources, to which 9 ceded by the national government can be added. In addition, there are 179 terrestrial resources, including motor-pumps and heavy machinery, to which the resources provided by the municipalities are added.

Two reasons led us to choose this region of Galicia in Spain for our case study:

- (a) In the last five years, the most tragic episodes related to forest fires in Spain occurred in this region.
- (b) Official statistics on forest fires show that the percentage of intentional forest fires is higher than the national average.

Thus, with the intention of incorporating tacit knowledge into the design of natural disaster management plans and policies, the case study of forest fires in Galicia (Spain) is presented, and an approach is made to the definition of the problem, the assessment of current management plans, and the listing of proposals that can guide the revision of these policies. The aim is to explore how a type of environmental disaster with a profound impact, such as forest fires, is thought of from the local level and thus collaborate in the design of effective prevention plans that introduce the perspective of local actors. This approach can promote collaboration between governmental and non-governmental organizations to advance disaster resilience.

2. Materials and Methods

This paper proposes public engagement as a mechanism for incorporating and transferring experience-based social knowledge into the design of forest fire prevention, management, and recovery plans. This community-driven approach contributes to increasing social resilience to forest fires. The methodology aims to move beyond the linear model and transfer the flow of ideas and priorities from citizens to risk governance and the design of disaster risk reduction policies and plans. The tacit knowledge of the population is accessed through an analysis of 12 in-depth interviews with local people, farmers, firefighters, and engineers conducted during the years 2021 and 2022 (see Table 1). A semi-structured script was used to conduct the interviews, which included the following topics: definition of forest fires and their evolution over the years; identification of key actors in forest fire management; assessment of the work carried out by them; causes of forest fires; strengths and weaknesses of forest fire prevention, management, and recovery plans; and proposals for improvement. The data were analyzed using thematic data analysis, which is a flexible method for identifying, analyzing, and reporting themes within qualitative data (Marshall and Rossman 2014). This approach allowed for the identification of recurring themes in the main arguments expressed by participants to identify gaps in disaster and emergency management and sustainable development.

Table 1. Interview Profiles.

N°	Code	Profile	Date
1	E1	Association of communal forests	June 2021
2	E2	City councilor	June 2021
3	E3	Forestry engineer	June 2021
4	E4	Ecological Association	June 2021
5	E5	Farmer	July 2021
6	E6	Wildfire brigade	July 2021
7	E7	Drone developer	July 2021
8	E8	Regional forest fire extinguishing manager	September 2021
9	E9	Wildfire brigade	September 2021
10	E10	Wildfire brigade	September 2021
11	E11	Farmer	October 2021
12	E12	Physical geographer	October 2021

Source: Compiled by authors.

The analysis task was carried out using the qualitative analysis software NVIVO, and the process was conducted in three stages. In the first stage, through deductive logic,

three families of thematic codes were established: Definition of the problem, Assessment of management plans, and Proposals for improvement. In the second stage, through an inductive process, the sub-codes that complete each of these three large trees were identified. Finally, in the third stage of the analysis, the SWOT and CAME matrices were constructed. SWOT analysis is a tool commonly used in strategic planning. The letters stand for Strengths, Weaknesses, Opportunities and Threats. The CAME analysis is a strategic planning tool that complements the SWOT analysis and allows guidelines to be established on the aspects found in previous diagnostics. CAME stands for Correct, Adapt, Maintain, and Exploit. The main objective of the CAME matrix is to correct weaknesses, address environmental threats, maintain strengths, and exploit opportunities.

3. Results

3.1. Thematic Analysis

3.1.1. Defining the Wildfire Problem

When defining the problem of forest fires, the interviewed population established two categories of wildfires to which they attributed distinctive characteristics. On the one hand, there are small forest fires, which, they say, have always occurred in summer and are usually of human origin. These fires are different from the large fires that have occurred in recent years, which represent a new civil protection emergency.

“In recent years the number of fires has decreased, but the areas affected are increasingly larger (...) the fire operation is not prepared for issues such as those, such as those that occurred in 2017. It is prepared for a medium level”. (Interview 11)

The interviewed population considers that in Galicia, there is a certain tolerance toward small forest fires with which they have always coexisted in rural areas, and that it is not until the wave of large fires in 2017 that a social and political awareness of firefighting is awakened.

“Yes, it burns every year, and it has to burn. It is known that part of the surface is going to burn and that’s it. It is tolerated like that”. (Interview 6)

Despite the fact that in their discourse it is recognized that the numbers of fires have improved and that in recent years there have been fewer forest fires, the severity of those that do occur is greater than in past decades, turning fires into complex emergencies aggravated by the abandonment of land, the depopulation of rural areas, and the increase in biomass.

“Statistically, the number of fires has decreased drastically. If we had an average of 10,000 fires, we are at an average of 2,000 fires. So, there are fewer fires. The problem we have is that the fires that are generated are becoming more and more complicated because climatic conditions, or the abandonment of the rural environment”. (Interview 8)

The forest fires that affect Galicia every year have their origin in human activity. The people interviewed differentiate between direct and indirect causes. The direct causes are subdivided into intentional and unintentional. Intentional fires are fires caused by arsonists or disputes between neighbors.

“They provoke to hurt, to spoil. Because they are not aware of what it’s worth. They are not aware of the work it gives and what it’s worth”. (Interview 7)

Fires with direct but unintentional causes would be those wildfires that are caused by accidents, for example, when operating machinery or by traditional uses of fire for agricultural and livestock purposes. Indirect causes of fire include depopulation of rural areas, aging of the population, increase in forest cover, and proliferation of pyrophytic species. This classification differs from that presented in official statistics, which do not take indirect causes into account. This broader definition of the problem of forest fires allows for a social approach to the design of plans and public policies capable of addressing the different dimensions.

“In other words, fires of human origin account for practically 100% (...) Well, I believe that in the first place, there is a lack of sensitivity on the part of the population, which in some cases is aged, very rural and also has a traditional fire management tradition. Perhaps the new values of environmental protection have not been transmitted to them”.
(Interview 3)

3.1.2. Assessment of Plans and Policies

Public plans and policies to combat forest fires contemplate three phases: prevention, extinction, and recovery. The people interviewed consider that the greatest political and economic effort in Galicia is made in the extinguishing phase, neglecting both prevention and recovery.

“A lot of effort is put into extinguishing fires because this is what has the greatest impact on society. Perhaps we are not tackling the problem with the best tools precisely because of public opinion, because of society’s awareness of the problem. And so, it seems that extinction really needs to be reinforced”. (Interview 3)

The extinguishing phase is the one that concentrates the greatest economic resources dedicated to technical and human resources. The extinguishing technologies available in Galicia are considered innovative and are compared with those available in countries such as the United States or Australia. The human resources available are extensive, and fire-fighting teams from the different administrative levels, State, Autonomous Community, and City Councils, are recognized.

“Then in Croatia I also took part in a European Union simulation exercise, and in terms of fires, Spain is at the forefront, not in the world, but after the United States and Australia, we would be the best, especially in firefighting”. (Interview 10)

However, a point of conflict is identified in the discourse: despite the scale of the investment made in this phase, neither the technical means nor the human resources are oriented effectively and efficiently toward firefighting tasks. Available technologies are not effective when it comes to extinguishing a large fire; these fires cannot be put out, and the priority is to collaborate in the evacuation of the population. Extinguishing technologies would also not make it easier to fight small fires when they occur in large numbers and simultaneously, as it is not possible to reach all the sources in time to control the emergency.

“When fires overlap, as they sometimes did in 2007 or 2006, it is impossible to pay even if the UME or the Russian army comes. The fact is that nature rules the fire. You can start a fire here, but it is the wind that decides whether the fire moves or not”. (Interview 9)

Despite the existence of specialized groups, such as the aforementioned Military Emergency Unit (UME), the permanent military unit for civil protection created in 2005 by the Spanish government that mobilizes to protect citizens from any catastrophe anywhere from Spanish territory, the availability of human resources for firefighting has some weaknesses, according to the people interviewed. First, the capacity for coordination between the fire-fighting teams contracted by the different administrations is questioned. Thus, the teams contracted by the local councils would have greater knowledge of the territory, but more deficient training, while the teams contracted at the national and regional levels would have more appropriate professional skills, but lack of knowledge of the terrain in which they operate is a barrier. Second, the seasonality of contracts is criticized. Even though fires occur in the summer months, temporary contracts make it difficult to professionalize firefighting teams.

“The logical thing would be to have people working all year, at least 9 months, so that these people would be working keeping roads clean, etc.”. (Interview 2)

The economic resources received by the extinguishing phase led to the creation of a large industry oriented toward putting out wildfires, but the population considers that extinguishing fires cannot replace the social and political commitment to the prevention and recovery phases.

“The issue with fires is the lack of prediction. An adequate prevention policy. But also, that there are interests, there are companies that make money in firefighting, and this creates a dynamic of abandonment”. (Interview 5)

The difficulties in extinguishing large forest fires led to a shift in the discourse toward the prevention phase as the one toward which human and material resources should be directed. The prevention phase brings together all the tasks aimed at physical prevention and social prevention.

“When we talk about prevention, it is not only physical prevention of making firebreak areas, but we also must dedicate a lot to social prevention (. . .) Many times people in the countryside simply need to be listened to and to connect the administration with rural people”. (Interview 3)

Physical prevention includes intervention work on the ground to prepare it so that, in the event of a fire, its consequences are limited. These tasks include clearing biomass, opening firebreaks, or controlled burning. Social prevention tasks would focus both on raising public awareness to reject small and large forest fires, and on strengthening the social and economic value associated with living in rural environments.

“So here, when you start to see a column of smoke around here, I can assure you that I have calls on that phone, because everyone is watching to make sure that it is not going to burn. There is an environmental awareness, but it is also an environmental awareness that in many cases is self-serving”. (Interview 2)

Paying attention to these physical and social prevention tasks during the months when the occurrence of fires is low would make it possible to extend the contracts of the firefighting teams. However, the success of prevention will depend on a broad commitment involving society as a whole, especially landowners and administrations.

“Ideally, these brigades that work for three months in the summer should work all year round on prevention. I think it is a political decision, that the same money could be allocated to prevention, but it is dedicated to extinction”. (Interview 5)

Reaching this social and political commitment would also allow progress to be made in the recovery of the land devastated by wildfires. This phase is considered to be neglected, and a lack of interest on the part of public and private agents is denounced.

“As most of the land here in Galicia is privately owned, we can’t blame it on the administration, but rather on a lack of private interest. But, well, the lack of private interest also derives from the fact that perhaps there is not enough stimulus from the administration”. (Interview 3)

3.1.3. Suggestions for Improvement of Wildfire Management

Among the proposals for improving forest fire management plans, the following are identified. Firstly, the rebalancing of the resources dedicated to the three phases of prevention, extinction, and recovery. Investing in the prevention and recovery phases would have the advantage of maintaining the contracts of professionals dedicated to extinguishing fires during the months of low forest fire incidence, when they could devote themselves to social and physical prevention, as well as to recovery tasks.

“The technicians of the teams in winter are doing this prevention work and in summer they are integrated into the fires in the provinces where they are. And what we have achieved in recent years is that these teams, where there are no bases for them to work on in the summer, create an annual team, working on prevention all year round”. (Interview 10)

Stabilizing the working conditions of the professionals involved in firefighting tasks would not only strengthen the prevention and recovery phases but would also facilitate the exchange of knowledge and learning between those with more specialized training in firefighting or agroforestry and those with a deeper knowledge of the territory and learning based on their experience.

“Local crews with people from the municipality to extinguish fires within a municipality, because it makes people from a particular district extinguish fires in their district. It is assumed that they will make more effort to do it and they have more contact with the terrain, they know more when it comes to defining roads and so on, but you must invest more in training them”. (Interview 3)

The success of prevention, extinction, and recovery plans requires collaboration between administrations at different levels: state, regional, and local. They also require collaboration between public and private agents. In this sense, it is proposed that surveillance could also be carried out by non-technological means, through the involvement of local communities and landowners, as was done in the past and is still done in other communities.

“What they do is that they have the people, those who still work in the farmhouse, those who work in the countryside, they give them aid to go out and tackle fires if there is a fire in their area. Which makes sense because obviously, who better to know the roads and where a fire can be put out than those who are working there all day long, in that area?”. (Interview 2)

It is a matter of strengthening the social, economic, and environmental values associated with life in rural environments. To do this, the imaginary of backwardness associated with life in the countryside must be reversed.

“There is a relationship linking the rural environment to poverty, hunger and so on. So, this is kind of ingrained. People actually educate their children so that they leave the village as soon as possible, so that they don’t stay to work with the cows”. (Interview 5)

Some of the strategies that could be developed would include awareness-raising campaigns on natural resources and the promotion of local employment through entrepreneurship in socially and environmentally sustainable businesses. The repopulation of rural areas cannot depend on people living in the city and sleeping in the countryside; employment opportunities must be provided to develop economic activity in rural environments. Economic revitalization will facilitate the consolidation of health, education, and leisure services.

Advancing in the collaboration between public and private agents in the development of socio-economic and land management plans that allow for new social and economic uses of the forest and new forms of responsibility in its care. These include the work of forest associations, proposals for land stewardship, and the possibility of establishing an insurance policy.

“We’re going to have an hour on the 6th with Decathlon where people come, and it’s explained to them what the invasive species are. Forest Communities must generate their own resources”. (Interview 1)

3.2. SWOT and CAME Analysis

Following the thematic analysis of the content of the interviews, the following SWOT/CAME matrix is proposed to provide a synthesis to guide the incorporation of tacit knowledge into the design of disaster risk reduction plans in the specific field of forest fires (see Figure 2).

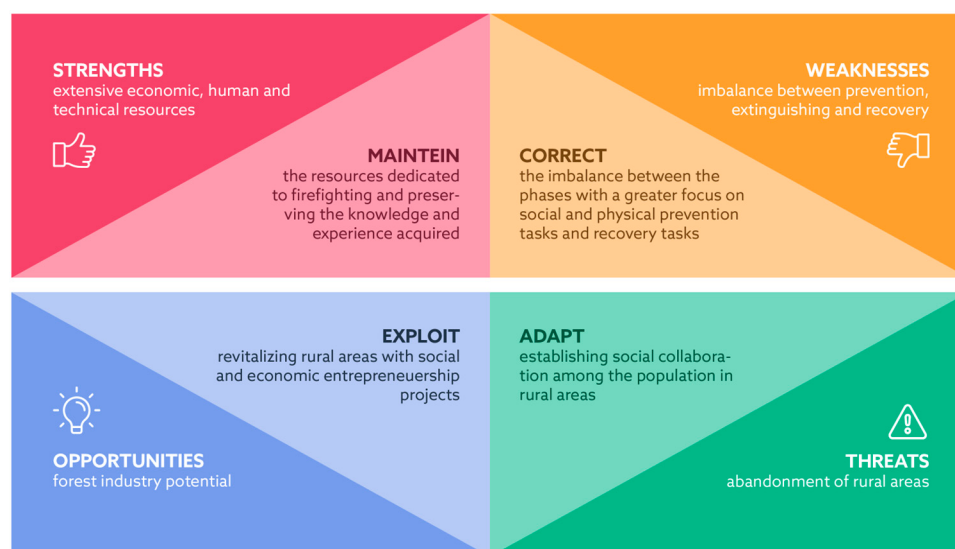


Figure 2. SWOT and CAME analysis.

3.2.1. Internal Analysis

Starting with the strengths identified by the interviewed population of the current forest fire management plans, the availability of ample economic, human, and technical resources in the fight against fire is highlighted. Among the weaknesses mentioned is the imbalance between resources and the attention given to the prevention, extinction, and recovery phases, with extinction tasks always taking precedence over prevention and recovery tasks.

The proposal made to maintain the strengths and correct the weaknesses focuses on rebalancing the three phases in the fight against fire, understanding the process as a circular process and not a linear one. This reformulation would make it possible to correct the problems of seasonality of employment among the personnel who form the firefighting patrols and to take advantage of technical knowledge and proximity to the territory to make progress in social and physical prevention.

3.2.2. External Analysis

The main threat identified in the interviews refers to the abandonment suffered by rural areas due to depopulation, aging, and the transformation of agricultural and livestock activity. The socio-demographic changes suffered by rural areas, together with the small-holding form of ownership, have an impact on the territory. The young population is often unaware of where their land is located, and the small size of the land also makes it difficult to exploit it profitably. Adapting to this reality involves exploiting the opportunities offered by the forestry industry and the development of new businesses in the primary sector, such as agro-livestock cooperatives, small farmers, or ranchers, that are socially and economically sustainable. Achieving these objectives would revitalize rural areas and strengthen socio-environmental values and social and intergenerational cohesion.

4. Discussion

Forest fires have been a recurrent problem in southern European countries in recent years (Pausas and Fernández-Muñoz 2012). Despite the reduction in the number of fires, they have increased in size, intensity, and severity, becoming a serious threat to civil protection (Plana et al. 2018), causing severe damage to infrastructure and other material and natural assets (San-Miguel-Ayanz et al. 2013). Given the seriousness of this threat, in recent years, there has been a progressive increase in the economic resources dedicated to fire extinction and to the training and preparation of professionals who can fight forest fires. Despite the efforts made, large fires overwhelm the capacities of firefighting teams every year (Costa Alcubierre et al. 2011; Alcasena et al. 2015).

When it comes to finding the explanatory causes of this new environmental threat, previous studies allude to a combination of natural or climatic elements, such as strong winds, low humidity or drought (Trigo et al. 2006; Viegas et al. 2009; Koutsias et al. 2012; Pausas and Fernández-Muñoz 2012; Cardil et al. 2014; Salis et al. 2014), and socio-economic elements, such as the loss of population in rural areas and the abandonment of land dedicated to crops and livestock (Wunder et al. 2021). The result is an explosive combination in which the landscape is transformed, and the increase in biomass is highly dangerous (Mazzoleni et al. 2004; Palahi et al. 2008; Fernandes et al. 2014).

Given this reality, increasing resilience in territories that, similar to Galicia, are prone to forest fires becomes a relevant policy objective (Lelouvier et al. 2021; Leone et al. 2020). Previous studies have shown that the traditional fire suppression-oriented approach under the “zero fire policy” (Górriz-Mifsud et al. 2019), results in a paradox where efforts to immediately extinguish wildfires contribute to increasing the fuel load available for the next fire (Castellnou et al. 2019; Otero and Nielsen 2017; Xanthopoulos et al. 2020). The limits of fire suppression strategies have become evident even in technologically advanced countries due to the high economic cost and inefficient landscape transformations in the face of extreme fires. Thus, many practitioners and policymakers recognize the need to develop novel approaches that address the causes of extreme fires in a comprehensive way (Wunder et al. 2021). In seeking a new risk-reduction paradigm, it is essential to redefine the problem in terms of its complexity and to recognize wildfires as complex socio-environmental phenomena (Bowman et al. 2009; Howitt 2014; Moritz et al. 2014).

Extinction-oriented models assume that wildfires are primarily a civil protection issue and not a symptom of broader societal problems (FAO 2011). In contrast to these models, Barberis and Fontana (2017) argued for the need to design RDD plans in which the coordinated work of all actors converges. Therefore, many professionals and policymakers recognize the need to develop more proactive, community-centered, and integrated fire management throughout the entire risk management cycle: prevention, preparedness, response, and recovery (Myers 2006; Rego et al. 2010). Thus, there is a move away from the paradigm of total suppression and recognition of the need to strengthen long-term prevention and preparedness (Birot 2009; Dunn et al. 2020). A social-ecological resilience approach to wildfires is thus cemented (Schumann III et al. 2020).

New forest fire management plans should focus on strengthening governance at the local level, the participation of public and private actors in the definition and evaluation of prevention and action plans, and the transparency of information. Tedim et al. (2016) argued that the current challenge posed by forest fires must be resolved through local understanding of the phenomenon, which will allow the design of territorial development strategies that reduce the vulnerability of populations to the threat of a major fire and strengthen resilience and sustainable economic development. Thus, these authors (Tedim et al. 2016) developed the Fire Smart Territory (FST) action framework.

The FST methodology addresses the physical, biological, and cultural dimensions that define wildfires, underpinning the change in basic assumptions from the current suppression-focused framework (Meyer 2015) to one of coexistence with fire (Tedim and Leone 2017). The FST framework for action values, on the one hand, nature-based solutions, in which ancient wisdom about fire uses is recovered within a planning framework that covers the risks of a major fire, and, on the other hand, social measures that result in reducing the probability of unintentional or deliberate fires occurring.

The main barrier that the authors identify for implementing the FST approach is mistrust between actors (Lövbrand 2011; Newton and Weichselgartner 2014). This distrust hinders the effective participation of all actors. Effective participation requires methods to engage in dialogue, explore shared interests, solve problems together, and build relationships between actors involved in the governance process (Gao and Zhang 2001; Servaes and Malikhaio 2005). Burnside-Lawry and Carvalho (2015) recommend that DRR practitioners adopt these methods in their communication and participation strategies as a means of building trust, which is a prerequisite for successful disaster risk-reduction plans.

5. Conclusions

In the summer of 2022, Galicia suffered the third largest number of hectares devastated by fire so far this century. Minimizing the negative consequences and impacts of natural disasters, including forest fires, is one of the main challenges facing society today. This article proposes an approach to natural disasters that takes into account their social and cultural dimensions. Despite the effort made to incorporate participatory mechanisms into risk governance, much of the previous research on disaster risk reduction in academia has been conducted under the linear model of knowledge sharing. In these experiences, knowledge co-production and participation are limited, and gaps between research and practice persist. The underlying assumption of these models is that the one-way flow of information from experts to the local population will improve awareness and lead to behavioral change that will have a positive impact on disaster risk reduction. Against this background, the call for an inclusive governance model for risk management has been echoed in several countries around the world, regardless of their political system or party in government. Participation-based proposals for strengthening relations between experts, politicians, and local people are a field of growing interest in the DRD. Political authorities and institutions in charge of risk and emergency management are faced with the challenge of incorporating the values and preferences, the tacit knowledge, of local populations, and strengthening the two-way communication channels of those who are affected by the outcomes of decisions taken.

Projects such as MITIGACT seek to advance social research on this controversial situation by addressing all forms of existing knowledge and allowing the participation of all social actors through in-depth interviews in which the aim is to review and design public policies and sustainable technologies that reduce the risk of occurrence of forest fires. The following contributions are made in this article:

- Develop proposals to reduce and mitigate the consequences of forest fires through the incorporation of citizen knowledge into risk governance.
- Reformulate the unidirectional and vertical communication model between experts and civil society, replacing it with a bidirectional model in the field of risk governance.
- Redefine the concept of resilience through the co-production of a new wildfire reduction framework.
- Develop innovative forest fire prevention measures.

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