Multi-criteria decision making in flood risk management: research progress and the challenge of handling uncertainty and stakeholder participation

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Flood decision making tends to be complex and uncertain. These problems can benefit from the use of multi-criteria decision making (MCDM) tools.

- ranking and/or weights
- multiple stakeholders
- multiple criteria
- conflictive objectives
- can be integrated in GIS
Since the 90s MCDM has been successfully applied:

1. Introduction

**Selection of mitigation measures (Evers et al. 2012)**

**Risk assessment (Meyer et al. 2009)**

**Reservoir flood control (Alipour 2015)**

Despite practical experiences and methodological advances, **no literature review** explores the use of MCDM to flood risk management.
This study reviews applications of MCDM to flood risk management, seeking to assess emerging trends and identify issues for further research.
3. Results

3.1. Trends by year of publication

- growing awareness of disaster prevention
3. Results

3.2. Trends by MCDM method

- AHP, fuzzy AHP and ANP: 43%
- TOPSIS and fuzzy TOPSIS: 12%
- ELECTRE I, II, III and TRI: 13%
- MAUT and MAVT: 13%
- VIKOR and fuzzy VIKOR: 6%
- PROMETHEE I and II: 6%
- CP, spatial CP and fuzzy CP: 4%
- SAW: 3%
- Others: 2%
- Others: 2%
3. Results

3.3. Trends by area of application

- Alternative ranking: 22%
- Hazard assessment: 15%
- Vulnerability assessment: 15%
- Reservoir control: 5%
- Risk assessment: 21%
- Susceptibility assessment: 12%
- Coping capacity: 6%
- Emergency management: 4%
3. Results

3.4. Trends by country of application

- Asia: 50%
- Europe: 35%
- North America: 8%
- Africa: 4%
- Australia: 1.5%
- South America: 1.5%
3. Results

3.5. Trends regarding uncertainty and sensitivity analysis

Uncertainty in MCDM:
- selection of the method
- structuration of the problem
- identification of evaluation criteria
- assessment of the objectives weights

8 papers (6.25%) performed uncertainty analysis
3. Results

3.5. Trends regarding uncertainty and sensitivity analysis

35 papers (27.34%) performed sensitivity analysis of the criteria weights
3.6. Trends regarding stakeholders’ involvement

50.78% reported the participation of multiple actors

Participation was **fragmented** and restricted to specific stages (e.g. selection of evaluation criteria and the definition of weights)

Only 4 studies seek to **obtain consensus** in which participants take decisions by agreement rather than by majority vote.
3.6. Trends regarding stakeholders’ involvement

43 out of 65 studies described the participatory techniques applied.
4. Conclusion

- MCDM have a good vitality and acceptance in the literature.
- The involvement of multiple stakeholders was fragmented.
- Shortcomings remain in the application of uncertainty analysis.
- Greater rigor in addressing the uncertainties around stakeholders’ judgments as well as in endorsing an active participation in all stages of the decision-making process should be undertaken in future applications. This could help to increase the quality of decisions and subsequent implementation of chosen measures.
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