



Incorporating stakeholders' knowledge into flood vulnerability assessment: a multi-criteria approach

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The management of flood risk calls for a better understanding of vulnerability, as hazards only become disasters if they impact a system that is vulnerable to their effects. Although different frameworks have been proposed to assess vulnerability, they often focus on the physical vulnerability of structures, assuming a homogeneous social vulnerability and coping capacity for the entire population. Furthermore, the multiple relationships between input criteria are often neglected and the role of stakeholder participation in the modeling process has received little attention.

To tackle these issues and increase the model transparency, a participatory approach was developed to assess the vulnerability to floods while considering the relationships between the coping capacity, social vulnerability and structural criteria. The applicability of the proposed framework was demonstrated in the municipalities of Lajeado and Estrela, southern Brazil. The approach relies on constant stakeholders' engagement in the main stages of the index development, including the criteria selection, weighting and standardization, as well as the index structuration and validation. For this purpose, participatory methods such as the Delphi technique, focus groups, workshops, and questionnaires were used. A total of 101 expert stakeholders from governmental organizations, universities, research institutes, NGOs, and private companies participated in the process. The preferences of each participant regarding the criteria importance were defined through the Analytical Network Process (ANP) multi-criteria method, which can incorporate feedback and interdependence relationships.

The final product is a set of individual and group flood vulnerability maps. The validation questionnaire indicated that the participants found the results clear, trustworthy, and valuable, suggesting that participatory modelling activities like the one proposed here are worthwhile. 89% were very satisfied and 11% were satisfied with the transparency of the process and with the feedback received. All respondents found the resulting maps very useful or useful for their professional activities. This finding becomes even more relevant when considering that several respondents work for the local Civil Defense and the National Center for Monitoring and Early Warning of Natural Disasters, thus, exerting a great influence over decisions related to flood risk management in the region.

The results highlight that to enhance the credibility and deployment of model results, multiple viewpoints should be integrated without forcing consensus. The approach proposed herein is particularly novel in the context of vulnerability assessment in the respect that stakeholders were actively involved in all steps of the vulnerability modelling process and that the relationship between criteria was considered. The use of participatory tools to integrate interdisciplinary knowledge led to an increased, shared understanding of the problem by avoiding the limited perspective of a single expert. In addition, it allowed transforming implicit and tacit knowledge into information useful for vulnerability modelling.