A systemic approach to micro-scale flood adaptation: opportunities and challenges in peri-urban areas.

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sktodowska-Curie grant agreement No 101034328. This publication reflects only the author's view and the Research Executive Agency is not responsible for any use that may be made of the information it contains.

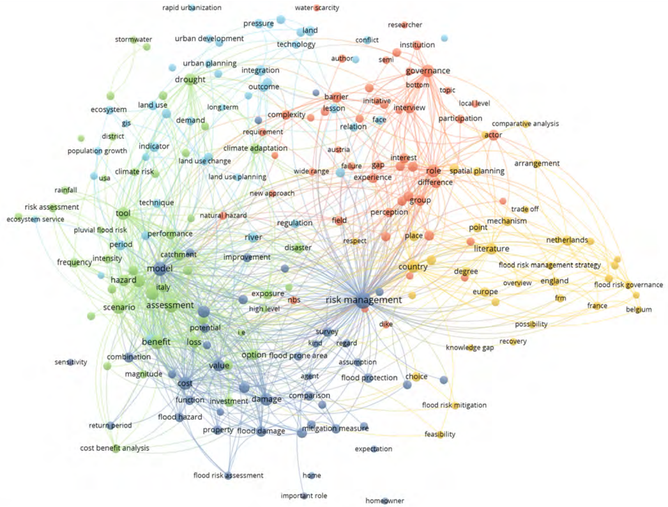


Fig. 1 (right): thematic areas of research database (VosViewer). Risk management (blue); FRM (red); urban development (light blue); risk management (green); FRM cases (yellow).
Fig. 2 (below): systematic literature review methodology (Raikes et al., 2019).

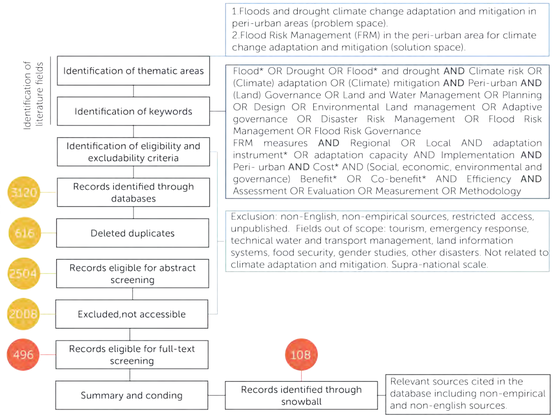


Fig. 3 (top left): different multi-scalar levels, divided in macro, meso and micro levels and including hydrographic systems, administrative and urban systems.
Fig. 4 (top right): implications of a multi-scalar perspective.
Fig. 5 (below:) philosophies around equitable climate change adaptation and assessment methods (based on Meyer and Roser (2006); Adler and Treich, 2015; Kreibich et al., 2015; Röthlisberger et al., 2017, among others).

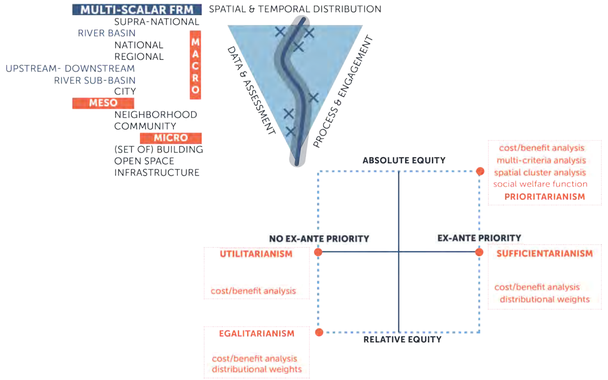
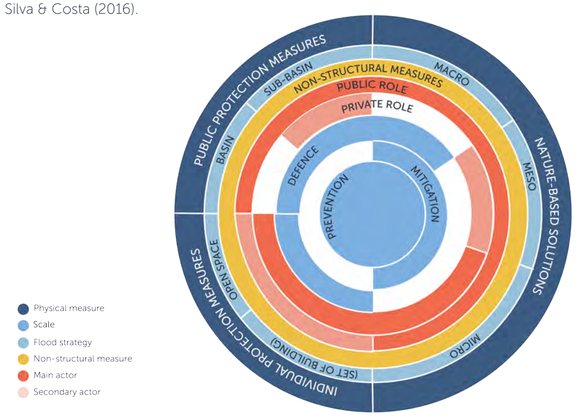


Fig. 6: testing visualization of pre-disaster multi-scalar FRM measures. The measures are grouped in public protection measures, individual protection measures and NBS (Rehan, 2018). Measures can be employed in combination as they contribute to one (or more) strategy. Preparedness activities are continuous across the disaster cicle. Adapted by Matos Silva & Costa (2016).



INTRODUCTION - The poster presents the results of a systematic literature review, part of doctoral research, supervised by Politecnico di Milano (POLIMI) in Italy, and the Royal Melbourne Institute of Technology (RMIT) in Melbourne, Australia, under the MSCA-cofunded RMIT European Doctoral Innovators (REDI) program. The research project deals with strategies for flood adaptation and mitigation, aiming to define (1) assessment tools supporting decision-makers in identifying effective strategies across scales and (2) governance and codesign approaches for their application.

RESEARCH TOPIC - The research investigates the problematization around the adaptation and mitigation of water-related extreme events in peri-urban areas. Followingly, it examines Flood Risk Management (FRM) strategies, bridging between social science, risk assessment, architecture, and planning; and, lastly, the set of measures that are implemented across different scales; assessment methods and case studies.

METHODOLOGY - The systematic literature review analyzes the state of the art of thematic areas (Fig. 1 and Fig. 2), with an explorative approach, building on a set of keywords. We use the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) approach. The literature review is conducted between November 2022 and May 2023, firstly through Scopus and Web of Science; secondly, by scanning the reference list of the relevant papers and through the databases of the project partners. The database accounts for a total of 604 sources.

FINDINGS - Climate change is proceeding at a fast pace, significantly modifying the hydrological cycle, and increasing the occurrence and strength of water-related extreme events. The approach towards flood has shifted from crisis management to risk management. FRM involves various strategies: prevention, defence, mitigation, preparation, and recovery (Dieperink et al., 2016), resulting in different measures. Despite hard infrastructural solutions being linked to a failure threshold and with high resource requirements, green solutions' uptake remains limited and small-scale due to institutional, financial, and procedural barriers. Individual protection measures are being promoted, to increase private coping capacity and tackle residual risk locally. Nevertheless, it is very difficult to assess the efficiency, costs and benefits of a set of measures at the system level, across different scales (Fig. 3). In addition, upstream low-density urbanized areas are key to climate adaptation as they provide flood regulation services and benefits to urban areas, but remain a difficult target for climate adaptation solutions (Winter and Karvonen, 2021). This tension between scales (Fig. 4) calls for a theoretical debate, on who should be responsible for climate adaptation and how to ensure equitable benefits distribution. Various philosophical positions around adaptation are presented in literature (Fig. 5), leading to the use of different assessment methods with implications on the spatial distribution of costs and (co-)benefits. As research output, FRM measures are mapped and grouped into four categories: structural, non-structural, nature-based and individual protection measures. The last two include micro-scale flood adaptation measures (Fig. 8), transforming the built environment in the interface between public and private actions. We highlight the need to take a multi-scalar approach towards FRM, understanding the contribution of a combination of FRM measures across scales (Barendrecht et al., 2020, 2021; Kreibich et al., 2015; Rehan, 2018).

NEXT STEPS - The research tests an analytical framework, where interdependencies between FRM strategies, measures and actors are presented (Fig. 6); co-designed FRM scenarios (Fig.7); a multi-scalar assessment strategy for decision making; a governance strategy to support FRM measures uptake and increase public and private adaptation capacity.

Fig. 7 (right):
Scenario BAU-A: low density upstream area prone to flood.
Scenario BAU-B: flooding occurrence
Scenario C: public adaptation strategies (red)
Scenario D: a combination of public adaptation strategies (red) and micro-scale solutions (green and blue).

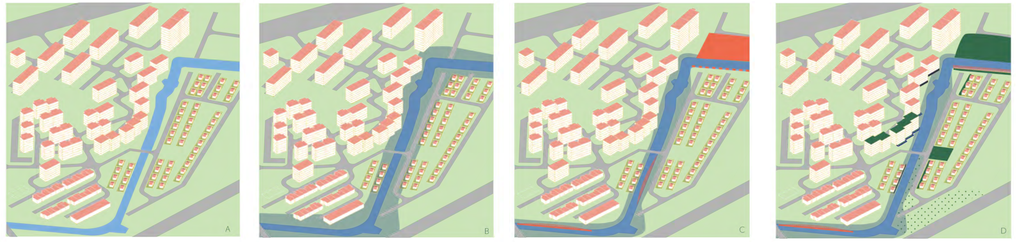


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Fig. 8 (below): mapped micro-scale FRM strategies and case studies. The list of measures doesn't aim to be completed but to provide an overview of solutions and broad categories.

Pluvial flooding · Fluvial flooding · (Set of) buildings · Open space