



Indicators to Promote Sustainable and Climate Resilient Water Management at Urban Natural Spaces

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ABSTRACT

The Horizon Europe project NATURELAB – *Nature Based Interventions for improving health and well-being* proposes an integrative and innovative approach to contribute to resilient communities with a focus on health and care prevention. The project established a portfolio of key indicators and guidelines to characterize, design, protect and manage different types of nature spaces. The indicators focus on the characteristics of the nature site and its context, comprising not only the variables that can affect health and well-being but also the settings and resources that ensure that people can have comfort, and their basic needs attended to. The indicators will be tested and validated through its application to 15 experimental sites, located in Europe and Peru. The project aims at contributing to the sustainability of the territory and the resilience to extreme events – such as intense precipitation and heat waves.

This study introduces the NATURELAB indicators proposal, aiming to guarantee sustainable and climate-resilient water management in urban natural spaces. These indicators were developed based on prior knowledge, findings from other projects funded by the EU, and tailored to meet specific needs.

1. Introduction

Societies have faced unprecedented challenges, above all in cities, where approximately 55% of the global population is gathered. Living in urban areas presents several opportunities, but can lead to some drawbacks, such as a lack of sense of belonging and the absence of attachment to nature. The contact with natural elements in cities allows the acknowledgment of the fact we are not separate from the ecosystems. Exposure to Nature-based Solutions (NbS) also provides other numerous benefits, especially for health, including mental and physical well-being. In this context, NATURELAB – *Nature Based Interventions for improving health and well-being* has an innovative approach to contribute to resilient communities, by enhancing the green and blue areas' benefits, as the resilience to climate change and urban water management. Therefore, the project directly attends the UN SDG 3, SDG 6, SDG 11 and SDG 13. In its research, NATURELAB established indicators designed to ensure sustainable and climate-resilient water management in urban natural spaces. This portfolio will be validated through application to 15 Sites in Portugal, Greece, The Netherlands, Germany, and Peru.

2. NbS supporting water sustainability and urban resilience under climate change

NbS are emerging as sustainable solutions that contribute to urban resilience and to the maintenance, enhancement, and restoration of biodiversity and ecosystems, while addressing societal challenges and promoting sustainable and resilient urbanization (Beceiro et al., 2020; Wendling et al., 2018). Blue green infrastructure, which is part of the urban water infrastructure, has a potential value for climate change mitigation and adaptation. Additionally, this type of infrastructure plays a key role in enhancing circularity, optimising the water-energy-materials nexus (Fu and Butler, 2021). There are many co-benefits provided by urban green spaces in addition to improved public health, when good planning, design and management is assured (Ward Thompson and Silveirinha de Oliveira, 2016). NbS had gained visibility in urban planning and development, with several European cities incorporating green infrastructure, such as parks, green roofs, and urban forests, into their strategies to address urban challenges like heat island effects and air pollution. Taking into account this importance, several regulations and policies were developed by the EU or with its support. Multiple benefits for society, the economy, the environment, and human well-being are brought by NbS. As

with consideration of any health outcomes associated with an environmental exposure, how the exposure is measured is important in determining what relationships are apparent, and what causal pathways and mechanisms can be inferred (Nieuwenhuijsen et al., 2015). Studies of green space and health to date have used a variety of measures and indicators.

3. Guidelines to support urban NBS contribution towards water and communities' sustainability

The attributes of green spaces play a crucial role in determining the potential for human activities and reflect the sustainability of water usage and management. The NATURELAB project considers the following steps towards the evaluation of the urban natural spaces: (i) Characterization of the context and activities to be carried out; (ii) Characterization of the water availability and needs; (iii) Definition of the system to assess water sustainability, based on indicators; (iv) Development of a diagnosis and sustainability targets definition; (v) Identification and characterization of the measures to be implemented. The proposal of indicators to promote sustainable and climate resilient water management at urban natural spaces is presented in Table 1.

Table 1. Indicators to promote sustainable and climate resilient water management

Indicator	Description	Metrics and ease of determination	Recommendation
Water sources available	Water availability in the site	Which types of water supply sources exist?	Explore lakes, rivers, abundant nature, serene water
Impervious area	Surface imperviousness	Percentage of impervious area (%)	Minimize concrete, prioritize green spaces; foster biodiversity, preserve natural drainage.
Water needs	Water related facilities availability and needs	Water supply needs (total, toilet equipment, water supply points, irrigation, washing)	Assess water needs; enhance facilities for conservation and access
Physical access to water supply	See Silva et al. (2023)	N. of operational physical access points to water supply in the area	Ensure easy access; promote safety around water bodies
Wastewater disposal	See Cardoso et al. (2020)	Wastewater disposal exists and is adequately used?	Monitor, maintain wastewater systems for environmental and public health
Stormwater management		Solutions for stormwater management are adequately used?	Invest in green infrastructure; mitigate floods, protect ecosystems.
Drinking water consumption	B-WaterSmart Silva et al. (2023)	Water supply consumption	Promote conservation; ensure safe, sustainable drinking water practices.
Drinking water in non-potable uses	See Cardoso et al. (2020) and Silva et al. (2023)	Is drinking water being significantly used for non-potable uses?	Implement greywater systems; optimize non-potable water usage wisely.
Water use from alternative sources		Is being used for non-potable uses?	Explore diverse sources; reduce reliance, ensure sustainable water use.
Redundancy in Water supply sources	See Cardoso et al. (2020)	Which types of water supply sources are being used?	Establish backup sources; ensure resilience for water supply.
Redundancy in stormwater storage capacity		Is there a volume to store rainwater or stormwater?	Increase storage capacity; bolster resilience against fluctuating precipitation levels.
Risk of Water supply interruption		Water supply interruptions occurrence	Assess risks, diversify sources, ensure contingency plans for interruptions.
Risk of Flooding		Flooding incidents	Implement floodplain management; safeguard areas prone to inundation
Risk of Wastewater discharges		Wastewater discharges to ecosystem services	Monitor, regulate wastewater discharge; protect ecosystems from harmful contaminants
Risk of Water quality compliance		Is the water quality compliant with the legal requirements for its use?	Ensure standards met; monitor, maintain water quality for environmental health.

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