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# Policy Brief

Baltic Sea Centre
Stockholm University

# Multifunctional wetlands – reality or utopia?

The restoration and creation of wetlands is being discussed as a way to solve several societal crises. It can mitigate climate change by preventing greenhouse gas emissions, but also reduce eutrophication, prevent floods and droughts and favour biodiversity. However, a single wetland cannot fulfil all environmental requirements; a diversity of wetland types is needed, where the right wetland is put in the right place.

Wetlands are high on the political agenda, both nationally and within the EU, and landscape rewetting is seen as a nature-based solution to a range of societal problems. Rewetting takes place either through restoration of land where a wetland has historically existed, or through new establishment on other land areas. However, several issues need to be considered to maximise the positive impact. This policy brief describes the benefits and challenges of rewetting the agricultural landscape and highlights the need for a landscape perspective. In the text, rewetting is used as an umbrella term for the ambition to increase the amount of wetlands in the landscape.

## RECOMMENDATIONS

- **Foster** a diversity of wetland types with different characteristics to meet multiple objectives. One wetland cannot be optimised to benefit all ecosystem services.
- **Create** wetland diversity using different sitings, design and management for different main purposes.
- **Plan** for management and maintenance, so that wetlands do not lose their functions.
- **Evaluate** the impact continuously – rewetting can both increase and decrease greenhouse gas emissions.

Photo: Lars Johansson/Mostphotos


Photo: Lars Johansson/Mostphotos

Fens often harbour characteristic orchids.

## FACTS: WHAT IS A WETLAND?

The Swedish Wetland Inventory (VMI) defines wetlands as vegetated areas where water is generally close to the soil surface. This includes deeper water as long as the surfaces is covered by plants. The Convention on Wetlands (Ramsar) also covers open water down to a depth of six metres, such as ponds, small lakes and coastal zones.

- **Bogs** are usually nutrient-poor wetlands that are located at high elevations in the landscape and therefore receive water mainly through precipitation.
- **Fens** are wetlands that are strongly influenced by surface water or groundwater.
- **Riparian wetlands** include areas that are strongly influenced by nearby lakes or water courses.


Photo: Bluejava/Mostphotos

Bog.


Photo: Lars Johansson/Mostphotos

Grazed riparian wetland.

### More water in the agricultural landscape

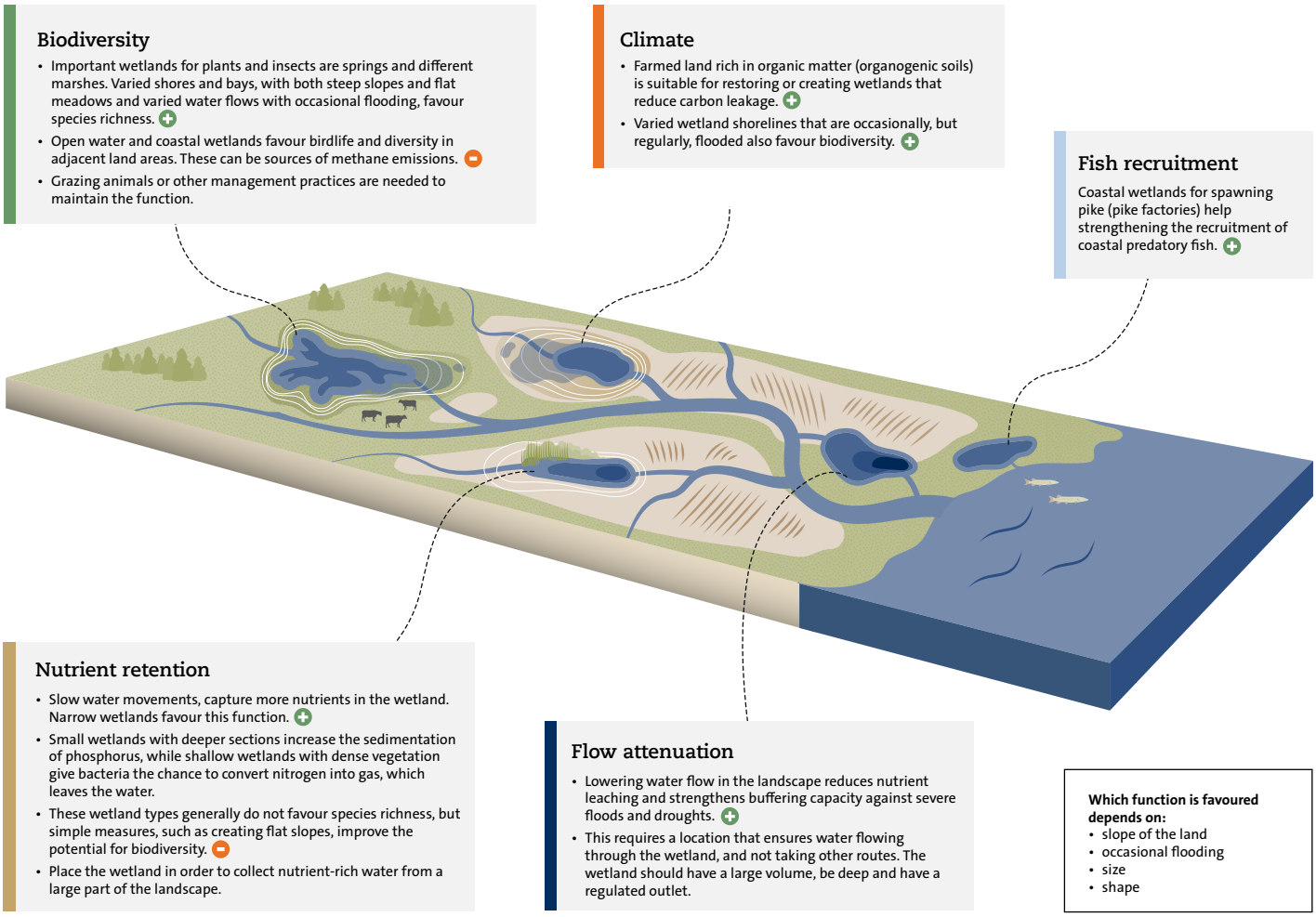
An important motivation behind the current wetland debate is that many historically drained wetlands emit carbon dioxide, as draining led to oxygenation of the soil and decomposition of its organic matter. Fields with high organic content have sunk as a result of these decomposition processes and, in some cases, may have become useless. However, in the agricultural landscape, the main reason for increasing the number of wetlands has been to slow down water movements, to reduce the risk of flooding downstream and to avoid nutrient leaching. To achieve these objectives, new wetlands have been created while straightened water courses have been restored, or remeandered, to a more natural form.

### Home of red-listed species

Wetlands are important habitats for many species, not only those living in aquatic environments but also many terrestrial species, including birds, bats, spiders and insects, which utilise the wide range of resources often found in and around these environments. This importance is emphasised by the large number of wetland-associated species found in the IUCN Red List of Threatened Species. Finally, a wetland can provide great recreational value, both in urban and rural areas. For example, interviews with landowners show a great interest in creating shallow ponds for ice skating for themselves or their children. Ponds in towns and cities are also popular destinations for visitors and provide cooling on hot summer days. These benefits have stimulated public investment, by both past and present governments, to create and restore wetland habitats. The issue is also being explored as part of the EU's objective to restore degraded nature to counter climate impacts and reduce threats to biodiversity. Given the multiple benefits, it is easy to expect one type of wetland to achieve multiple objectives, but this is rarely the case. Factors that favour one benefit may reduce or completely counteract the value of another.

### Historical perspective needed when rewetting

In the Middle Ages, wetlands were important fodder grounds for livestock, but as the human population increased in the 18th and 19th centuries, more arable land was needed for agricultural production. This led to the draining of large amounts of wetlands - up to 90 per cent in some areas. An unwanted effect was faster water movements through the landscape, causing increased nutrient runoff, resulting in eutrophication of lakes and coastal areas. In addition, biodiversity was lost, areas became more vulnerable to flooding and carbon emissions increased. Recovering these




To maximise the benefits of different wetland functions, a diversity of wetland types is needed in the agricultural landscape. Depending on their location, design and management, some ecosystem services are promoted (green plus), while others are unaffected or disadvantaged (red minus).

Illustration: Elsa Wikander/Azote

functions requires knowing what type of wetland is needed, and how to re-wet the landscape properly.

The natural shape of the landscape is the main reason wetlands exist. They are found where flows are slowed down, such as on plains and in depressions in the landscape, or where groundwater comes to the surface. The underlying hydrological processes, like precipitation and runoff, combined with soil type, determine the structure of the wetland and how it affects the surrounding environment. Varied water flows with occasional flooding are often important features for achieving ecological and climate benefits.

## Landscape location determines impact

To reduce carbon emissions, wetlands on carbon rich organogenic soils need to be restored. Although rewetting of these can promote biodiversity, other wetland types have the greatest impact on species richness. Important wetlands for biodiversity are springs, and more or less calcareous rich fens, which often have low carbon emissions. Other types being restored and constructed for biodiversity have open water and connected riparian wetlands, that favour birdlife. Their role in reducing carbon emissions is less important, and they may even be sources of methane emissions. In other words, it can be difficult to maximise biodiversity and climate benefits in the same wetland. Measures to mitigate nutrient leakage or reducing flood risk successfully often involve centrally located sites in an area that receives a large amount of runoff water. However, these wetlands have a high primary production which often negatively affect species diversity. Finally, a special kind of wetland restoration is the so-called "pike factories", aiming to enhance the reproduction of pike in the vicinity of the Baltic Sea. The location of these usually has little impact on other ecosystem services.

## Wetlands favouring biodiversity ...

Water is the basis for life, and the presence of water and waterborne nutrients create conditions for species-rich habitats. Open water and riparian wetlands in the agricultural landscape therefore often harbour a high biodiversity in the water as well as in the surrounding land areas. The open landscape contains marshes with a high biodiversity, especially in regards to plants and insects.

Success factors in rewetting the agricultural landscape include restoring the hydrological dynamics with a long-term management perspective. Since wetlands are highly productive, they can rapidly be overgrown with tall plants if management measures are not taken, which will disadvantage many threatened species.

Historically, wetlands were important sources of winter fodder and thus were regularly harvested. Today, management is mostly performed by grazing cows, and occasionally horses and sheep. Constructed wetlands in pastures typically include a pond to ensure water supply for the livestock. It is often beneficial if wetland banks vary, with steeper banks combined with regularly flooded shorelines, as different species benefit from different factors.

The effect of grazing animals on wetland biodiversity is complicated. For instance, grazed wetlands with high animal densities such as grazed marshes may favour bird life, especially wading species, and simultaneously disadvantage insects and spiders. Al-

though low vegetation favours many insects and spiders, trampling can harm species whose larvae develop in wet soil. However, there is a lack of research in this area. Results also suggest that trampling damage to wetlands can lead to increased greenhouse gas emissions, primarily of methane, and erosion of soil particles and loss of phosphorus.

### ... or to trap nutrients and attenuate flows

The main reason for establishing wetlands in the agricultural landscape today is to reduce diffuse nutrient leakage from arable land, but there is also a growing interest in establishing or restoring wetlands to mitigate extreme flows associated with a changing climate. Both objectives require careful siting to capture a significant proportion of nutrient-rich runoff water.

Optimal locations can be calculated from water flows and nutrient loads, using various digital tools. Nutrient retaining wetlands are often small and deep, particularly suitable for phosphorus sedimentation. For high nitrogen removal, a lot of vegetation and fairly shallow wetlands are needed, where bacteria can convert the nitrogen into gas that leaves the water. Over the years, sediment accumulates in the wetland, causing it to lose its function if it is not regularly excavated.

In the context of a changing climate, there is increasing interest in constructing or restoring wetlands for flow attenuation or irrigation ponds. To be able to reduce flows, a large volume is required, i.e. deep ponds, preferably with a regulated outlet. Both of these objectives require careful siting, ensuring that water actually flows through the wetland. Recent research shows that constructed wetlands can efficiently buffer flooding during normal rainfall, though their capacities are insufficient during heavy rainfall.

### Trade-offs between benefits

The ecological and climate functions of a wetland are defined by its design, landscape location and management. Often, features that maximise one benefit may be negative for another. While nutrient retention is often optimised in small wetlands that receive nutrient-rich water and have high productivity, biodiversity can rarely be optimised in the same ones. Similarly, greenhouse gas emissions and biodiversity respond differently to fluctuating water levels and grazing. Multifunctionality should therefore not be a primary goal for individual wetlands, it is better achieved at the landscape level. Another important issue to recognize is that although an individual wetland cannot be optimised for multiple benefits, good planning in terms of design and management can provide added values that deliver other ecosystem services. For example, simple adaptations, such as adding shallow slopes, can improve the biodiversity potential of a wetland that primarily is optimised for nutrient retention.

### Results require a long-term approach

Restoring wetland functions requires patience and it can take up to several decades before the ecosystem reaches full recovery. This calls for a long-term perspective but also resources for continuous monitoring. Such resources are often lacking because existing financial compensation to landowners has not sufficiently covered both establishment and management. Since effects of measures take time, it is important to perform this work right from the start. However, there is a lack of knowledge about the link between restoration and long-term functioning, as implemented measures are rarely evaluated over time. Moreover, there are no wetlands where measurements of all benefits, such as flow, nutrients, biodiversity and carbon sequestration or undesirable side-effects are evaluated simultaneously. In other words, more knowledge is needed to optimise the potential of wetlands in the landscape.

*This policy brief is based on research carried out in collaboration with researchers from Stockholm University, Swedish University of Agricultural Sciences (SLU) and The Rural Economy and Agricultural Society (Hushållningssällskapet) in Halland.*

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