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## Nature-based solutions: future research needs to meet the challenges of water management

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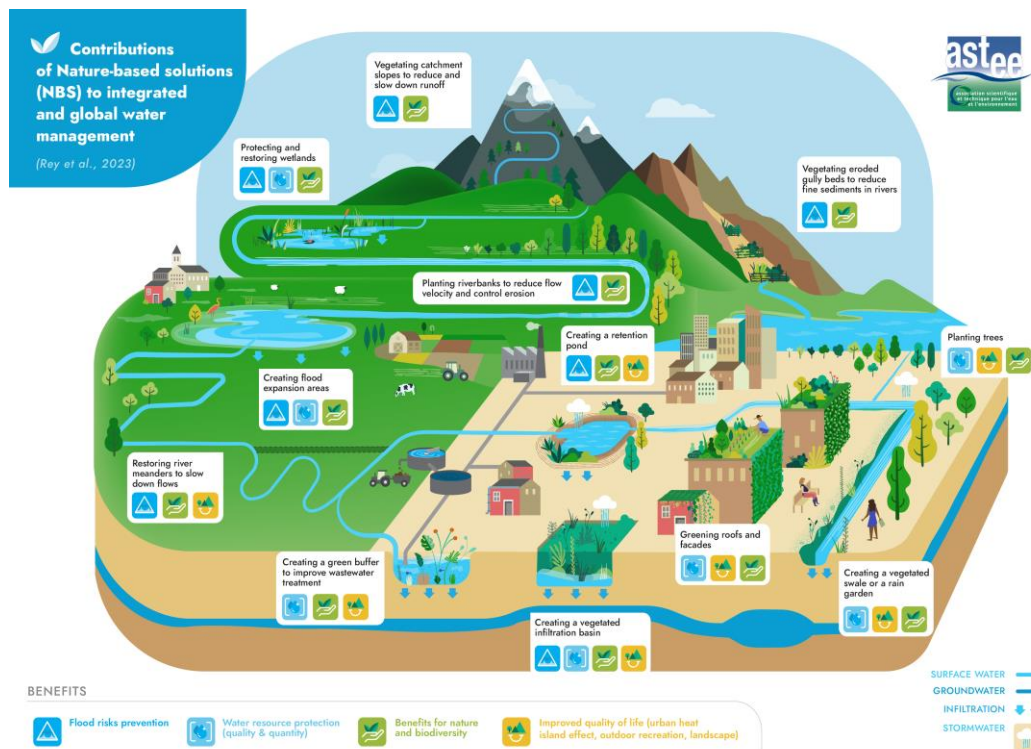
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**Abstract:** Nature-based solutions (NbS) are actions for the preservation, restoration and sustainable management of the natural environment that rely on the functioning of ecosystems to meet societal challenges. These co-benefits approaches deliver benefits for both nature and society, as one cannot be achieved without the other. In the field of water, whether to preserve its quality or reduce the inherent natural risks, the knowledge exists for implementing this type of solution, and extensive research is conducted. The aim of this presentation is to compile, discuss and bring to the fore these scientific developments and issues. Following a description of the NbS concept and of its application in the field of water, we present scientific approaches helping to balance gains for biodiversity and society in the global water cycle. A focus is placed on the preservation of water resources and the necessary interdisciplinary and transdisciplinary research is emphasised.

**Keywords:** nature based solutions; water management; research; practices

According to the International Union for Conservation of Nature (IUCN), which formalised and promoted the concept, Nature-based Solutions (NbS) are “*actions to protect, sustainably manage, and restore natural and modified ecosystems that address societal challenges effectively and adaptively, simultaneously benefiting people and nature*” (IUCN France, 2015). They benefit both biodiversity (a *sine qua non* condition) and human well-being. NbS comprise three types of actions: the preservation of functional ecosystems in good ecological condition, the restoration or improvement of degraded ecosystems, or the creation of ecosystems. These actions must address ecological, economic and social issues. Along with “ecosystem services” and “natural capital”, the NbS concept is seen as a way of rethinking spatial planning, resource management and socio-economic development.

NbS can help tackle many societal challenges (IUCN France, 2015). They have many applications in the water field and contribute to better-integrated and comprehensive water management (IUCN France, 2019) (Figure 1). Multidisciplinary performance indicators of NbS impacts have been developed to help decision-makers make informed choices (Dumitru and Wendling, 2021).



**Figure 1.** Contribution of NBS to integrated and global water management (Rey et al., 2023)

However, water professionals are currently raising many questions, among which: How effective are NbS? How can this be assessed? What are monitoring requirements before, during and after NbS implementation for their long-term adaptive management, operation and maintenance? What does this imply in terms of skills, professions, organisation and governance? What socio-economic approach can facilitate this? How can this process be appropriated by local authorities, citizens and users? What about the coherence of public policies and actions related to water management? These issues mobilise in particular researchers, who report existing results and identify new research needs. We propose to address them in this presentation. We will in particular show that they call for an interdisciplinary research, as targeted as possible, i.e. that produces and enhances knowledge to guide public policy, improve managers' knowledge and facilitate decision-making.

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