Enhancing Forest Fires Preparedness in Portugal: Integrating Community Engagement and Risk Management

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Abstract – The growing incidence, intensity, severity, and size of forest fires and escalating economic constraints have made reliance on fire suppression activities as the main fire management strategies, in Portugal, less tenable. Recognition of this led fire and municipal civil protection agencies to include community preparedness in comprehensive risk management planning. Because this is a new element of risk management in Portugal, agencies need information on cost effective approaches to facilitate community preparedness. Using data from a study of forest fire preparedness in Portugal, this article discusses the development and testing of a model of forest fire preparedness. Data from 197 residents from several communities in northern Portugal were used to test the model. Analysis confirmed that people’s beliefs about the effectiveness of preparing (outcome effectiveness) interacted with social processes and competencies (community participation, collective efficacy) to explain differences in levels of forest fire preparedness. Because the social processes and competencies identified derived from people’s life and community experiences, the findings highlight the importance of integrating risk communication with community engagement and development strategies if the goal of increasing preparedness is to be effectively pursued. Activities fire and municipal agencies can use to facilitate preparedness are discussed, as is the potential for using the model in Europe and Australia.

Keywords – forest fire preparedness, risk communication, community engagement, development

1. Introduction

Forest fire incidence is high in Portugal. It has the highest frequency of fire ignitions and burned area in Europe (Catry et al., 2010; San-Miguel and Camia, 2009). In 2010, half the fires and burned area in all southern European countries were in Portugal (JRC, 2011). Since the start of the official database on the fires, in 1980, almost 572 thousands events were record although 71% burned less than 1ha. Only 4,905 occurrences (0.9%) burned 100 ha or more. Two main trends have emerged to characterize fire occurrence in Portugal (Figure 1). The first concerns the increasing in the number of fires and the area burned. Data on the number of fires is depicted by the red line in Figure 1 (scored against the right column in Figure 1 which describes the number (No.) of fires). Data on the area burned is depicted by the histogram in Figure 1 (with the total hectares (Ha.) burned measured against the left hand column in Figure 1). The maximum value of area burned was reached in 2003 (425,839 ha) and the maximum number of fire events was reached in 2005 (35,824) (Figure 1). The second trend is reflected in the occurrence of larger and catastrophic fires. The occurrence of fires larger than 20,000 ha is a 21st century reality, and some of these fires can be even considered mega-fires (Kearney and Warren, 2006; Pyne, 2007; San-Miguel Ayans, 2011; Tedim et al., 2013; Williams et al., 2011).

Forest fires represent significant ecological, social and economic threats to many communities in Portugal. The expansion of the wild land-urban interface is putting more people at risk and increasing potential damage to property. This trend results not only from the expansion of urbanization into wild lands but because forest, in many places, is coming closer to the settlements as a consequence of the abandonment of agricultural lands. The fire protection represented by the agricultural land buffer surrounding many settlements is disappearing in many places facing depopulation, ageing and a loss of value of agricultural products. The abandonment of agricultural land reflects also a significant social change (e.g., loss of...
land management expertise and knowledge of fire culture. Despite growing increases in risk associated with social change, this has not been accompanied by changes in socially-based approaches to risk management. However, the growing incidence and severity of fires and the consequent emergent risk to people and settlements is highlighting weaknesses in the historical reliance on fire suppression methods, rather than more proactive risk management, in Portugal and the need for a shift in how fire risk is conceptualized and managed.

The traditional approach to managing forest fires in Portugal focused on suppression activities. Historically, this has resulted in less attention being given to social risk management and prevention (e.g., community preparedness). However, following the extreme fire seasons of 2003 and 2005 inadequacies in existing approaches were recognised and the National Fire Plan (2006) was established. This plan promoted fire prevention (e.g., through the establishment of municipal plans to defend forest from fire, the development of actions to protect people and goods primarily through the creation of defensible space), population sensitization using passive means (e.g., distributing pamphlets), improvement of surveillance, detection and alert, and at an operational level a better balance between the protection of people and goods and forest protection. Furthermore, the National Fire Plan was cognizant of the fact that a combination of an increasing number of fire occurrences and limited fire fighting resources, meant that it was important to advocate that communities and fire agencies work collectively to manage shared risk. The National Fire Plan also identified a need for complementary action on the part of property owners and communities. This involves people preparing in ways that reduce the risk to properties and increasing their ability to defend their properties. If people prepare and develop strategies to defend their properties, fire agency resources can focus more on fire suppression activities and suppression becomes easier if fire fighters do have to defend homes. By working collectively, more cost effective approaches to managing forest fire risk can be developed. This can be done by increasing community involvement in planning and facilitating community preparedness in ways that increase people’s capacity to prevent and respond to fire events. The importance of marshalling agency and community resources in this way can also be traced to recognition that climate change will act to increase fire risk in areas in Portugal susceptible to experiencing fires. For people to play active roles in fire risk management they must know what to do.

People can prepare by, for example, creating a defensible space around their property, using fire-resistant materials for renovation or building, safeguarding their house (e.g., ensuring roof tiles fit tightly to prevent embers entering through the roof). Preparing reduces the risk of injury and death, facilitates people’s capacity to cope with disruption, and helps them adapt to and recover from fire impacts. Well prepared people and homes also increase the likelihood of people being available to assist recovery efforts in their community, facilitate the maintenance of the social networks that assist social recover, and helps sustain the economic vitality of areas adversely affected by fire. Identifying what can be done and informing people of their risk and what they should do not, however, mean that people will automatically act and prepare (see Paton and McClure (2013) for a review). The hazard preparedness literature has identified a need to develop...
programs to facilitate preparedness. It has also identified the fact that these programs are most effective when based on engaging with the community rather than passively disseminating information to people (Paton and McClure, 2013). The question then becomes one of identifying how to accomplish this task. In Portugal, the challenge of doing so is complicated by the fact that the move to including a community or social dimension introduces a significant point of departure in forest fire risk management planning in Portugal (Paton and Tedim, 2012).

To facilitate preparedness, agencies need to know how to develop the community resource. This paper discusses research into identifying community predictors of preparedness. By doing so it provides agencies with guidelines for developing community preparedness within a risk management strategy designed to facilitate greater community involvement in local forest fire risk management. It discusses the testing of a model that identifies the predictors of forest fire preparedness in communities developed in Australia and in Portugal. Testing the model in Portugal serves two separate but related purposes. Firstly, demonstrating that the model can predict preparedness in different locations increases the validity of the model. Secondly, because Australia and Portugal sit at different ends of a cultural continuum (Hofstede, 2001), testing the model in Portugal will offer insights into the cross cultural utility of the model. The foundation for this belief derives from the fact that Australia and Portugal sit at almost the opposite ends of the cultural dimensions of individualism-collectivism (Australia- 90; Portugal- 24), power distance (Australia- 36; Portugal- 63), and uncertainty avoidance (Australia- 51; Portugal- 104) used to categorize cultural differences (Hofstede, 2001). By testing a theory in countries that differ substantially on their respective positions on key cultural dimensions, it is possible to make judgments about the degree to which a theory can provide insights into cross cultural equivalence of a model of preparedness and its predictors.

2. Forest fire preparedness model

2.1. Predicting community preparedness

The theory (Paton et al., 2008a) proposes that preparedness is predicted by the interaction between people's beliefs about whether or not it is possible for personal action to mitigate personal risk and social processes that influence how people develop and enact risk beliefs when faced with complex hazard events. The process starts with whether people believe that actions can be taken to mitigate forest fire risk.

Personal beliefs about the effectiveness of preparing

The theory being tested here (Paton et al., 2008a) proposed that whether or not people prepare is first influenced by their beliefs about the amenability of forest fires to mitigation through individual action. That is, whether they think that it is possible for people to influence their risk. This interpretive process is captured by the Outcome Expectancy concept (e.g., Bennet and Murphy, 1997; Paton et al., 2005). Using the outcome expectancy concept to frame understanding of this interpretive process, the theory proposes that people will be disinclined to act if they form Negative Outcome Expectancies believe that forest fires are too catastrophic for any personal action to be effective (e.g., "forest fires are too destructive to prepare for"). If, on the other hand, people believe that personal action can influence personal safety, and form Positive Outcome Expectancies (e.g., "preparing will significantly reduce damage to my home should a forest fire occur") people are motivated to start the preparedness process. Outcome expectancy beliefs are particularly important when people face intense and complex fire hazards. However, believing that it is possible for personal action to make a difference to one's safety and knowing what to do and/or how to act are not the same thing (Paton and McClure, 2013). Consequently, the major component of the theory describes the social interpretive processes that people use to guide their preparedness actions.

Peoples' perception of risk and how they might mitigate it is socially constructed (Earle, 2004; Paton and Bishop, 1996). This suggests that the ability of community members to interpret forest fire risk and prepare to manage their risk will be a function of the degree to which they possess the processes and competencies that help them to interpret their circumstances and take action to deal with novel issues facing the community. Processes and competencies that are relevant here are the degree of connectedness within a community that underpins the sense of social responsibility for managing risk, being actively engaged with others in ways that facilitates developing risk beliefs and discussing how to manage risk, and having experience of taking action to deal with issues that represent collective problems for a community.

Social influences on forest fire preparedness

Faced with complex and uncertain events, when they do not possess all the information they need themselves, peoples' perception of risk and how they might mitigate it, is influenced by information from others who share their interests and values (Earle, 2004; Lion et al., 2002; Paton and Bishop, 1996; Paton et al., 2008a; Poortinga and Pidgeon, 2004). Thus levels of community participation will influence the availability of a social context in which people can formulate risk beliefs and actions. As this will be true in any culture, the variable community participation (e.g., "I have attended a public meeting on a community issue") can be included in a cross cultural comparison. The above studies also revealed how discussion with other community members increased the ability of people to collaborate to determine what consequences they could face, work out what would be an effective response, and then consider what information and resources they require to enact their mitigation strategies. One construct that encapsulates community members' ability to identify needs and formulate questions is collective efficacy. Collective efficacy (e.g., "community groups can get something done about local problems") is a measure of co-operation and
assistance available within a community and community members’ ability to assess their capabilities and resource needs and formulate plans to use resources to confront challenging tasks and it has demonstrated its utility in collectivistic cultures (Duncan et al., 2003; Paton et al., 2008b). Community participation was assessed using a measure developed by Eng and Parker (1994), and collective efficacy using a measure developed by Zaccaro et al. (1995).

Intention to prepare has been identified as mediator and has been found to be a good predictor of actual preparedness (Lindell and Perry; 2004; Paton et al., 2005; Sheeran, 2002). Intention is useful in other respects. Its inclusion permits an analysis to identify how factors such as, for example, resource limitations (e.g., time, money, physical resources, expertise) that could prevent people from converting their intentions into actual preparedness. As with the other variables, the items comprising the intention measure were examined for cultural applicability by the authors and pilot tested in each location to ensure face validity. This helped ensure that the meaning attributed to the intention variable was comparable for each population. The intention measure comprised items that assessed people’s intention to acquire hazard knowledge, increase actual preparedness, and to work with other people/civic agencies to develop knowledge and capability (Paton et al., 2005).

The analysis in Australia identified that holding negative outcome expectancy beliefs had an inverse relationship on community processes. Negative outcome expectancy (NOE) had a negative influence on whether people would engage with others and so reduced the likelihood of preparing. Thus, in the Portuguese analysis, it is hypothesised that negative outcome expectancy will have a negative influence on social processes and so act to reduce the likelihood of preparing. Based on the Australian findings, it is hypothesized that if people hold positive outcome expectancy (POE) beliefs, the relationship between POE and preparedness will be mediated by the social interpretive processes (community participation and collective efficacy) used to articulate members needs and expectations. Next, it is hypothesized that the relationship between the social interpretive processes and preparing will be mediated by intentions to prepare. The theory thus proposes that outcome expectancy beliefs, community participation, collective efficacy and intentions play interdependent roles in explaining differences in level of forest fire preparedness. In order to test the theory it is important to use an analytical technique that can assess the interdependences between variables. For this reason, structural equation modeling was used.

2.2. Testing the model

Data were collected using a questionnaire first developed for investigating forest fire preparedness in Australia (Paton et al., 2008a). Before it could be used, it first had to be translated into Portuguese. The procedure recommended by Brislin (1986) was followed. It was then back translated from Portuguese into English. The original versions and back-translated versions were compared, examined for meaning errors, and corrections were made as required to ensure equivalent content. The scales included in the questionnaire, and which are used to test the model, are listed in the left hand column of Table 1.

Data were collected from communities in northern Portugal that experience a high frequency of forest fires. The municipalities in which the questionnaires were distributed: Arcos de Valdevez, Baião, Cinhães, Melgaço, Miranda, Montalegre, Fonte da Barca, Terras de Bouro, and Vieira do Minho. A total of 1000 questionnaires were delivered to households in these areas. From this sample, 207 participants responded by completing the questionnaire. Data screening (see below) condensed the total number of participants to 197.

In order to screen the data for missing values, and to ensure the assumptions of Structural Equation Modeling (SEM) were met, the Statistical Package for the Social Sciences, (SPSS) version 17.0 was used prior to analysis. Assumptions pertinent to the use of SEM include multivariate normality, linearity of relationships, symmetry of residual covariances, absence of multicollinearity, singularity, homoscedasticity, and extreme cases, sufficient number of indicator variables (minimum ratio of 1 per latent variable), a sufficiently large sample size (minimum ratio of five times more cases than the number of independent variables), independence of observations, and random sampling of participants (Ho, 2000; Reisinger and Mavondo, 2006; Kline, 2005).

A missing values analysis (MVA) ascertained the amount and pattern of missing data. Ten cases that had > 50% of missing values were excluded from the study on the basis that substituting the mean for participants who had over 50% of their data missing could not be justified.

<table>
<thead>
<tr>
<th>Measure</th>
<th>Source</th>
<th>No. of items</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Cronbach’s α</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Outcome Expectancies</td>
<td>Bennet and Murphy, 1997; Paton et al. (2005)</td>
<td>3</td>
<td>10.41</td>
<td>2.92</td>
<td>0.71</td>
</tr>
<tr>
<td>Negative Outcome Expectancies</td>
<td>Bennet and Murphy, 1997; Paton et al. (2005)</td>
<td>3</td>
<td>8.81</td>
<td>2.46</td>
<td>0.64</td>
</tr>
<tr>
<td>Collective Efficacy</td>
<td>Zaccaro et al. (1995)</td>
<td>4</td>
<td>14.37</td>
<td>2.03</td>
<td>0.71</td>
</tr>
<tr>
<td>Community Participation</td>
<td>Eng and Parker (1994)</td>
<td>4</td>
<td>10.36</td>
<td>3.08</td>
<td>0.83</td>
</tr>
<tr>
<td>Intentions to Prepare</td>
<td>Paton et al. (2005)</td>
<td>3</td>
<td>6.69</td>
<td>1.74</td>
<td>0.74</td>
</tr>
<tr>
<td>Preparedness</td>
<td>AFAC (2005)</td>
<td>16</td>
<td>5.94</td>
<td>3.25</td>
<td>0.82</td>
</tr>
</tbody>
</table>
Mean substitution was used in the further eight cases that had less than 50% of missing values. Calculation of Mahalanobis Distance detected three multivariate outliers that exceeded the X2 critical value of 27.88, p < 0.001 which were subsequently eliminated on the basis that they were not representative of the sample. Examination of standard scores (z-scores) did not detect any univariate outliers following deletion of the multivariate outliers. The assumption of multivariate normality was assessed through inspection of values of skewness and kurtosis, histograms, normal Q-Q plots, and analysed through the Kolmogorov-Smirnov and Shapiro-Wilk tests of normality. Kline (2005) suggests that values of kurtosis greater than 10.0 and values of skew greater than 3.0 may be indicative of a lack of normality. According to these criteria, values of skewness and kurtosis did not indicate deviation from normality, with all values falling beneath 1.17. VIF and tolerance statistics were inspected and revealed an absence of multicollinearity and singularity. Examination of scatterplots and normality probability plots of the residuals also indicated that the assumptions of linearity and homoscedasticity had been met. All other assumptions of SEM were met and analysis of the Model proceeded.

Because it allows the assessment of multiple and interrelated relationships between variables simultaneously, SEM was used to test the measurement and structural models. Screening and assessment of data confirmed that the data were suitable for SEM analysis (see below). The models were estimated in the population (Ho, 2000). Values that are < 0.05 suggest a good fit to the data, while values between 0.05-0.08 reflect an adequate fit (Reisinger and Mavondo, 2006). The Goodness-of-Fit Index (GFI), Normed Fit Index (NFI), Tucker-Lewis Index (TLI), Incremental Fit Index (IFI), and Comparative Fit Index (CFI) all approximate the degree to which the theoretical model is superior to the null or independence model. They range from 0 (no fit to the data; a fit that does not improve on the goodness-of-fit when per degree of freedom when the model is estimated in the population (Ho, 2000)). Values that are > 0.90 are considered to reflect an adequate fit to the data. The first analysis discussed is that relating to the measurement model which examines if the measured variables are reliable indicators of their respective constructs.

Measurement Model Analysis

Goodness-of-fit measures and indices indicated that the measurement model was a good fit to the data ($\chi^2$ (104, N = 197) = 126.50, p = 0.07, RMSEA = 0.03, 90% CI: 0.00 → 0.03, GFI = 0.93, NFI = 0.88, TLI = 0.97, IFI = 0.98, CFI = 0.98, PCLOSE = 0.93) signifying that the measurement variables significantly represent their respective latent variables/constructs. In addition, all factor loadings were significant at p < 0.001 or p < 0.02. This is further evidence that the measured variables are reliable indicators of their respective latent constructs. Confirmation of the measurement model provided the basis for testing the structural model (Figure 2). The hypothesised structural model was evaluated using the maximum likelihood method of estimation.

Each latent variable was allowed to covary in order to represent unanalysed associations, and each indicator loaded on only one latent variable (Kline, 2005; Reisinger and Mavondo, 2006). As recommended by Ho (2000) and Reisinger and Mavondo (2006), for both the measurement model and the structural model analysis, multiple fit indices were inspected.
Figure 2: A summary of SEM analysis

2.3. Discussion

The analysis confirmed that personal beliefs regarding the efficacy of preparedness interacted with social characteristics (community participation) and competencies (collective efficacy) to help explain differences in levels of forest fire preparedness in Portuguese communities. As predicted, negative outcome expectancy reduced the likelihood of people preparing (Figure 2). Even though not significant, the negative relationship between NOE and community participation provides a further insight into how such a belief can constrain the preparedness process. The analysis confirmed that the relationship between positive outcome expectancy and preparing was mediated by social processes (community participation) and competencies (collective efficacy). Not finding any direct relationship between personal beliefs and preparing is consistent with the predictions of the theory, especially when applied to a highly collectivistic country like Portugal. The finding of a good fit between the data and the hypothesised model and accounting for 39% of the variance in levels of forest fire preparedness.

Structural Model Analysis

The analysis demonstrated that the model was a good fit to the data, ($\chi^2 (123, N = 197) = 143.80, p = 0.10, CMIN/DF = 1.17, RMSEA = 0.03, 90\% 0.00 \rightarrow 0.05, NFI = 0.87, TLI = 0.97, IFI = 0.98, CFI = 0.98, PCLOSE = 0.97$). Significant relationships are in bold. Non-significant relationships are shown by hashed lines. Overall, levels of forest fire preparedness were low. The average number of house protection items adopted was 6 (of 16). The model accounted for 39% of the variance in levels of forest fire preparation.

The analysis demonstrates how preparedness results also from ensuring that people can make sense of and use information and resources to meet their needs. This has significant implications for policy and practice. For example, the National Fire Plan (2006) led to focusing on encouraging community preparedness using passive means (e.g., distributing pamphlets). The analysis reveals that people’s interpretation of risk and its enactment into risk management activities is socially mediated. Passive communication does not permit the engagement of people in ways that facilitate interpretation, translating information to meet local circumstances, and developing plans to meet local needs. The analysis provides the evidence base to inform policy development (e.g., to move from passive to active community engagement approaches to risk communication) and it identifies how such risk communication strategies could be developed (see below).

The analysis highlights how, from a risk management perspective, an effective public education strategy must work with and engage with the community. In this context, it is important to note that the social context factors that predicted the adoption of forest fire protective measures were pre-existing community characteristics (e.g., participation) and competencies (e.g., collective efficacy) that derived from people’s engagement in daily community activities over time. This suggests that the effectiveness of risk management strategies can be increased by integrating them with mainstream community development strategies (Paton, 2008; Pearce, 2003). Thus community engagement strategies must assess and if necessary develop and encourage use of social networks (e.g., active participation) within which people can develop appropriate risk beliefs; the competencies (e.g., collective efficacy, planning) that help people identify ways to respond and that help people identify how to put strategies into action.

This work identified a need for community outreach
strategies to increase preparedness. This need was indicated by finding that, on average, only 6 or 16 preparedness items were undertaken. In particular, current preparedness activities are problematic as people were least likely to adopt the structural (e.g., defensible space, house protection) and planning (e.g., household fire response plan) activities that will make the greatest impact on helping fire agencies focus on suppression activities. If people do not adopt structural protection (e.g., defensible space), they and their properties remain more at risk and will require fire agencies to divert more suppression resources to protecting homes. Structural preparedness is particularly important if household preparedness is to effectively complement agency roles in an integrated risk management strategy.

An important aspect of the model is that it focuses on beliefs and processes that are highly amenable to change through risk management and risk communication strategies. This allows the model to be used to inform both policy development and the development of intervention strategies. For example, the model suggests that strategies to promote preparedness should focus on influencing outcome expectancy beliefs and the use of social processes to facilitate preparedness (Paton and Wright, 2008). With regard to personal beliefs, the theory identifies how negative outcome expectancy arises because people assume that forest fires are beyond personal control and are too catastrophic for personal actions to be effective. Such beliefs could be countered by presenting images that compare properties close to each other where one is damaged by fire and the other not to illustrate how actions can affect damage. This approach can be supplemented by clearly differentiating the fact that while people cannot control forest fire they can control its consequences (e.g., a defensible space reduces threat from embers and protects property) and emphasizing the need to focus on the consequences of the action of fire on property and not on the causes of the fire or the fire itself.

Preparedness can also be facilitated by getting people to personalize impacts (e.g., asking them to consider what a fire might mean for them and their community) and by arranging discussions with people from communities that have prepared and who can talk about its effectiveness. Information should focus on explaining how fire affects properties and how specific actions prevent loss (Paton and McClure, 2013; Paton and Wright, 2008). These authors discuss how information is most effective when it deals with specific topics (e.g., discuss embers, how they occur, and how to protect from them) rather than covering everything at one time and when people discuss how to use this information. This can be facilitated through organizing social meetings that include property assessments and showing what an effectively prepared property looks like. Workshops, consultative liaison committees, public forums are also useful approaches to promoting discussions and identify new ideas and issues from within the community.

Consistency between this study and a research in Australia (Paton et al., 2008a) introduces the possibility that the model of forest fire preparedness has cross-culturally applicability, increasing the potential to use it to assist forest fire risk management planning throughout Europe and Australia. The fact that the findings of the Portuguese analysis are comparable to those obtained in Australia suggests the theory has cross cultural utility. While this suggestion remains tentative until examined for other hazards, the finding of cultural similarity has theoretical and practical implications. Demonstrating cultural equivalence in this way provides a common basis for collaborative learning and research across national borders and increase the scope for developing international cooperation by facilitating the development of complementary research programs in different countries and facilitate the spread of the benefits of research findings more widely. From a practical perspective, confirmation of cross-cultural equivalence increases access to information on risk management and risk communication programs in different countries.

The analysis discussed here did offer support the predictive validity of the theory and suggests that it has good cross cultural utility. However, there are some weaknesses in the approach adopted that require attention. Firstly, the analysis used scales developed for highly individualistic countries and simply translated them for use in Portugal. While the reliabilities of the scales were acceptable (though negative outcome expectancy was low), this could reflect the scales used. Future work should identify more culture-specific variables and re-test the model. Secondly, the communities selected for the study were situated in very high fire risk areas all rural in nature. This enhances the assessment of social influences by optimizing social conditions (e.g., rural communities tend to be more cohesive). It will be important to examine in the applicability of the theory in more highly urbanised areas.

The support for the theory discussed here suggests it provides a good starting point for developing community engagement forest fire risk management strategies. Developing an evaluation research program around this process would provide an appropriate context for identifying and developing culture specific measures of the personal and interpretive processes that underpin sustained hazard preparedness.

3. Conclusions

This article identified the benefits of accommodating personal beliefs and social processes in developing community engagement strategies for use in facilitating forest fire preparedness in Portugal. The analysis suggested that this can be cost effectively by integrating risk management with community development initiatives. This fosters social capital and will result in enduring benefits for communities and not just in the context of their experiencing forest fires. This increases the cost effectiveness of this aspect of risk management, an important and pragmatic consideration at a time when financial constraints need to be accommodated in risk management planning.
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Citation