Wetland Restoration

INTERVENTION CATEGORY: RESTORATION

DESCRIPTION

Wetlands protect and improve water quality, provide fish and wildlife habitat, store floodwaters and maintain surface water flow during dry periods. Restoration of wetlands provides renewal of wetlands that have been drained or lost due to anthropogenic activities. Wetlands that have been converted to other uses often retain basic soil and hydraulic characteristics, and can therefore be restored. In general, the best way to prevent further loss of ecological and economic value due to degradation of wetlands is by eliminating the pressures driving the loss and deterioration.[1]

Wetland restoration involves the re-establishment of the hydrology, plants and soils of former or degraded wetlands that have been drained, farmed or otherwise modified. The integrated nature of a wetland system implies that a restoration project needs to take a holistic approach, including the reintroduction of native species (flora and fauna), to succeed. On-the-ground activities associated with wetland restoration can include excavation of upland soils, removal or installation of dams/dykes, removal of riverbed/bank reinforcement, and overall removal of barriers to support the re-establishment of natural hydrology.[2] Existing drainage infrastructure such as underground tiles or open ditches need to be removed or plugged.[3] Similar to other NbS, the process leading up to implementation of wetland restoration typically consists of collection of scientific information, collaboration with stakeholders, modeling of scenarios for feasibility, and preparation of an environmental assessment.[4]

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WATER SECURITY CHALLENGES (WSCs) ADDRESSED

TYPE		IMPACT	MAGNITUTE	DEPTH OF EVIDENCE BASE
Water availability	Groundwater recharge	Increased mean annual groundwater recharge	★★☆	★★☆
	Dry season flows	Maintained dry season flows	★★☆	★★☆
Disaster risk	Flood risk	Reduced peak discharge	★★☆	★★★
Water quality	Erosion and sedimentation	Reduced on-site erosion and sediment yields	★★☆	★★☆
	Nutrients and pollutants	Reduced in-stream nutrient and pollutant concentrations	★★★	★★★

The ability of wetlands to store large amounts of water, and release it slowly, plays a key role in the natural regulation of water quantity during periods of droughts and floods. An acre of wetland can store 3.8 to 5.7 million liters of floodwater, thereby reducing the peak load on stormwater and wastewater systems.[5] Depending on their location in the watershed, wetlands can attenuate peak flows, minimizing the potential flood damage downstream and increase resilience to storms, thereby avoiding potential damage to grey infrastructure and human lives. Coastal wetlands provide these protective functions against coastal flooding, storm surges and sea level rise.[6] Water retention by, and water supply from, wetlands differ widely between different ecological and climatological systems. By trapping sediments, wetlands also reduce downstream transport of sediments.[1]

Wetlands contribute to water quality through their natural ability to filter effluents and absorb pollutants. Microorganisms in the sediment and vegetation in the soil help to break down many types of waste, eliminating pathogens and reducing the level of nutrients and pollutants in the water.

OTHER BENEFITS

WHAT?	HOW?
Water temperature control	Provision of shade by vegetation
Habitats/biodiversity	Important habitats can be established for various bird species, fish populations and other wildlife[1]
Carbon sequestration	Vegetated wetlands can act as carbon sinks when CO_2 is sequestered in biomass[7]
Provisional ecosystem services	Provision of food, fiber, timber, medicinal resources, etc.[8]
Recreation and tourism	Increased aesthetic value and more pleasant environment

LINKAGES TO CLIMATE CHANGE

Mitigation: Wetlands can sequester large amounts of carbon and therefore contribute to mitigation of climate change effects.[16] However, the net effect of sequestering C in wetland soils can be offset by the emission of carbon in the form of CH_4 as the result of anaerobic decomposition of organic matter.[17] This trade-off needs to be evaluated for case-specific circumstances.

Adaptation: Intensification of hydrological extremes is projected in many areas worldwide as a consequence of climate change. Restoration of wetlands contributes to mitigation of these extremes by reducing flood risk and enhancing groundwater recharge and dry season flows.

DESIGN-ENABLING CONDITIONS AND TYPICAL CONSTRAINTS

- Site-specific constraints considered in Ramsar guidelines for wetland restoration include consideration of the local context of natural resources, such as availability of water, landscape morphology, substrate characteristics, and presence of flora and fauna. There are several ecological constraints derived from climate, geomorphology, and various other characteristics of the catchment.[9]
- Water resources allocation needs to match ecological water demand and be guaranteed in appropriate regulations.[2]
- The historical range of conditions, prior to degradation of a wetland, needs to be well-understood to establish realistic goals for a wetland restoration project.[10]
- Land acquisition is typically needed in case the wetland has been used for agricultural or other economically productive purposes.[11]
- Reported constraints for wetland restoration projects in the US include safety hazard concerns (due to a nearby located airport), engineering conflicts (impact on existing flood control channels), territorial disputes and habitat displacement (related to deposition of dredge material produced in wetland restoration).[4]
- Maintenance needs are typically kept minimal, especially as close-to-natural conditions are approached. However, the following maintenance activities can be required:
  - Regular inspection and maintenance of any dikes, berms, or water control structure that were needed for the wetland restoration[12]
  - Controlling non-native and invasive species, and herbivores[13]
  - Mowing, burning, or other activities reinstating/mimicking the natural disturbance regime[13]
  - Reducing or preventing human intrusion[13]
  - Controlling local pollutants[13]

RELATION TO GREY INFRASTRUCTURE

INFRASTRUCTURE?	SERVICE PROVIDED BY GREY SOLUTIONS	TYPE OF RELATION
Ditches, water distribution systems	Rewetting of wetland	Complementary
Water treatment plant	Primary water treatment	Alternative
Dams and levees	Flood control	Alternative

Wetlands can provide significant support to traditional infrastructure for water treatment, water supply, drought mitigation and flood control (or even replace such grey structures). Often, water quality and quantity regulation services provided by wetlands are cost-competitive to those provided by conventional infrastructure solutions, while providing a wide range of socio-economic and biodiversity co-benefits.[1]

COMMON RISKS AND TRADEOFFS

- Wetland degradation is often not just caused by one direct impact on-site, but rather by the cumulative effect of numerous, indirect impacts of upstream processes (e.g., affecting surface flow dynamics) which need to be taken into account in the restoration project.[10]

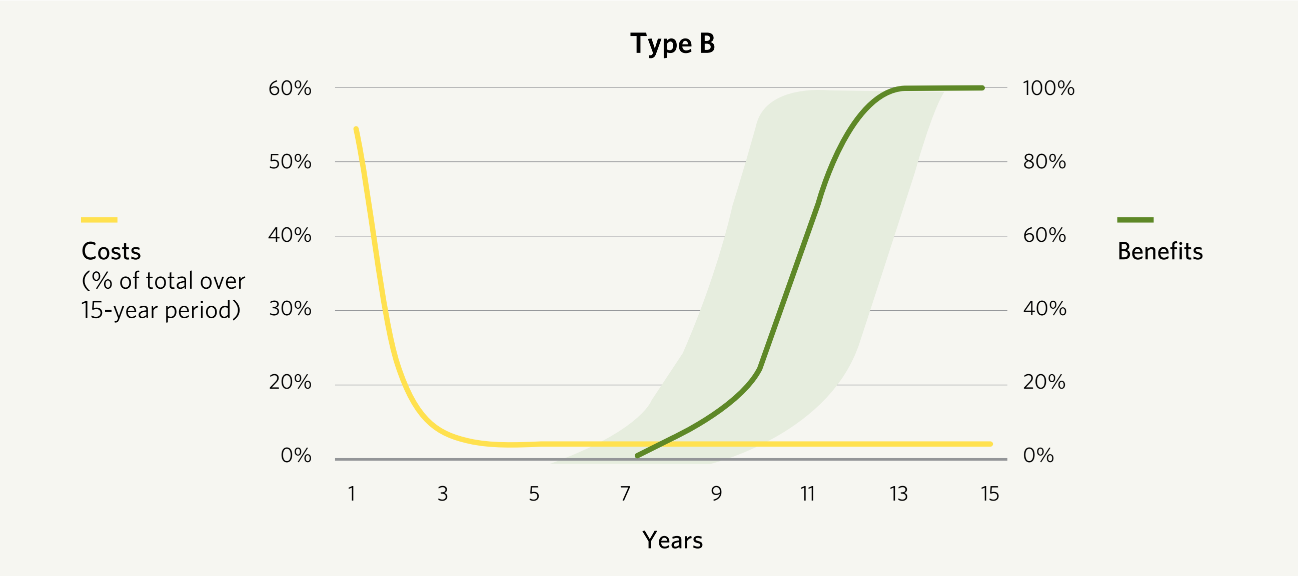
- Invasive species may thrive in the nutrient-rich habitats, e.g. caused by seeds contained by flood waters.[12] In general, if wetlands are being used for treating wastewater, benefits to biodiversity may be restricted as only highly tolerant species would be present.
- Damage to any installed structures by nutria or beaver.[12]
- Particularly in tropical regions: the creation of new habitats for mosquitos and thereby vector-borne disease risks.[14]
- Not all types of pollutant reduction are well-documented in wetland restoration projects.[3]
- There is also the potential for accumulation of toxic substances in wetlands, in effect turning wetlands into potential 'hotspots' where high levels of contamination can prove detrimental to wetland ecosystem functioning and health.[15]
- In some circumstances, wetlands can contribute to natural processes that generate hazards. For example, wetlands may attenuate flood flows at the start of the rainy season when they are relatively dry, whereas they generate runoff and potentially contribute to flood flows later in the wet season under saturated conditions.[3]

MONITORING OPPORTUNITIES

- Status of vegetated habitats can be monitored with satellite imagery, aerial photos and ground-truthing by field surveys.[18, 19] Different wetness indices can be computed from remote sensing imagery to monitor hydrological dynamics in wetlands.[20]
- Impacts on water quantity (dry season) can be monitored by measuring streamflow and groundwater levels at downstream sites.
- Impacts on water quality can be monitored locally by measuring concentrations of relevant parameters (e.g., nutrients or sediments)

IMPLEMENTATION COSTS AND TIMING OF BENEFITS

Wetlands restoration in most cases involves a number of trade-offs, providing improved state of water-related ecosystem services and livelihood options for some, while potentially eliminating sources of income for others. In the long term, benefits are usually enjoyed by the majority of stakeholders.[1] An extensive review of costs of wetlands restoration activities yields a wide range, roughly from thousands to hundred thousands of €/ha.[21] The type of wetland ecosystem plays an important role in determining costs, with coastal systems often more expensive to restore. Although restoration costs can be substantial and require long-term investment, resulting benefits (economic and otherwise) are high and often outweigh such costs.[22, 23] It generally takes time for the benefits from restoration efforts to accrue, as wetland ecosystems generally do not recover quickly.21



Restoration of the Ciobarciu wetland in Romania (source: CEEweb for Biodiversity)

EXAMPLES

Although wetlands occur in a high number of river basins worldwide, (scientific) literature documenting restoration efforts is dominated by North America and Western Europe.[23] Some examples are listed below:

Cambridgeshire, United Kingdom24

Brief description: A long-term restoration initiative to convert drained, intensively farmed arable land to a wetland habitat mosaic aims to prevent biodiversity loss from the nationally important Wicken Fen National Nature Reserve and to increase the provision of ecosystem services. Activities include land purchase, fencing, re-engineering of ditches, as well as various maintenance actions.

Lessons learnt:

- Net gain to society as a whole is computed at $199/ha/yr, for a one-off investment in restoration of $2320/ha. Benefits relate to WSCs (flood protection) as well as co-benefits such as GHG emission reductions, recreation, and grazing.

Illinois River, United States[25]

Brief description: The 1,052 ha Hennepin and Hopper Lakes Restoration Project along the Illinois River aims to restore the site's wetlands, prairie, savanna, and two lakes and thereby reestablish biodiversity on former corn and soybean fields in the Hennepin Drainage and Levee District. Restoration was initiated in 2001 by turning off the drainage district's pumps but retaining the levees and other drainage structures in order to exclude multiple flow paths to and from the river. Water is withdrawn from the river and passed through the restored wetland complex. Water quality is improved through reestablishing wetland functions that reduce nutrient, silt, and sediment loads to Illinois River. Estimated annual net benefit is US$1,827 per ha of restored wetland, and estimated total net benefit for the entire project area is US$1.83 million.

Lessons learnt:

- Declines in income due to reduced production of corn and soybean are well below the benefits gained from wetland restoration, over a 20-year period.

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