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Territorial Vulnerability. From an Interdisciplinary Systematic Literature Review to a Compounded Index

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UNVEIL Project



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Understanding vulnerability to Expand Insight on Local units



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Aims:

- ▶ Assessment of the **vulnerability of territories** (Italian municipalities)
- ▶ Conceptualization of vulnerability across **three main dimensions** (environmental, socio-economic, political-Institutional)
- ▶ Build an aggregate index (**ESPIV index**) to measure and monitor vulnerability of local units



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SYSTEMATIC LITERATURE REVIEW (1)

Why? (Petticrew and Roberts 2006; Dacombe 2018)

- Assess how territorial vulnerability has been discussed, **operationalized**, and **measured** by previous research
- Track studies across disciplines
- Identify **gaps** in the literature

PRISMA Protocol (Carrera-Rivera et al. 2022; Moher et al. 2015)

- Different steps: planning, conducting and refining, data extraction, displaying of the results
- Pre-determined inclusion/exclusion criteria



260 journal articles published in English between January 2008 and December 2023 which **empirically** investigate the concept of **territorial vulnerability** and/or resilience



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SYSTEMATIC LITERATURE REVIEW (2)

Main findings:

- ▶ **Intertwined relationship** between the three main dimensions of territorial vulnerability (socio-eco, environmental, political-institutional)
- ▶ Yet, the political-institutional dimension is less investigated
 - Mainly studied at the country level
 - No agreed-upon definition
 - Few papers analyze its determinants and effects
 - Few political indicators incorporated in the indices
- ▶ There are no unique and agreed-upon measures and methods to assess the vulnerability of a territory
- ▶ No overall vulnerability
- ▶ **! Indicators are specific to the crisis/hazard/risk studied**



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FROM THE SLR TO A NOVEL INDEX

- ▶ Territorial level: **Italian municipalities**
- ▶ Three challenges → Three new indices
 - Health hazards
 - Economic and financial crises
 - Hydrogeological risk
- ▶ Three dimensions of territorial vulnerability
 - Socio-economic
 - Environmental
 - **Politico-institutional**
- ▶ Two components
 - **Potential conditions** (exposure and sensitivity)
 - **Adopting and coping capacities** (characteristics, intervention and mitigation strategies)

Ex. Vulnerability to health crises index

Socio-eco

Potential conditions

- Total population
- Age of the population
- Immigration
- Health status
- Education
- Economic status
- Housing quality
- Household size

Adaptive and coping capacities

- Education
- Economic status
- Employment status
- Infrastructures
- Vehicles
- Housing quality

Environmental

Potential conditions

- Density
- Green coverage
- Air quality

Adaptive and coping capacities

- Proximity to services

Political-inst.

Potential conditions

- Health coverage
- Health services supply pressure

Adaptive and coping capacities

- Health services
- Quality of institutions
- Government effectiveness
- Emergency preparedness
- Economic resources



THE CONSTRUCTION OF THE INDICES (1)

(Mazziotta and Pareto 2013)

1 Selection of the indicators

- Relevance (previous studies + novel indicators)
- Data available at the municipal level
 - * Regional data?
 - * Regional dummies?
 - * Average when data is available over a period of 5/10years?

2 Classification of indicators

by dimension and by component

3 Normalization of the indicators (Mazziotta and Pareto 2021)

- For harmonization of the data
- But also to control for the positive/negative influence of each factor on the vulnerability of a territory
- Min-max transformation



THE CONSTRUCTION OF THE INDICES (2)

(Mazziotta and Pareto 2013)

4 Aggregation

1. **By component**

- Indicators are substitutable → compensatory aggregation method (Mazziotta and Pareto 2013)
- Principal Component Analysis (PCA) to weigh each indicator for its variability

2. **By dimension**

- Indicators are non-substitutable → non-compensatory aggregation method (Mazziotta and Pareto 2013)
- Geometric mean

3. **Overall index** aggregating the sub-indices



THE CONSTRUCTION OF THE INDICES (3)

- * Some factors **influence both potential conditions and the adaptive and coping capacities** → How to treat them during the aggregation step?
 - (1) Aggregate only by dimension
 - (2) Calculate them only in the component in which they have a higher impact
 - (3) Consider them in both components
- * Should we **weigh dimensions differently** when calculating the overall index?
 - Different influence according to the risk/hazard observed (ex. More relevance to socio-economic dimension when vulnerability to health risks and economic crises; to environmental dimension for vulnerability to hydrogeological hazard)
- * Or weight by their variance (Lapietra et al. 2023)



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