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A systematic analysis of Horizon 2020 Nature-Based adaptation Solutions projects

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With the advances of the Nature-Based Solutions (NBS) concept, much attention is being given to its potential for climate change adaptation. Accordingly, Nature-Based adaptation Solutions (NBaS) have become central elements for action on climate. In the EU, the Horizon 2020 (H2020) program translates the ambition of positioning Europe as the world's leader in NBS. In an effort to draw a comprehensive roadmap of these efforts, this study investigates 21 H2020 projects that utilize NBaS throughout different ecosystems. The main objectives of this study are to provide an inventory of current knowledge, to extract identified risks and knowledge limitations, and to propose future research orientations.

For this purpose, the CORDIS database was used to identify the relevant projects. Using the keyword nature-based solutions and through a rigorous search of research topics and programs, the following projects were retained (based on the existence of deliverables at the time of this study): CLEARING HOUSE, CLEVER Cities, Connecting Nature, DRYvER, EdiCitNet, EuPOLIS, FutureMARES, GrowGreen, NAIAD, Nature4Cities, NATURVATION, OPERADNUM, PHUSICOS, proGIreg, RECONECT, REGREEN, RENATURE, ThinkNature, UNaLab, Urban GreenUP and URBiNAT. Consequently, 137 deliverables were individually examined. Numerous findings were then obtained. These were divided into general and specific results.

In terms of general results, the definition of the NBS concept is still debated: some projects adopt the EC's definition, others compare between the EC's and the IUCN's definition, while many reformulate their own. Second, the continental geographical gradient of pilot sites follows a dense South-West orientation in contrast to a less developed North-Eastern line. In terms of target ecosystems, 61% of the projects target the urban realm, while freshwater ecosystems come second. The coastal, natural and mountainous environments are the least addressed. The focus on urban systems makes most of the generated knowledge, designed solutions and monitoring methods more or less restricted to this realm, hence not necessarily applicable in other settings. Regarding climatic challenges, urban heat islands and floods came first. These are followed by sea level rise, intense precipitation, heat stress, storms, erosion and landslides.

In terms of specific findings, current knowledge and limitations were grouped in-depth per ecosystem (urban, freshwater, marine-coastal, mountainous, forest-natural, and agricultural) and per main research topics (climate change adaptation, risks of oversimplification, system complexity, uncertainty, the scale quandary, progress measuring-monitoring, and disservices). On

this basis, several research perspectives were then proposed. Accordingly, interest in NBS-NBaS should extend beyond the urban ecosystem, while deeper knowledge on nature (the physical fundamentals of the N) in NBS-NBaS is needed. It is also important to understand if NBaS are intended to withstand weather change and/or climate change. For the implementation of wide-scale solutions, an extension beyond conservationism is needed, and a better accommodation of uncertainties is required. Therefore, understanding ecosystem tipping points, thresholds, and the resource efficiency of NBaS is primordial. Finally, it is crucial to acknowledge that both ecosystem development and climate change will keep progressing throughout the existence of NBaS. Therefore, the interacting co-evolution of ecosystems, NBaS and climate change should be further studied where their interaction could be forgotten.