Flood risk and water resources management with nature-based solutions on Florence city environment

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• Integrated approach for planning NBS interventions in urban areas
• Evaluation of NBS multifunctionality through ES indicators
• Characterization of NBS use for hydraulic risk mitigation and water resources management

Source: www.flickr.com/photos/la-citta-vita/4749837642
The following slides have been produced thanks to the work of the entire team working on the Florence Project. The project was financed in 2019 by Fondazione Cassa di Risparmio under a dedicated programme to support academic research.
1. Mapping Ecosystem Services priority areas (main function and cobenefits) and constrains.
2. Multicriteria Analysis
3. Preliminary evaluation of suitable sites for NBS implementation.

Evaluation of **Ecosystem Services** and definition of **indicators** to identify the most suitable areas for NBS’s installation.

**Ecosystem Services:** benefits people obtain from ecosystems (MAE, 2005)

- **Provisioning services**
- **Regulating services**
- **Supporting services**
- **Cultural services**

Source: WWF Living Planet Report 2016
Based on a literature review of the main ES associated to NBS and the analysis of the context of the urban environment of the city of Florence, the following ES have been considered.
MULTICRITERIA ANALYSIS

A multicriteria analysis on the indicators that characterize runoff mitigation and flood control (emerged as the main issue to be solved) is carried out to select the most critical areas.
Assessment of the Social Vulnerability Index of Municipality of Florence

Although different groups of society are exposed to a natural risk in a similar way, the risk has different consequences since diverse are the skills and the abilities to react to a danger. An index that evaluate the social vulnerability to floods for the Municipality of Florence, is proposed on the basis of the major factors that influence social vulnerability. The most suitable proxy variables are selected from data of Italian National Institute of Statistics (Census 2011), statistical yearbooks of the Municipality of Florence and other pertinent data.

SELECTED REFERENCES


**MULTICRITERIA ANALYSIS**

**Tree decision making**

**Nature Based Solutions site selection**

- Constructing decision making tree

**FACTORS**

- BENEFITS
  - Imperviousness
  - Hydrologic Class
  - SVI

- COSTS
  - Slope
  - Density Drainage

**CONSTRAINTS**

- Slope $\geq 10\%$
- Fluvial areas

**CONSTRAINTS**
Criterion that determines which areas should be considered as absolutely NOT suitable.

**FACTORS**
Criterion that contributes to a certain degree to the output (suitability)

- **Benefit criteria**: contributes positively to the output: the more you have, the better it is
- **Cost criteria**: contributes negatively to the output: the less you have, the better it is
Development of different test scenarios for the identification of a pilot area:

**SCENARIO 0**

*AHP Matrix – CR = 0 < 1*

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**Weight**

- Imperviousness – 0.200
- Slope – 0.200
- Hydrologic Soil Class – 0.200
- Density Drainage – 0.200
- Social Vulnerability Index – 0.200
Development of different test scenarios for the identification of a pilot area:

**SCENARIO 1**

*AHP Matrix – CR = 0.069 < 1*

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**Weight**
- Imperviousness – 0.267
- Slope – 0.460
- Hydrologic Soil Class – 0.112
- Density Drainage – 0.090
- Social Vulnerability Index – 0.071
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**MULTICRITERIA ANALYSIS**

Results validation by developing an archive analysis of the pluvial flood events occurring in Florence.

**SCENARIO 1 – Area pilota 1**

Svincolo Peretola (Viale Guidoni in entrata alla città)


Source: [https://www.quinewsfirenze.it/una-barriera-di-acqua-tra-firenze-e-prato.htm](https://www.quinewsfirenze.it/una-barriera-di-acqua-tra-firenze-e-prato.htm)
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NEXT STEPS

Hydraulic modelling of the selected pilot area, simulating the effects of introducing a Sustainable Urban Drainage System (SUDS).

BIO-RETENTION CELL

RAIN GARDENS

GREEN ROOF

INfiltration TenCh

PERMEABLE PAVEMENT

RAIN BARREL

ROOFTOP DISCONNECTION

VEGETATIVE SWALE