



Urban Vulnerability Assessment to Seismic Hazard through Spatial Multi-Criteria Analysis. Case Study: the Bucharest Municipality/Romania

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In the context of an explosive increase in value of the damage caused by natural disasters, an alarming challenge in the third millennium is the rapid growth of urban population in vulnerable areas. Cities are, by definition, very fragile socio-ecological systems with a high level of vulnerability when it comes to environmental changes and that are responsible for important transformations of the space, determining dysfunctions shown in the state of the natural variables (Parker and Mitchell, 1995, The OFDA/CRED International Disaster Database). A contributing factor is the demographic dynamic that affects urban areas.

The aim of this study is to estimate the overall vulnerability of the urban area of Bucharest in the context of the seismic hazard, by using environmental, socio-economic, and physical measurable variables in the framework of a spatial multi-criteria analysis. For this approach the capital city of Romania was chosen based on its high vulnerability due to the explosive urban development and the advanced state of degradation of the buildings (most of the building stock being built between 1940 and 1977). Combining these attributes with the seismic hazard induced by the Vrancea source, Bucharest was ranked as the 10th capital city worldwide in the terms of seismic risk.

Over 40 years of experience in the natural risk field shows that the only directly accessible way to reduce the natural risk is by reducing the vulnerability of the space (Adger et al., 2001, Turner et al., 2003; UN/ISDR, 2004, Dayton-Johnson, 2004, Kaspersen et al., 2005; Birkmann, 2006 etc.). In effect, reducing the vulnerability of urban spaces would imply lower costs produced by natural disasters.

By applying the SMCA method, the result reveals a circular pattern, signaling as hot spots the Bucharest historic centre (located on a river terrace and with aged building stock) and peripheral areas (isolated from the emergency centers and defined by precarious social and economic conditions). In effect, the example of Bucharest demonstrates how the results shape the 'vulnerability to seismic hazard profile of the city, based on which decision makers could develop proper mitigation strategies. To sum up, the use of an analytical framework as the standard Spatial Multi-Criteria Analysis (SMCA) – despite all difficulties in creating justifiable weights (Yeh et al., 1999) – results in accurate estimations of the state of the urban system. Although this method was often mistrusted by decision makers (Janssen, 2001), we consider that the results can represent, based on precisely the level of generalization, a decision support framework for policy makers to critically reflect on possible risk mitigation plans. Further study will lead to the improvement of the analysis by integrating a series of daytime and nighttime scenarios and a better definition of the constructed space variables.