Nat4Wat: A web-based tool to select nature-based solutions for urban water management

Nat4Wat : un outil en ligne pour sélectionner des solutions fondées sur la nature pour la gestion de l'eau urbaine

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RÉSUMÉ

Nat4Wat est un outil d'aide à la décision en ligne conçu pour orienter le choix de solutions fondées sur la nature destinées à la gestion des eaux pluviales et au traitement de l'eau. L'outil structure la démarche à travers des scénarios définis par l'utilisateur, intégrant les caractéristiques de l'eau, les besoins de gestion et les contraintes locales. À partir de ces données, Nat4Wat propose différentes SFN — des toitures végétalisées aux bassins de rétention — en estimant la surface nécessaire et en évaluant leur multifonctionnalité, leurs contraintes opérationnelles et leurs coûts grâce à une analyse multicritère (MCDA). Il combine l'expertise scientifique et les retours d'expérience issus de cas réels, tant commerciaux que de recherche, validés avant publication. En conciliant rigueur technique et simplicité d'usage, Nat4Wat facilite l'adoption pratique des SFN et contribue à une gestion urbaine de l'eau plus durable et résiliente.

ABSTRACT

Nat4Wat is a web-based decision-support tool designed to guide the selection of nature-based solutions for stormwater management and water treatment. It structures the decision process through user-defined scenarios that integrate water characteristics, management needs, and contextual constraints. Based on these inputs, Nat4Wat suggests a range of NBS—from green roofs to detention ponds—by estimating their required surface and assessing their multifunctionality, operational constraints, and costs through multicriteria decision analysis. The tool combines expert knowledge with data from scientific literature and real-world cases contributed by companies and researchers. Each case is reviewed and presented to help users compare performance and implementation options. By merging technical rigor with accessibility, Nat4Wat fosters the practical adoption of NBS, supporting more resilient and sustainable approaches to urban water management.

KEYWORDS

decision-support system, multicriteria analysis, nature-based solutions, stormwater management, urban drainage

1 INTRODUCTION

Navigating the diverse array of nature-based solutions (NBS) for stormwater management and water treatment presents a considerable challenge, given the multitude of available options (Palermo et al., 2023). Each solution comes with its own set of characteristics, benefits, and considerations, making the decision-making process intricate. Factors such as local climate, soil conditions, infrastructure requirements, and project goals further contribute to the complexity. Selecting the most appropriate NBS demands a nuanced understanding of these variables and a thoughtful consideration of the unique challenges presented by each stormwater or sanitation scenario (Orta-Ortiz & Geneletti, 2022). Despite this complexity, the potential for sustainable and effective urban water management through NBS remains immense, emphasizing the need for informed decision-making in this evolving field.

In this communication, we focus on Nat4Wat as a user-friendly web-based tool to select NBS for stormwater management (https://nat4wat.icra.cat, (Pueyo-Ros et al., 2026). Nat4Wat includes structured scenarios, integrating diverse nature-based solutions for water management, guided by multicriteria decision analysis (MCDA), expert-based knowledge and empirical cases.

2 USER'S JOURNEY

The main entrance point of the tool is the creation of a scenario. In the context of Nat4Wat, a scenario refers to a comprehensive and structured set of information that encapsulates various aspects of water management. Each scenario within the tool consists of four integral components:

2.1 Water Characteristics and Management Needs

This initial part outlines essential information, including the specific characteristics of the water in question (e.g., greywater, rainwater, raw wastewater) and the management requirements. When rainwater, runoff water or combined sewer overflow discharge water are selected, the options for stormwater management NBS are enabled. The user can optionally provide the following information:

- The accumulated rain for the event of interest.
- The catchment area (in case of CSO discharge water, total volume must be provided instead of rain and catchment area).
- The duration of the rain or discharge.
- The diameter of the drainage pipe, if not provided, it is assumed that there is not drainage pipe.
- The infiltration rate of the receiving soil in mm/s. If not provided, it is assumed that no infiltration is possible. Then, NBS without storage capacity are rejected.

Additionally, the user can provide other requirements regarding multifunctionality, surface availability, and operational constraints.

2.2 List of Potential Nature-based Solutions

The tool generates a thorough list of potential NBS that align with the specified water characteristics and management needs. This ensures a diverse array of options, ranging from household-scale solutions like green roofs to larger-scale interventions such as ponds or detentions basins. Each NBS contains information about the ecosystem services provided (on a scale from 0 to 3), operational constraints and, if enough information is provided, the surface required to handle the volume.

The surface is estimated with a flow-balance equation as follows:

$$Q = A(\phi K_t t'_0 + K_s t'_1) + Q_d t'_1 \qquad \begin{array}{c} if\ K_t t \le H\ then\ t'_o = t\ and\ t'_1 = 0 \\ otherwise, t'_o = \frac{H}{K_t}\ and\ t'_1 = t - t'_o \end{array} \qquad \text{(eq. 1)}$$

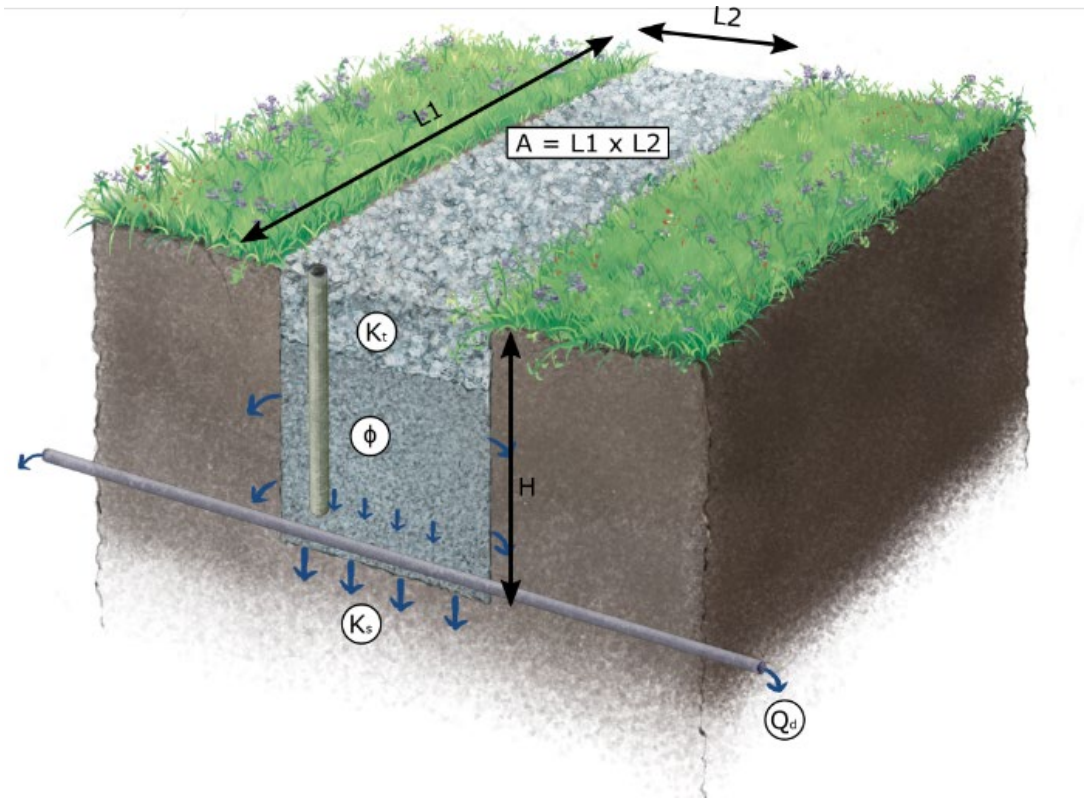

Figure 1.Illustration of equation parameters in a bioretention cell ***(Jaurrieta et al., 2024)***

where:

- Q: Volume at the time *t* that the NBS can retain or infiltrate (m^3).
- A: surface of the NBS (m^2)
- K_t: Hydraulic conductivity of the NBS' layers (m/s). When the NBS stores water in a superficial layer, this is assumed as 10 m/s.
- K_s: Hydraulic conductivity of the receiving soil (m/s).
- t: duration of the rain event (s)
- ϕ: porosity
- H: height of the NBS (m).
- Q_d: The flow of the drainage pipe (m^3/s).

2.3 Multicriteria Decision Analysis (MCDA)

The third step of the scenario creation involves the application of a multicriteria decision analysis, a systematic approach that aids users in comparing among feasible management alternatives and, finally, selecting the most suitable NBS based on a set of predefined criteria. Users can assign weights to each criterion, allowing for a nuanced and personalized decision-making process. The criteria are multifunctionality (in terms of ecosystem services provided by the NBS), operational constraints, land footprint and CAPEX. The data for the criteria was extracted from a scientific and grey literature review and reviewed by a panel of experts from the MULTISOURCE project (https://multisource.eu).

2.4 Compendium of Commercial and Scientific Cases

The selected NBS is illustrated by a compilation of both commercial and scientific cases. Scientific cases consist of research papers that delve into the performance and scientific aspects of the NBS, providing a more comprehensive understanding. Commercial cases are real-world examples contributed by companies with

practical experience, detailing case characteristics. The companies also provide their contact information in case the users want to hire them to construct the NBS. The tool provides interfaces for researchers and companies to share their own case studies, which are peer-reviewed before being shared in the tool.

3 CONCLUSIONS

In summation, Nat4Wat represents an innovative and scientifically rigorous tool in the domain of nature-based solutions (NBS) for stormwater management. Its methodical approach to scenario creation, encompassing key parameters such as water characteristics, NBS options, multicriteria decision analysis, and empirical cases, establishes a robust framework for informed decision-making. As the global water crisis intensifies, Nat4Wat stands as a pivotal contribution, offering a sophisticated and scientifically grounded avenue for the strategic incorporation of nature-based solutions in sustainable water management practices that can be used by practitioners, decision-makers, and individual citizens.

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