

# **ADVANCES IN FOREST FIRE RESEARCH**

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## Assessing social vulnerability to wildfires of communities from a relative value approach: a working hypothesis

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Social vulnerability, Community, Exposure, Sensitivity, Adaptation

### Abstract

The present paper provides an overview of the research carried out by the Institute of International Sociology of Gorizia (ISIG) in the framework of three EU funded projects (ECOSTRESS – DG ECHO, RESILOC – H2020, and FirEURisk – H2020). Throughout these three research projects, a relevant corpus of literature has been analysed and re-elaborated, allowing for the development of methodologies and instruments for the assessment of social vulnerability at a local/community level. This paper provides, first, a theoretical overview on the issue, second, the results and potentialities of such instruments stemming from recent field applications, and third, the potential outline for operational approaches in the field of wildfire resilience-building strategies for local communities.

By addressing the complexity of vulnerability, both as a concept and as a phenomenon, the paper focuses on social vulnerability to wildfire, intended as the magnitude of social impact deriving from wildfires, and the (in)ability of local communities to cope with wildfire as a stressor.

In the absence of standard assessment benchmarks and thresholds for (social) vulnerability, the paper argues for a relative perspective of analysis, within which the ‘vulnerability’ of a community is analysed in comparison with other similar units of analysis.

Furthermore, the paper argues for participatory approaches towards such assessments, that would allow for an increased level of integration of local knowledge within the analysis. Moreover, building on the results of recent research projects, the paper promotes participatory approaches to vulnerability assessment as a preliminary ‘needs assessment’ by means of which end users/communities may identify ‘areas of vulnerability’, as well as existing resources/adaptive capacities, to be considered in the elaboration of resilience strengthening strategies or equivalent development/strategic planning processes at local level.

### 1. Introduction – a research framework for social vulnerability

The paper provides an overview of the research carried out by the Institute of International Sociology of Gorizia (ISIG) in the framework of three EU funded projects<sup>1</sup>, namely summarising the relevant corpus of literature that has been analysed and re-elaborated to develop instruments for the assessment of social vulnerability at a local level.

This paper provides a theoretical overview on the issue which could serve as a basis for operational approaches in the field of wildfire resilience-building strategies at local/community level, to be further explored within the framework of FirEURisk H2020 project.

#### 1.1. Social Vulnerability

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<sup>1</sup> ECOSTRESS (DG ECHO): ISIG developed a Relative Social Vulnerability Index and SWOT Analysis of Coastal Case Studies in the Upper Adriatic. RESILOC (H2020): ISIG coordinated the activities related to the analytical framework for the vulnerability analysis at Local Community level. FirEURisk (H2020): ISIG is coordinating the definition of a methodological framework for wildfire vulnerability assessment, with a specific focus on societal vulnerability.

Vulnerability, both as a concept and as a phenomenon, does not have a univocal definition, nor a unique methodology for its assessment (Füssel, 2007; Fekete & Montz, 2018; Cutter, 2018). It may be broadly understood, however, as the potentiality for loss of a unit/system in the light of stressors. The UNDRR defines vulnerability as “the conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards”<sup>2</sup>.

Vulnerability is a multifaceted concept: it lacks a definitional unity and clarity (Cutter, 2018) both within, and between, academic research and policy and practitioner driven work (Füssel, 2007; Fekete & Montz, 2018). It is also a dynamic concept, eventually shaped by the recent waves of increased awareness regarding the profound climate change impacts (Hinkel, 2011).

Especially after the 1994 *World Conference on Natural Disaster Reduction* in Yokohama, the concept of vulnerability has become very prominent in the field of risk reduction studies (Cutter, 2018). Vulnerability has been increasingly associated with the term “resilience”, whose success was at least partially determined by its positive tone.

There are several elements that are generally acknowledged as being entailed by the concept of vulnerability:

- Exposure: the stress or stresses to which an individual, community, society, ecosystem, structure, etc. are exposed (i.e., they are at risk from a hazard).
- Sensitivity: the extent to which the exposed elements are affected or indeed modified by the stress.
- Adaptive capacity/coping mechanisms: existing or lacking skills, resources, opportunities that allow the exposed/affected elements to survive, absorb the impacts, and manage the adverse outcomes.

Vulnerability studies investigate on different thematic dimensions or types of vulnerability; every dimension has shaped different research perspectives, academic corpuses of knowledge, and consequently different assessment/measurement methods. The MOVE framework (Birkmann et al., 2013) and the 4-dimensional model proposed by Fuchs and Thaler (2018) stand as relevant attempts to systemize different perspectives on the issue of vulnerability under the same framework. The former identifies six dimensions of vulnerability: social, economic, physical, cultural, environmental, and institutional. The latter works on a combination of physical, economic, institutional, and social dimensions of vulnerability.

Within the abovementioned frameworks, social vulnerability describes a state of people, or populations, rather than physical structures, therefore a ‘social space’ whose boundaries are defined by the “political, economic, and institutional capabilities of people at a specific time and place” (Burton, Rufat, & Tate, 2018, p. 53). Social vulnerability refers to the inability of people, organisations, communities, and societies, to resist adverse impacts from stressors to which they are exposed.

## **1.2. Social Vulnerability to Wildfires**

Social vulnerability to wildfires refers both to the magnitude of social impact deriving from wildfires, and the inability of local society to cope with stressors to which it is exposed. It entails both a structural and a processual dimension. According to the *FAO Strategy on Forest Fire Management*, 90% of wildfires are caused by human activities and behaviours, which are in turn interrelated with meteorological conditions, territorial topography, and fuel availability, following a non-linear and dynamic relationship.

Leone et al. (2003, 2009) proposed a systematisation of the main human-related variables explaining wildfire occurrence, stemming from several previous studies. Martínez et al. (2009) identified seven groups of anthropogenic risk factors associated with wildfires:

- Socio-economic transformations in rural areas.
- Human presence and socio-economic transformations in urban areas.
- Persistence or transformation of traditional activities linked to fire in rural areas.
- Accidental or negligent events related to infrastructures and facilities.
- Landscape structure and housing patterns.

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<sup>2</sup> <https://www.undrr.org/terminology/vulnerability>

- Indirect factors (i.e., regulations and behaviours) of intentional fires.
- (Lack of) forest policy.

These or similar dimensions are used by the authors to identify relevant variables (i.e., indicators) describing exposure and sensitivity associated with fire risk in different geographical contexts (Martínez et al., 2009; Ager, Preisler, Arca, Spano, & Salis, 2014; Vallejo-Villalta et al., 2019; Costafreda-Aumedes et al., 2017).

In the broader framework of human activities, consolidated and/or emerging patterns of territorial development, as well as local policies, play a relevant role in adapting the whole system to wildfire risks, as well as in making available coping mechanisms. Also in this case, relationship between established policies/practices and efficiency and efficacy in fire risk reduction is hard to be traced, for instance in the case of fire management procedures (Fernandes, 2013; Moritz et al., 2014)

Jucker Riva et al. (2018) investigated the impact of land management practices (LMPs) in the enhancement of forests and rangelands resilience vis-à-vis environmental disturbances, including wildfires. They isolated 16 LMPs, clustered in five groups, highlighting that that removal of vegetation was the most beneficial single LMP: clearing of vegetation; managed grazing; planting of shrubs; planting of trees; other practices.

## **2. Assessing Social Vulnerability: towards a participatory approach**

If defining vulnerability is fraught with difficulty, assessing and measuring it is even more difficult. While the notion of measurement refers to the elaboration of specific quantification instruments which can describe the phenomena of vulnerability, the notion of assessment includes a broader spectrum of approaches to identify, investigate, quantify, weight and rank of a set of vulnerabilities.

Various critiques have been voiced at the methodologies of measurement, mainly in relation to the challenges of using indexes, to problems associated with spatial and context differences and assessment of data at various scales of analysis (Barnett, Lambert, & Fry, 2008; Fekete & Montz, 2018). Comparisons have been warned against, on the argument that vulnerability is a context-specific rather than a generic condition (Barnett, Lambert, & Fry, 2008). Also, another critique is focused on the dynamic nature of the vulnerability phenomena (Adger, 2006), which determines shortcomings in the use of static indicators. When considering analysing vulnerability from a community perspective, the dynamic nature of both the phenomenon (i.e., vulnerability) and of the unit of analysis (i.e., the community) plays indeed a fundamental role. Quantitative methods and data can provide for a static picture of a community but limited in the understanding of the real implications and connections of intervening factors at community level, for instance adaptive capacity elements (i.e., skills and resources). Moreover, each community is very different than the other, so in order to be able to grasp fully the interactions and implications of the identified variables with the context itself, there is the need to incorporate in the analysis the local knowledge and awareness. This may be achieved by means of participatory approaches to assess vulnerability.

The understanding of vulnerability and resilience at community level depends on who, what, where, and for whom – all of which are socially constructed and temporally changing (Cutter, 2018). Resilience and vulnerability are embedded in interdependencies between systems, scales, and historical processes. It may be thus challenging to identify thresholds or benchmarks in vulnerability assessments (Fekete, 2019). In a word, vulnerability, as well as resilience, may be approached from a relative perspective rather than in absolute terms (Cutter, 2016; Fekete, 2019). Understanding vulnerability as a relative concept means to consider it in context, so to allow for its observation in comparison with other similar units of analysis, for example neighbouring communities exposed to similar hazards.

Most studies derived from the methodologies devised by Cutter<sup>3</sup> provide a spatial assessment and an empirical ranking. A vulnerability score (a numerical value which aggregates all the operations performed through collecting values for indicators, aggregating them, etc.), is not considered to be high or low *per se*, but by reference (distance) to a mean value, therefore, only by reference to other units of analysis, which compose this mean. Such approach, adopted for the purpose of this paper and of illustrated research projects, enables

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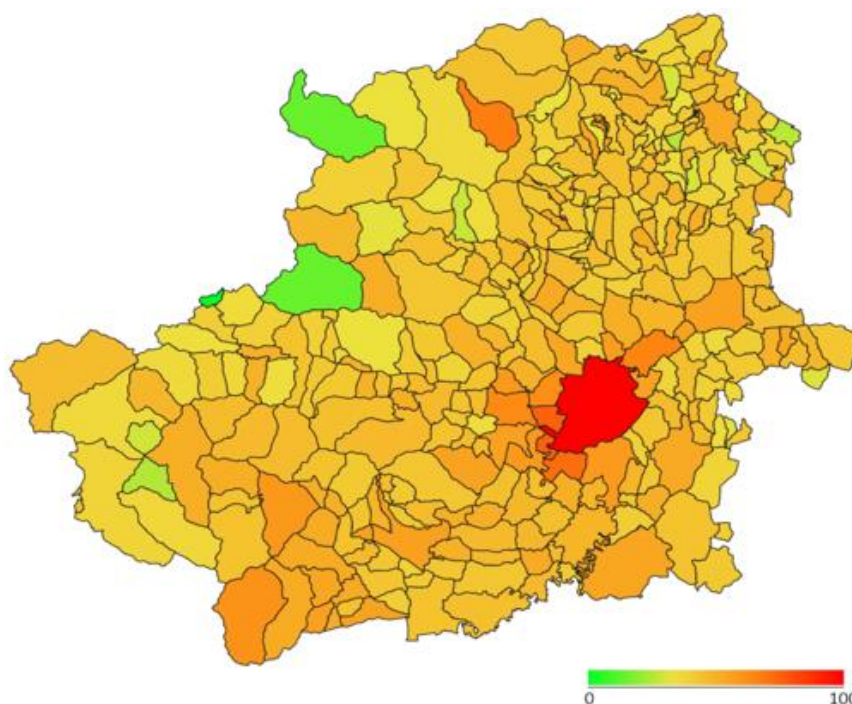
<sup>3</sup> See for instance Cutter, Boruff, & Shirley, 2003; Cutter, Burton, & Emrich, 2010; Guillard-Gonçalves, Cutter, Emrich, & Zêzere, 2015.

participatory assessments of vulnerability and resilience of communities, which could allow for a more grounded integration of context knowledge. The later, appears to be key to ensure an accurate analysis/representation of the status quo at community level, that might escape to top-down approaches.

### **3. Applications of proposed methodology: results and benefits for building targeted resilience strategies at local level**

The RESILOC Community Vulnerability Indexes are the result of a participatory process that engaged project end-users (i.e., pilot local communities) in both data collection process and assessment. Starting from a standard set of indicators and related proxies (i.e., quantitative, and qualitative variables), aggregated in five dimensions (social, economic, institutional, human capital, environmental) each pilot Community was requested to select the most relevant ones and to attribute different weights among those considered relevant (i.e., medium and high). The vulnerability relative indexes were then calculated, based on available statistical data, as well as on qualitative variables gathered from end-users. Vulnerability community scores have been calculated for involved pilots (i.e., municipalities) in a relative perspective, against their area of reference (i.e., neighbouring communities).

Ultimately, snapshots of community vulnerability were developed for each pilot, representing an initial ‘needs assessment’ at local level, enabling the identification of ‘vulnerability areas’ upon which building a resilience-strengthening strategy perspective. An example of such snapshot is provided in Figure 1, while Figure 2 provides an example of visual representation of a Relative Social Vulnerability Index, performed in more than 300 contiguous communities within the Turin Metropolitan City area (2019, RESBA, Interreg Alcotra Project).



**Figure 1 - Example of visual representation of a Relative Social Vulnerability index in contiguous communities, ReSBA Project, Interreg Alcotra, 2019**

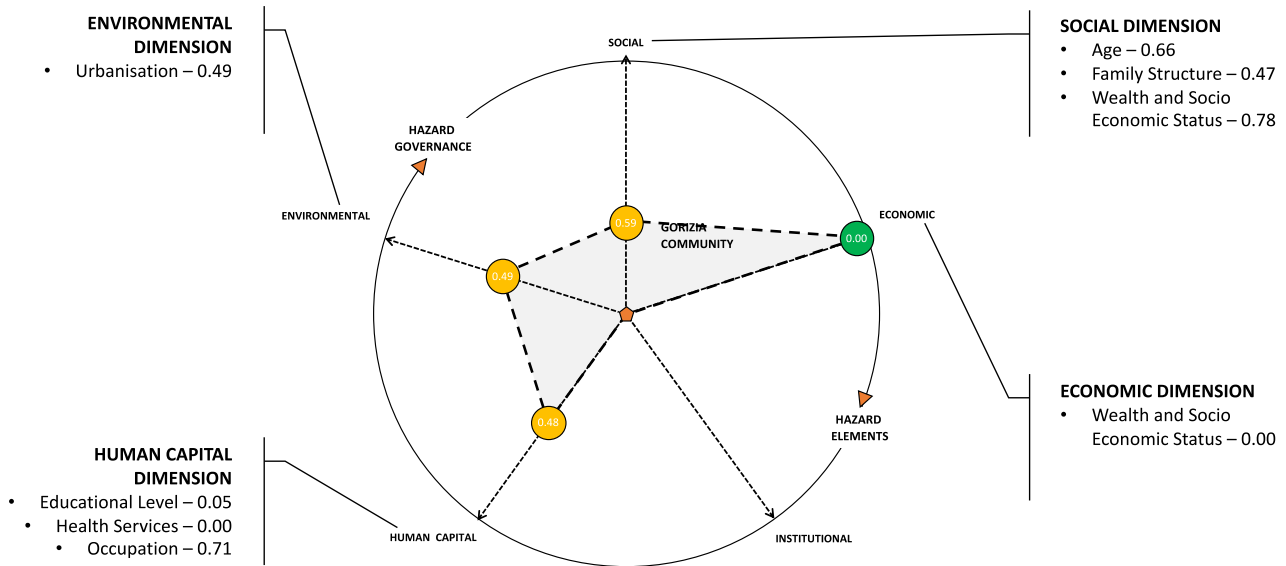


Figure 2 - Example of Vulnerability Snapshot at local level - indication of variables scores per each dimension.

### 3.1. FirEURisk Project –relative perspective and participatory approach towards analysing in social vulnerability of communities to wildfire

Building on the previous experiences of constructing relative indexes of vulnerability, within the framework of FirEURisk project, the direct and indirect effects of fire on people’s lives, and more generally, communities, will be analysed based on a methodological framework that:

- Identifies 5 dimension shaping the community and in terms of which vulnerability is assessed.
- Entails a relative approach, in which the ‘vulnerability’ of a community is analysed in comparison with other similar units of analysis.
- Integrates the role of community experts in the selection of the vulnerability indicators and proxies, as well as in the assessment of their relevance for the specific context.
- Integrates ‘local knowledge’ and ‘context-related’ insights within the calculation of the indexes, as variables are weighted according to the assessed level of relevance for the context at stake.
- Indexes allow for depicting the Vulnerability Framework of a Community based on static elements (i.e., statistical data), while expert interviews will allow for the integration of the “dynamic” components of the analysed communities.

Beyond the analysis of susceptibility to fire impacts, the methodology aims to support local communities in analysing their vulnerability to wildfire as a starting point for designing and implementing strategies that aim to strengthen adaptive capacities and overall resilience at the local level.

## 4. Conclusions

The literature review presented in this paper provides a glance on the extensive, yet diverse, theoretical basis for the definition of wildfire social vulnerability assessment methodologies at a local level. The paper argues that, in order to encompass the complexity of a relative, multi-dimensional, multi-scalar, temporally and spatially dynamic concept such as (social) vulnerability, the assessment processes must be implemented with a great degree of context-awareness, and eventually with the direct involvement of analysed communities.

The issue of vulnerability multi-scalar dimension(s) needs to be further investigated in order to develop effective ways to embed in the same assessment framework qualitative and quantitative information, which very often are collected on different scales and with different granularities (as illustrated in Burton, Rufat, & Tate, 2018).

Moreover, the analysed literature suggests that correlations among different elements characterising “social spaces” in terms of impact on the system exposure, sensitivity and adaptive/coping capacity, play a relevant role in increasing or lowering wildfire social vulnerability. From this perspective, the application of the Forest

Fire Circle model (Tàbara, Saurí, & Cerdan, 2003) might be useful to take into account the relevance of these relationships in wildfire social vulnerability assessment methodologies.

FirEURisk project provides for the fertile ground in which to further explore the integration of multi-scalar dimension in social vulnerability assessment, as well as for consolidating participatory approaches towards vulnerability assessment across the five project pilot sites.

## 5. Disclaimer

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## 6. References

- Adger, W. (2006). Vulnerability. *Global Environmental Change*, 16(3), 268-281.
- Ager, A., Preisler, H., Arca, B., Spano, D., & Salis, M. (2014). Wildfire risk estimation in the Mediterranean area. *Environmetrics*. doi:10.1002/env.2269
- Barnett, J., Lambert, S., & Fry, I. (2008). The Hazards of Indicators: Insights from the Environmental Vulnerability Index. *Annals of the Association of American Geographers*, 98(1), 102-119.
- Birkmann, J., Cardona, O., Carreño, M., Barbat, A., Pelling, M., Schneiderbauer, S., . . . Welle, T. (2013). Framing vulnerability, risk and societal responses: The MOVE framework. *Natural Hazards*, 67(2), 193-211.
- Burton, C., Rufat, S., & Tate, E. (2018). Social Vulnerability. In S. Fuchs, & T. Thaler, *Vulnerability and Resilience to Natural Hazards* (p. 53-81). Cambridge: Cambridge University Press.
- Costafreda-Aumedes, S., Comas, C., & Vega-Garcia, C. (2017). Human-caused fire occurrence modelling in perspective: a review. *International Journal of Wildland Fire*, 26, 983-998. doi:https://doi.org/10.1071/WF17026
- Cutter, S. (2016). Resilience to What? Resilience for Whom? *The Geographical Journal*, 182(2), 110-113.
- Cutter, S. (2018). Linkages between Vulnerability and Resilience. In S. Fuchs, & T. Thaler, *Vulnerability and resilience to natural hazards* (p. 257-270). Cambridge University Press.
- Cutter, S., Boruff, B., & Shirley, W. (2003). Social Vulnerability to Environmental Hazards. *Social Science Quarterly*, 84(2), 242-261.
- Cutter, S., Burton, C., & Emrich, C. (2010). Disaster Resilience Indicators for Benchmarking Baseline Conditions. *Journal of Homeland Security and Emergency Management*, 7(1).
- Fekete, A. (2019). Social Vulnerability (Re-)Assessment in Context to Natural Hazards: Review of the Usefulness of the Spatial Indicator Approach and Investigations of Validation Demands. *Journal of Disaster Risk Science*, 10(2), 220-232.
- Fekete, A., & Montz, B. (2018). Vulnerability. In S. Fuchs, & T. Thaler, *Vulnerability and Resilience to Natural Hazards* (p. 14-31). Cambridge: Cambridge University Press.
- Fernandes, P. (2013). Fire-smart management of forest landscapes in the Mediterranean basin under global change. *Landscape and Urban Planning*, 110, 175-182. doi:http://dx.doi.org/10.1016/j.landurbplan.2012.10.014
- Fuchs, S., & Thaler, T. (2018). *Vulnerability and resilience to natural hazards*. Cambridge University Press.
- Füssel, H.-M. (2007). Vulnerability: A generally applicable conceptual framework for climate change research. *Global Environmental Change*, 17(2), 155-167.
- Guillard-Gonçalves, C., Cutter, S., Emrich, C., & Zêzere, J. (2015). Application of Social Vulnerability Index (SoVI) and delineation of natural risk zones in Greater Lisbon, Portugal. *Journal of Risk Research*, 18(5), 651-674.
- Hinkel, J. (2011). Indicators of vulnerability and adaptive capacity: Towards a clarification of the science-policy interface. *Global Environmental Change*, 21(1), 198-208.
- Jucker Riva, M., Baeza, J., Bautista, S., Christoforou, M., Daliakopoulos, I., Hadjimitsis, D., . . . Schwilch, G. (2018). How does land management contribute to the resilience of Mediterranean forests and rangelands? A participatory assessment. *Land degradation & development*, 29(10), 3721-3735.

- Leone, V., Koutsias, N., Martínez, J., Vega-García, C., & Allgöwer, B. (2003). The Human Factor in Fire Danger Assessment. In *Wildland fire danger estimation and mapping: the role of remote sensing data* (p. 143-196).
- Leone, V., Lovreglio, R., Martín, M., Martínez, J., & Vilar, L. (2009). Human factors of fire occurrence in the Mediterranean. In *Earth observation of wildland fires in Mediterranean ecosystems* (p. 149-170). Berlin: Springer.
- Martínez, J., Vega-García, C., & Chuvieco, E. (2009). Human-caused wildfire risk rating for prevention planning in Spain. *Journal of Environmental Management*(90), 1241-1252. doi:doi:10.1016/j.jenvman.2008.07.005
- Moritz, M., Batllori, E., Bradstock, R., Gill, A., Handmer, J., Hessburg, P., . . . Syphard, A. (2014). Learning to coexist with wildfire. *Nature*, 515, 58-66. doi:doi:10.1038/nature13946
- Prior, T., & al. (2017). *Risk and Resilience Report. Mapping Social Vulnerability in Switzerland.*. Centre for Security Studies.
- Tàbara, D., Saurí, D., & Cerdan, R. (2003). Forest Fire Risk Management and Public Participation in Changing Socioenvironmental Conditions: A Case Study in a Mediterranean Region. *Risk Analysis*, 23(2), 249-260.
- Vallejo-Villalta, I., Rodríguez-Navas, E., & Márquez-Pérez, J. (2019). Mapping Forest Fire Risk at a Local Scale—A Case Study in Andalusia (Spain). *Environments*, 6(30), 1-22. doi:doi:10.3390/environments6030030