

ADVANCES IN FOREST FIRE RESEARCH

2022

Edited by
**DOMINGOS XAVIER VIEGAS
LUÍS MÁRIO RIBEIRO**

Designing an effective risk communication plan as a tool to reduce the risk associated with traditional burning practices in Portugal

Mayara Emilia Barbosa Souza*¹; Abílio Pereira Pacheco^{2,1}; Jorge Grenha Teixeira¹; José Miguel Cardoso Pereira³

¹ INESC TEC and Faculty of Engineering of the University of Porto. Rua Dr. Roberto Fria, 378, 4200-465, Porto, Portugal, {msouza, app, jteixeira}@fe.up.pt

² ForestWISE, Collaborative Laboratory for Integrated Forest & Fire Management. Quinta de Prados, Campus da UTAD, 5001-801, Vila Real, Portugal, {abilio.p.pacheco@gmail.com}

³ Forest Research Centre, School of Agriculture, University of Lisbon. Tapada da Ajuda, 1349-017, Lisbon, Portugal, {jmcperreira@isa.ulisboa.pt}

*Corresponding author

Keywords

Rural fires, risk communication, traditional burning practices, mental models

Abstract

Climate change increases the average temperature and reduces precipitation, leading to an increased risk of rural fires around the world, but mainly in regions with a Mediterranean climate, such as Portugal. Despite the high risk of rural fires, fire is still a traditional land management practice. Beyond fire misused risk, the accumulation of fuel loads, due to the high population dispersion and lower interaction of communities with the land, also drives rural fires risks. Thus, researchers have sought to understand the key features of communication practices to achieve the most desired natural risk management results in relation to rural fires. According to the Committee on Risk Perception and Communication, in 1989, risk communication is defined as “an interactive process of exchanging information and opinions between individuals, groups, and institutions”. However, there is a need for dialogue between the responsible for communication and relevant stakeholders. The Carnegie Mellon mental-models approach encompasses participatory processes to translate the nature and magnitude of the risk, allowing for a deeper understanding of what can be done to mitigate social and environmental impacts in the future.

Considering rural fires risks and risk communication challenges, this study aims to design an effective risk communication plan oriented to the rural population, in the context of rural fires. For this objective to be achieved, the mental models approach was developed, exploring the underlying reasons for resistance to behavioral change and defining guidelines to support the design of new risk communication strategies, including the dissemination of new behaviors and practices that mitigate the ignition of rural fires.

This systemic approach has been applied and tested in the rePLANT project, whose purpose is the development of research activities, innovation and transfer of knowledge and technology, to increase sustainable forest management, the competitiveness of the Portuguese forestry sector and reduce the impact of rural fires. Preliminary findings show what must be communicated about rural fires risk, how must be communicated, target audiences' profiles, the role of actors for effective risk communication on rural fires, attributes of good risk communication on rural fires, evaluation of the risk communication results.

Finally, it is expected that this research provides guidelines to help decision-makers and stakeholders to design an effective risk communication plan oriented to prevent traditional burning practices, as well as to mitigate socioeconomic and environmental impacts in the future. This approach also highlights the importance of exploring the underlying reasons for resistance to behavioral change and defining guidelines to support the design of new risk communication strategies.

1. Introduction

Climate change has been affecting society and nature in an intense and progressive way over the last few years (Shukla et al. 2019). The increase in the average temperature and the significant reduction in precipitation led to an increased risk of rural fires around the world, but mainly in regions with a Mediterranean climate, such as Portugal (Nunes et al. 2021). Despite the high risk of rural fires, fire is still a traditional land management tool,

used for the elimination of residual materials from agricultural and forestry activities, and cleaning method to eliminate of excess biomass in the control of invasive species (Nunes et al. 2021; Meira Castro et al. 2020; Pereira et al. 2013). Beyond the risk of fire misuse, the accumulation of fuel loads, due to the high population dispersion and lower interaction of communities with the land, also contribute to increase the rural fires risks.

These challenges motivated the launch of a set of legislative measures that seek to promote the management, cleaning, and control of these species (Nunes et al. 2021), such as Decree-Law 14/2019 which make burning prior communication and authorization mandatory. Although the efforts, the risk of rural fires stems in part from the absence of effective management policies aimed at rural areas (Coelho et al., 2020). Still, implementing risk-based long-term planning improve fire management efforts (Turco et al., 2019).

Thus, researchers have sought to understand the key features of best communication practices to achieve the most desired natural risk management results in relation to wildfires (Steelman and McCaffrey, 2013). In the past, the term “risk communication” was considered a one-way process of disclosing messages in which experts assumed the role of transmitters and, in turn, laypeople assumed the role of recipients of messages. However, this unidirectional character of messages within the scope of risk communication began to be understood as too limiting. According to this perspective, the Committee on Risk Perception and Communication, in 1989, presents a distinction between the terms “risk messages” and “risk communication”, exposing this the latter as “an interactive process of exchanging information and opinions between individuals, groups and institutions” (Committee on Risk Perception and Communication, 1989, p. 2).

Morgan et al. (2002) retrieve Fischhoff (1990), Gibson (1985), Gow and Orway (1990) to define the concept of risk communication, considering it as the communication whose purpose is to provide lay individuals with the information necessary for them to be capable of making independent and informed decisions about risks in the field of health, safety and the environment. However, there is a need for dialogue between the responsible for communication and the set of stakeholders (Palenchar, 2005). Stakeholder participation in the risk assessment and management process can enable not only improve the quality of decision-making, but it can also avoid harmful confrontations between the entities and the community (Renn, 2010). Mental models approach encompasses participatory processes to translate the nature and magnitude of the risk, allowing for a deeper understanding of what can be done (Morgan et al. 2002) to mitigate social and environmental impacts in the future.

Considering the rural fires risks and risk communication challenges, this study aims to design an effective risk communication plan oriented to the rural population, in the context of rural fires. For the objective to be achieved, a systemic approach was developed, exploring the underlying reasons for resistance to behavioral change and defining guidelines to support the design of new risk communication strategies, including the dissemination of new behaviors and practices that mitigate the ignition of rural fires.

2. Method

According to Fraser and Gondim (2004) “in the qualitative approach, what is intended, in addition to knowing the people's opinions on a given topic, is to understand the motivations, meanings and values that support opinions and worldviews. In other words, it is giving voice to the other and understanding from what perspective does he speak”. In this sense, the qualitative research approach is predominantly present in this study, combining participatory processes (such as interviews, dynamic interactions to build mental models, focus groups) and ethnographic (such as on-site visits and observations) to design an effective risk communication plan oriented to prevent rural fires in Portugal. Additionally, the quantitative approach was employed in the mapping and definition of lay sampling zones, through the application of Non-Parametric Multi-Criteria Analysis (Vego et al. 2008).

This systemic approach is divided into three main stages: understanding the expert perspective, understanding the context, and designing the solution, and six milestones, as shown in Figure 1. The research design involved mapping and defining the sample, identifying potential participants to be interviewed (including actors from industries, public entities, academics, the third sector, and society), developing the data collection instrument (semi-structured interview scripts), systematizing data collection with different actors (mental models development in a digital visual collaboration platform) on the risk of rural fires.

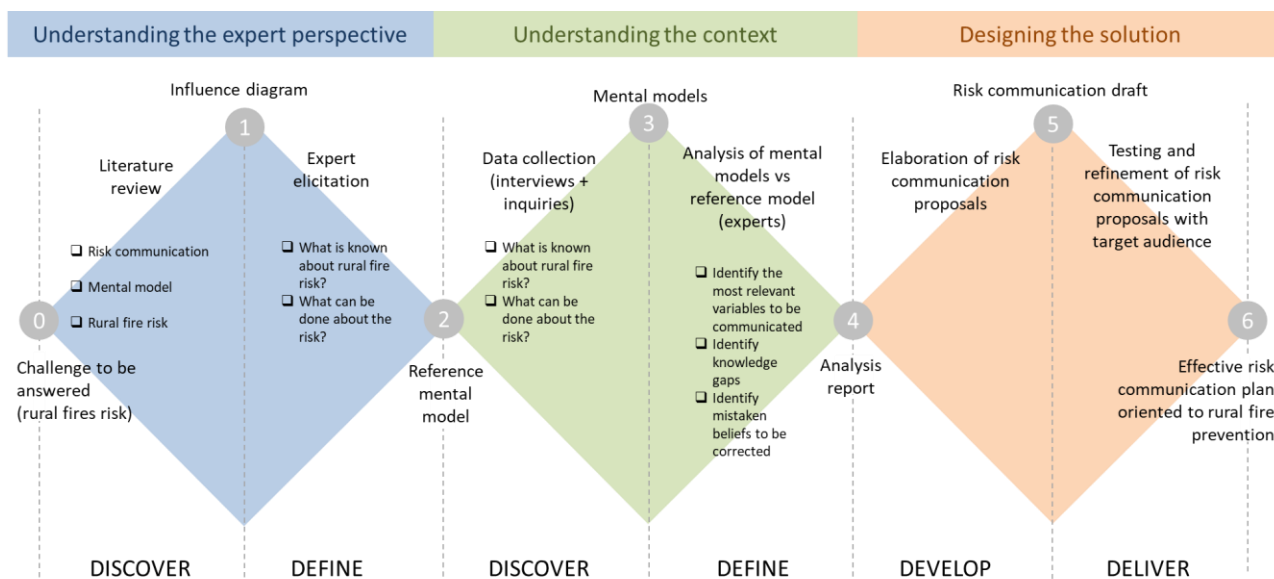


Figure 1- Systemic approach to design an effective risk communication plan oriented to mitigate the impact of traditional burning practices in rural fires

Overall, understanding the expert perspective stage included the literature review and expert elicitation to build the reference mental model. Literature review encompasses topics on risk communication, mental models and rural fires that enable in-deep understanding of the topics, especially regarding the best practices of risk communication, crucial tasks to develop an effective mental model and associated factors of rural fires risk, including risky behaviors and practices. Additionally, the bibliographic review established methodological premises to study development, being the first one is the mental model's elaboration, commonly represented by an influence diagram (Morgan et al. 2002).

Part of the expert elicitation consists of experts giving their contributions and comments regarding the mental model under construction. The experts' contributions are periodically validated by the research team and incremented in the reference mental model to translate the aggregated knowledge of the expert community regarding rural fires risk, behaviors, and practices to mitigate the ignition of rural fires.

Once concluded the reference mental model, Non-Parametric Multi-Criteria Analysis (Vego et al. 2008) was employed to map and define the lay sampling zones, as previously said. In this mapping, criteria were used, such as: Municipalities Council involved in the Forest Intervention Zones of Vale do Sousa; respective municipalities, districts, codes, terrain typologies and demographic data; analysis of occurrences associated with burning - last 3 to 5 years; construction of indicators for sample selection.

The understanding of the context stage begins with the data collection in the field through interviews with rural residents to understand their beliefs and perception about the impact of traditional burning practices in rural fires hazard, expressed in their own terms. Interview protocol was shaped by the expert mental model, so it allows for the expression of correct and incorrect beliefs (Morgan et al. 2002). However, to enrich the research at the beginning of this stage, participatory components such as focus groups and on-site visits and observations were added to compose the original Carnegie Mellon mental-models approach that we have been followed.

The data collected was transcribed, coded, and analyzed following a thematic analysis approach. We use software to support this process, NVivo. Once the results are summarized, the responses from interviews with rural residents will be analyzed in term of how well these mental models correspond to the expert model captured in the influence diagram (identify the most relevant variables to be communicated, identify knowledge gaps, identify mistaken beliefs to be corrected).

In addition, it will be applied inquiries to groups sampled from the intended audience to validate the mental model final analyses. This confirmatory questionnaire includes items captured about the beliefs expressed in the open-ended interviews and experts' model. The main purpose of this step is to estimate the population prevalence of these beliefs (Morgan et al. 2002).

Finally, the design solution stage encompasses three steps: elaboration of risk communication proposals which are presented as a risk communication draft, after the testing and refinement of risk communication proposals with the target audience, an effective risk communication plan oriented to rural fire prevention is concluded.

3. Preliminary findings and work in progress

We sought to present the systemic approach designed to build an effective risk communication plan to prevent traditional burning practices in Portugal. This systemic approach has been applied and tested in the first major project of initiative and operationalization of the ForestWISE Collaborative Laboratory – Collaborative Laboratory for Integrated Forest and Fire Management, called rePLANT, whose purpose is the development of research activities, innovation and transfer of knowledge and technology, to increase sustainable forest management, the competitiveness of the Portuguese forestry sector and reduce the impact of rural fires.

However, it is important to emphasize the original Carnegie Mellon mental-models approach have been amplified in this study, with the employment of participatory components (focus groups and on-site visits and observations), and quantitative elements (Non-Parametric Multi-Criteria Analysis), which supported deepening the knowledge of underlying reasons for resistance to behavioral change and defining guidelines to support the design of new risk communication strategies.

Preliminary findings show some themes resulted from the data analysis, between them: what must be communicated about rural fires risk, how must be communicated and attributes of good risk communication on rural fires, target audiences' profiles, the role of actors for effective risk communication on rural fires, evaluation of the risk communication results. Table 1 shows these themes and some respective quotes.

Table 1 - Preliminary findings (themes resulted from the data analysis and quotes)

<p>What must be communicated about rural fires risk</p>	<p>(...) <i>“if I'm going to communicate, I have to tell people what depends on them so that things go well. They cannot change the day, they cannot change the temperature of the day, they cannot change humidity, they cannot stop the wind. But they can make strips, they can put little vegetation so they don't burn too hard. That's why I would say that here in a communication strategy, the person has to be responsible for what he has control over and he has to pay attention to what he has no control over. And in risk communication, I think this is very important, making people realize that they have to act on the factors over which they have control”.</i></p> <p>(Regional Coordinator at a public institute that seeks to increase the protection of people, their property and reduce the impact of rural fires)</p>
<p>How to communicate and attributes of good risk communication on rural fires</p>	<p><i>“ I think proximity, because this works better if it is done locally, by local people, with local bodies, because obviously a massive campaign, as Portugal now calls it, obviously affects a part of the population that does these practices, it touches in some points, but I think it doesn't reach everyone, it's not like that, so accurate for this type of... or rather, a solution for this type of target audiences. I think this has to be much more worked on locally, with the action of local producers, with the association of farmers, with the parish councils, with the councils, it has more to be with this type of local solutions”.</i></p> <p>(Wood Regulation & Sustainability Manager at one of the main producers of wood-based panels in the world)</p>
<p>Target audience profiles</p>	<p><i>“There are several target audiences, not everything is the same, the message should not be the same for everyone”.</i></p> <p>(Lieutenant Colonel at a security force of a military nature from Portugal)</p> <p><i>“Communication must not only respond to this aging process, but at a later stage, it must respond to those who will succeed them”.</i></p> <p>(Executive Director at Forestry Association of Portugal)</p>
<p>The role of actors for effective risk communication on rural fires</p>	<p><i>“We contribute to, we are not the entity that generates awareness-raising actions, but we contribute to. AGIF does it in terms of general communication, in strategic terms, it gives the guidelines, because in the past it was the ICNF that was the responsible entity. All entities carry out awareness-raising actions at their various levels. We also do it,</i></p>

	<p><i>and this is important because we reach the population, the municipality, the parish and explain to the elderly, how it should be done, the risks they have, the impact they may have on these burnings”.</i></p> <p>(Lieutenant Colonel at a security force of a military nature from Portugal)</p> <p><i>“The presidents of the Municipality Council, in regions like ours, have a preponderant role in the transmission of this type of messages, even the priest, so it ends up being.... Then obviously, as the message passes, the more informal spaces such as cafes and communities turn out to be good places to spread the word, and people pass on this message of responsibility for the use of fire and the need to communicate its use”.</i></p> <p>(Forestry Technician at a consulting and technical support company, investment management and the execution of agroforestry work)</p> <p><i>“And that's another issue that we're really bad at, and that's alignment. it's like saying "Okay, there is all this, and we have to give all this to people so they can understand in 360 degrees the problem. And how do I have to do it?" And that too fails. And then each authority, each technician who is responsible for a given matter, always thinks that his or her own will definitely contribute to the solution of the problem, and is unable to bridge the gap with the other. I make a parenthesis again, that I think this is changing, but it is changing very slowly, that should have changed a long time ago”.</i></p> <p>(Executive Director at Forestry Association of Portugal)</p>
<p>Evaluation of the risk communication results</p>	<p><i>“You have to listen the person on the other side, he has to say what he perceived from the message and what he really understands from this message, if he agrees, if he does not agree, if he thinks it should be different, if there was another way to do it”.</i></p> <p>(Head Forestry Innovation and Development at a Portuguese pulp and paper company)</p> <p><i>“(…) very little has been done to evaluate the results of the many information campaigns that have been carried out. And one thing is done, which in my view is profoundly wrong, and that is to measure the success of a campaign by counting how many tens of thousands of pamphlets have been distributed. And that's the effort made, and how much money was spent. This is the effort made, this is the cost. What was the benefit? What has been gained? To what extent have behaviors changed? Very little is known. And this is a fundamental aspect”.</i></p> <p>(Full Professor and Ph.D. Natural Resources)</p> <p><i>“The truth is that the number of fires in Portugal has decreased a lot, the number of ignitions has decreased. I mean, today it's a third of what it was 20 years ago. Now... as there are no studies on this, we don't know if this is behavior change, per se, that is, more care, more prevention, more awareness-raising results, or prevention results, or campaigns, we don't know if that's it. , or if it's simply changes in, say, lifestyle”.</i></p> <p>(Associate Professor and Ph.D. Forest Sciences)</p>

We are currently in the context understanding phase, which we have already been carried out two focus groups sessions and also on-site visits and observations. These activities are the firsts steps to start collecting data in the field, that precede the interviews with rural residents to understand their beliefs about the impact of traditional burning practices on rural fire risk, expressed in their own terms.

Finally, it is expected with this research to provide guidelines of a systemic approach to help decision-makers and stakeholders to design an effective risk communication plans oriented to prevent burning practices, as well as socioeconomic and environmental impacts in the future. This approach also highlights the importance of exploring the underlying reasons for resistance to behavioral change and defining guidelines to support the design of new risk communication strategies, including the dissemination of new behaviors and practices that mitigate human caused rural fires.

4. References

- Coelho, Sílvia, Sandra Rafael, Miguel Coutinho, Alexandra Monteiro, João Medina, Susana Figueiredo, Sofia Cunha, Myriam Lopes, Ana Isabel Miranda, and Carlos Borrego. 2020. "Climate-Change Adaptation Framework for Multiple Urban Areas in Northern Portugal." *Environmental Management* 66 (3): 395–406. <https://doi.org/10.1007/s00267-020-01313-5>.
- Fraser, M. T. D.; Gondim, S. M. G. Da fala do outro ao texto negociado: discussões sobre a entrevista na pesquisa qualitativa. *Paidéia*, v. 14, n. 28, p. 139-152, 2004.
- Meira Castro, Ana C., Adélia Nunes, António Sousa, and Luciano Lourenço. 2020. "Mapping the Causes of Forest Fires in Portugal by Clustering Analysis." *Geosciences* 10 (2): 53. <https://doi.org/10.3390/geosciences10020053>.
- Morgan MG, Fischhoff B, Bostrom A, Atman CJ. *Risk Communication: A Mental Models Approach*. Cambridge, MA: Cambridge University Press, 2002.
- National Research Council, Committee on Risk Perception and Communication. 1989. *Improving risk communication*. National Academy Press, Washington, DC.
- Nunes, L.J.R.; Raposo, M.A.M.; Pinto Gomes, C.J. A Historical Perspective of Landscape and Human Population Dynamics in Guimarães (Northern Portugal): Possible Implications of Rural Fire Risk in a Changing Environment. *Fire* 2021, 4, 49. <https://doi.org/10.3390/fire4030049>
- Palenchar, M. J., Heath, R. L., & Orberton, E. M. (2005). Terrorism and industrial chemical production: A new era of risk communication. *Communication Research Reports*, 22(1), 59-67.
- Pereira, Mg, Tj Calado, Cc DaCamara, and T Calheiros. 2013. "Effects of Regional Climate Change on Rural Fires in Portugal." *Climate Research* 57 (3): 187–200. <https://doi.org/10.3354/cr01176>.
- Renn, O. (2010). The contribution of different types of knowledge towards understanding, sharing and communication risk concepts. *Catalan Journal of Communication & Cultural Studies*, 2(2), 177-195.
- Shukla, P. R. ; Skeg, J. ; Calvo Buendia, E. ; Masson-Delmotte, V. ; Pörtner, H.-O. ; Roberts, D. C. ; Zhai, P. ; Slade, R. ; Connors, S. ; van Diemen, S. ; Ferrat, M. ; Haughey, E. ; Luz, S. ; Pathak, M. ; Petzold, J. ; Portugal Pereira, J. ; Vyas, P. ; Huntley, E. ; Kissick, K. ; Belkacemi, M. & Malley, J. (eds.) (2019). *Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems*.
- Steelman, T. A., & McCaffrey, S. (2013). Best practices in risk and crisis communication: Implications for natural hazards management. *Natural hazards*, 65(1), 683-705.
- Turco, Marco, Sonia Jerez, Sofia Augusto, Patricia Tarín-Carrasco, Nuno Ratola, Pedro Jiménez-Guerrero, and Ricardo M. Trigo. 2019. "Climate Drivers of the 2017 Devastating Fires in Portugal." *Scientific Reports* 9 (1): 13886. <https://doi.org/10.1038/s41598-019-50281-2>.
- Vego, G., Kučar-Dragičević, S., & Koprivanac, N. (2008). Application of multi-criteria decision-making on strategic municipal solid waste management in Dalmatia, Croatia. *Waste management*, 28(11), 2192-2201.