Policy Brief

From Drainage to Water Retention

Advancing a Paradigm Shift Towards Sponge Landscapes for Enhanced Climate Resilience

September 2024

Sponge Scapes

Policy Recommendations Summary

Climate change forces us to rethink the way we manage our water systems at a landscape scale, and is resulting in a call for a more nature-based approach, where the water, soil, and climatic system drive the potential land use opportunities.

Over the last decades, several concepts and policies have emerged that stimulate the improvement of the water retention – so-called sponge functioning – of landscapes to enhance their resilience to a changing climate.

Sponge functioning is enhanced following three principles:

1. **Intercept rainfall** where it falls and stimulate infiltration into the soil;
2. **Slow down the runoff** that has formed on the surface, is drained from groundwater, or is accumulated in streams;
3. **Temporarily store** excess water in the soil, groundwater or surface water bodies.

Measures and strategies that improve the sponge functioning of landscapes often consist of local sponge measures combining Nature-based Solutions and more technical measures following a '*green where we can, grey where we must' approach*.

Sponge functioning is context-specific and must be evaluated for a myriad of different hydrometeorological events, ranging from annual floods and droughts to more extreme events.

Sponge functioning is no holy grail for super extreme events – '*when the sponge is full, it's full'* and likewise – '*when the sponge is empty, it's empty'*, yet for more frequently occurring events, this approach will contribute to the reduction of impacts both in space and time.

The additional benefits (co-benefits) of individual sponge measures in terms of biodiversity and provided ecosystem services are additional reasons for their implementation and call for an evaluation of all potential measures.

Key recommendations for creating effective sponge landscapes:

1. *Evaluate water and land management decisions for multiple goals*.
   Floods, droughts, biodiversity, water quality and socio-economic development all interplay in the same location on the ground, and suggested measures should thus be evaluated for all these aspects alike.
2. *Evaluate sponge measures for multiple hydro-meteorological events and onsets*.
   Rain and drought come in different magnitudes and temporality, and the landscape's response depends on whether the period before the event was characterized by dry or wet average conditions. Measures may be effective for one type of event but not for others.
3. *Let soil and water be a governing principle in spatial planning*.
   Avoid future risks by acknowledging that the landscape has both flood and drought risks in different locations and plan for resilient land and water use.
4. *Work at landscape scale*.
   Single measures may play a role locally, but significant impact at a larger scale requires an approach where multiple measures are combined into landscape-scale strategies for climate resilience.
5. *Ensure stakeholder engagement from the early onset*.
   Working at a landscape scale implies it is essential to co-create sponge strategies with the many stakeholders that make or are affected by public and private decisions through systematic involvement throughout the entire planning and implementation process.

Why Talk About Sponge Landscapes?

The escalating effects of climate change are manifesting through increasingly extreme weather events, ranging from more frequent and intense floods due to heavy rain to prolonged and more frequent dry periods.

These climatic shifts, combined with increased human impacts on the landscape such as intensive drainage schemes, urbanization and intensive agricultural practices, are significantly challenging our ability to manage our water and soil systems effectively.

The declining water retention capacity of soils, groundwater, and surface water – collectively called '*sponge functioning*' – limits our capacity to mitigate these extreme events.

This policy brief explores the transformative approach of converting conventional landscapes into 'sponge landscapes'. These landscapes, intercept rainfall, slow down runoff and temporarily store excess water can play a critical role in adapting to climate-related challenges.

Derived from the insights of the SpongeScapes project, this brief delves into why redefining and restoring the sponge functioning of our landscapes is essential for climate resilience.

We aim to clarify the concept of sponge landscapes, demonstrate their importance in building resilience, and offer actionable recommendations for policymakers to facilitate this vital transformation.

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The Importance of Landscape-scale Water

In many parts of Europe, landscapes have been modified significantly for the intensification of agricultural production, stream channelisation and urbanization, speeding up the transfer of water downstream. In addition, climate change is altering patterns of precipitation and temperature – together these are resulting in damages to properties, infrastructure and ecosystems beyond natural variability. Mitigation of floods and droughts can be achieved by restoring or enhancing the diminished water retention capacities at various spatial scales – from local sites to transboundary river basins.

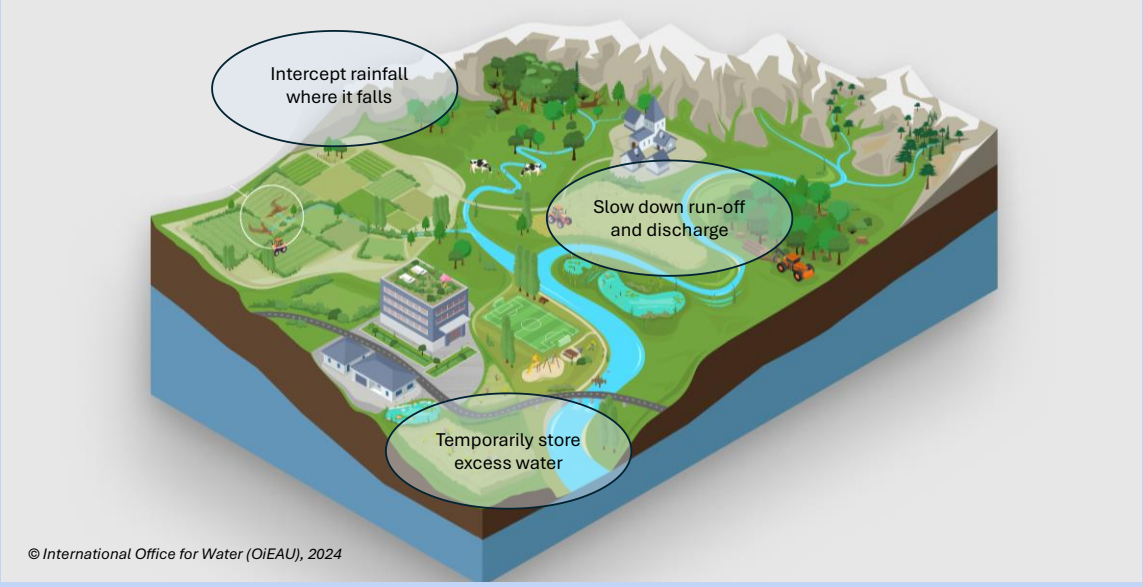
Local-scale implementation of these so-called 'sponge measures' is often well-understood through site-specific observations and hydrological models. Yet, their effectiveness may be constrained by wider larger-scale catchment impacts.

For these reasons, a landscape-scale approach to enhancing water retention is advantageous. Landscapes are areas, as perceived by people, whose character is the result of the interplay of natural and human factors[1].

What are sponge landscapes?

Sponge landscapes are landscapes in which the natural ability to intercept rainfall, slow down runoff and temporarily store excess water (sponge function) has been restored or enhanced, with measurable effects on the hydrological cycle of a catchment. Sponge landscapes are comprised of building blocks called sponge measures, which can be expanded, replicated or combined with other water retention measures to improve sponge functioning on the landscape scale. Both rural and urban areas play a role within creating an overarching sponge landscape.

Approaching water management challenges on the landscape scale, facilitates stakeholder engagement who identify with - and are invested in - the area. It also enables the quantified assessment of interactions between measures across various locations and habitats at a manageable scale.



[1] Council fo Europe. (2000). European Landscape Convention. Retrieved from: https://rm.coe.int/1680080621

Sponge Principles and Measures

We distinguish three main sponge principles:

1. Reduce the formation of runoff by intercepting rainfall where it falls and stimulating infiltration into the soil,
2. Slow down the runoff that has formed on the surface, is drained from groundwater, or is channelised in streams, and
3. Temporarily store excess water in the soil, groundwater or surface water bodies.

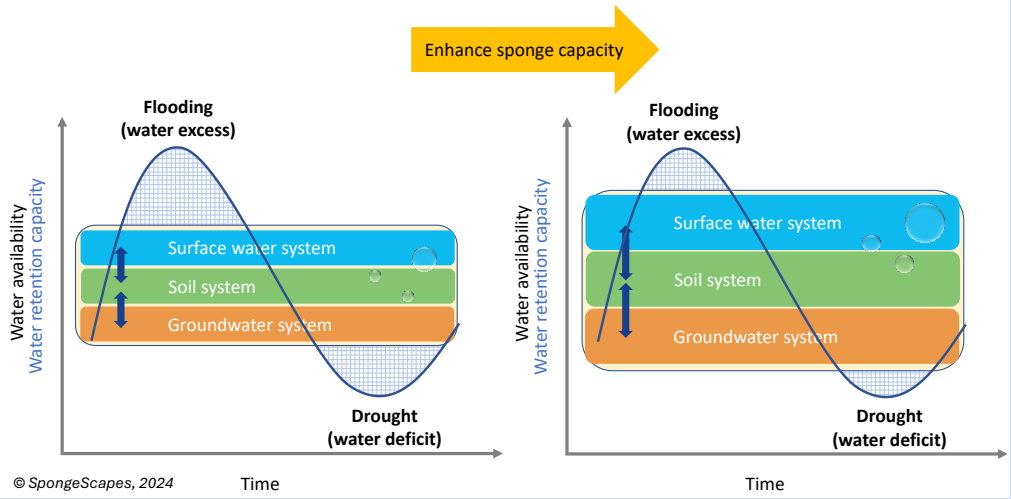
The degree to which these sponge principles are effective depends on the characteristics of the landscape and how this is altered for human use.

For example, heavy alteration of the landscape in a Dutch lowland stream reduced the travel time of a drop of water to flow from Buurse to Deventer (some 55 km distance) from 16.5 days in near natural conditions in 1850 to 9 hours today. This made the landscape susceptible to droughts. Natural inundation areas in the catchment are now being restored using techniques adapted from historic approaches to reduce the impacts of droughts[2].

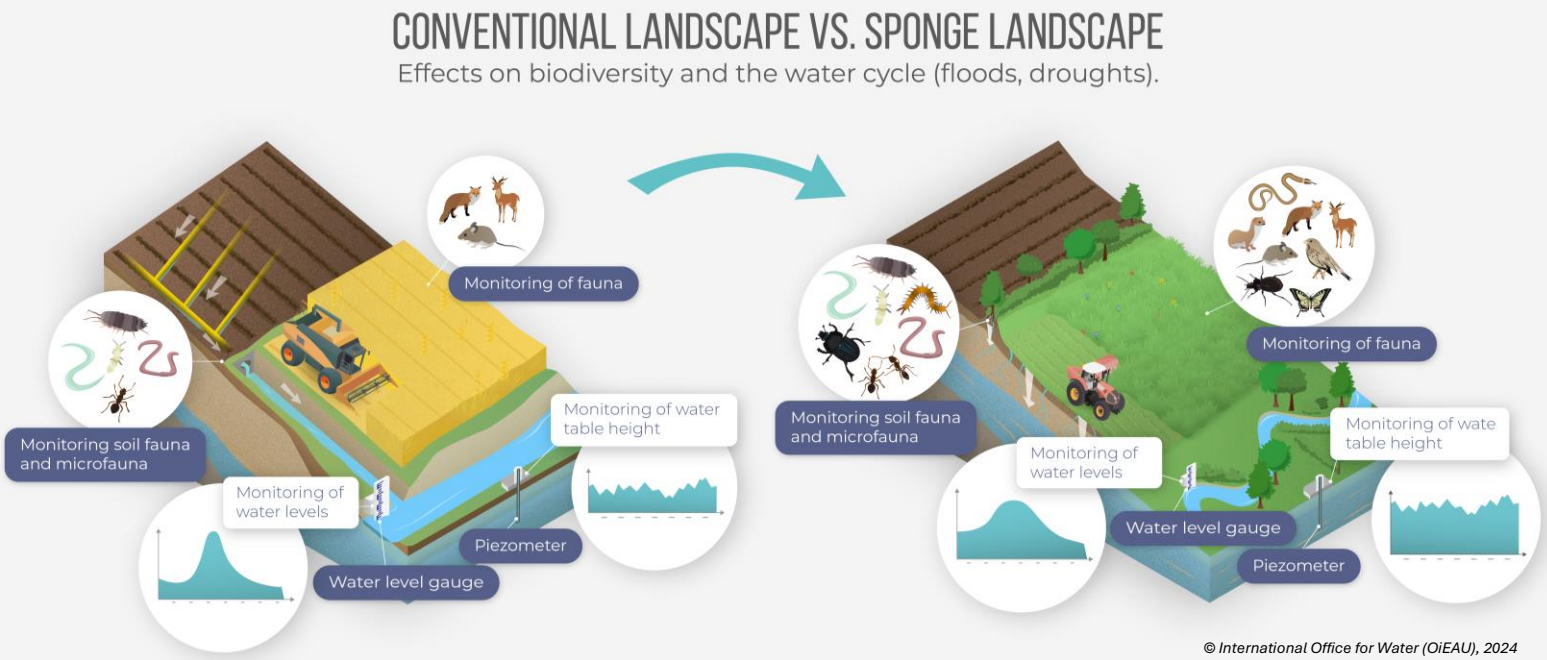
What is sponge functioning?

The term sponge functioning is borrowed from the function of a kitchen sponge that can soak up large amounts of water and slowly release this water when full capacity is reached. Hence, it refers to the capacity of natural and modified landscapes to store rainwater in soils and aquifers and on the surface, or by slowing it down when it flows through the landscape, thereby mitigating the impacts of hydro-meteorological extreme events such as floods and droughts.

The larger the sponge functioning, the more rainwater can be stored and/or used by vegetation and surface runoff slowed down, reducing or avoiding downstream flooding. Similarly, the more rainwater is stored locally and the slower it is released, the longer it is available during drought conditions. However, it is important to note the sponge functioning is not endless. Once the sponge is full, it can no longer store more water to reduce impact of flooding, and once the sponge is empty it can no longer provide water during drought. However, by increasing the sponge functioning, there is evidence to show we can mitigate the impact of extreme events as well as facilitate the recovery after they have passed.



[2] Het Overzicht. (2021). Alles stroomt op Het Lankheet. Retrieved from: https://hetoversticht.nl/alles-stroomt-op-het-lankheet



Sponge measures serve multiple goals

Sponge measures are actions that preserve, restore, enhance, or create ecosystems and their functions to increase landscape and soil water retention while providing co-benefits for people and nature by promoting biodiversity and ecosystem services.

Combinations of sponge measures need to be evaluated for their impact on multiple goals. The primary goals are of biophysical nature, and relate to flood and drought risk mitigation. Additional goals (referred to as co-benefits) include reducing soil erosion and enhancing soil health, water quality and biodiversity. At the same time, trade-offs such as upstream-downstream interactions need to be included in evaluations too. Monitoring of these multiple goals is essential to show the success of the implemented measures over time.

Sponge measures are location-specific

Working at a landscape scale implies multiple sponge measures must be combined for an overall effect. In different physiographic and/or climatic zones, different measures are relevant and these measures are location-specific:

In the upper part of the landscape capturing and infiltrating water into the groundwater is key. Reforestation is one of the common measures in this higher zone.

On the slopes and further down the valley slowing down the water is essential. This can be done by appropriate agricultural practices and adding micro-relief and hedges to enhance soil sponge functioning.

In the lower valley re-meandering of streams, restoration of wetlands and buffer strips along streams help increase the area where water can be temporarily stored.

Principle	Location	Examples of Measures
Intercept rainfall	Entire landscape	Meadows and pastures, hedges, green roof, afforestation, increase infiltration capacity of soils, …
Slow down the runoff	Along the water path*	Buffer strips, remeander, swales, permeable paving, leaky dams, …
Temporarily store water	Adjacent to the water path*	Reconnect floodplains, rain gardens, restoration of wetlands, detention basins , …

**Water path is the route that water takes through various environments, including groundwater, surface water, and soil*

Sponge measures functioning under different types of events

The evaluation of sponge measures must be done for different types of rain and drought events, ranging from events that occur frequently to those that occur occasionally or seldomly. For instance, a UK-based study showed that afforestation of catchments can reduce flood peaks of 2-year floods by up to 60-70% in heavily forested catchments, but this impact is reduced to 30% for 50-year floods (Iacop et al 2014).

Sponge landscape functioning can be enhanced by landscape and spatial planning and river basin management plans

Improving sponge functioning requires that landscape and spatial planning processes acknowledge that soil and water influence the best placement of different land use types. In dry zones in the landscape, other activities and land use types are more logical than in wetter zones. For example, natural floodplains reduce flood risks and enhance biodiversity, while constructing high-value properties near or in these flood-prone areas creates risks of damage to these properties. However, revising existing land use types is not always possible, and adopting a landscape perspective helps prioritize and, where necessary, identify possible alternatives.

A traditional stone check dam on Kavouropotamos stream on the island of Paros, Greece.
Photo: Thanos Giannakakis, WWF Greece

Sponge landscape management should also be an integrated part of river basin management plans as required for the Water Framework Directive.

Creating sponge strategies needs close cooperation between local stakeholders

Engaging a broad range of stakeholders from the project's early stages ensures just and inclusive spatial planning processes. This helps to align various interests and knowledge bases and reduces social and institutional uncertainties.

Showing success through pilots and monitoring multiple goals is essential to create the level of acceptance needed to help upscaling to landscape scale.

In this dialogue, the impact of different types of droughts and floods and how they are perceived by land users must be discussed. After all, the natural functioning of ecosystems related to streams and rivers needs a certain level of flood dynamics, and droughts are influenced by how effectively water is used during these periods.

Capacity building initiatives that educate and train stakeholders on the benefits and management of sponge measures can foster greater acceptance and more effective implementation.

Floodplain reconnection using logjams in the New Forest UK.
Photo: David Sear, University of Southampton

SpongeScapes

Three EU-Horizon projects are currently working on improving the evidence base for sponge measures and stimulating the upscaling of their implementation at landscape scale: SpongeScapes, SpongeBoost and SpongeWorks. Through a collection of examples in databases such as www.nwrm.eu with a portfolio of sponge measures, deep dives in dedicated case studies and implementation of measures in the field these projects further the thinking on sponge functioning for different landscapes and climatic zones throughout Europe.

This policy brief was published under the lead of the SpongeScapes project. The EU-funded project aims to consolidate, expand and disseminate scientific knowledge about sponge measures and sponge strategies relevant to different types of landscape and climatic zones throughout Europe to help landscapes become more resilient to the increasing challenges related to floods and droughts.

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