Case study: Gemenc floodplain, Hungary

WETWIN

Factsheet 12

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A large floodplain forest

The Gemenc floodplain, located along the lower reach of the Hungarian Danube, is one of the largest continuous floodplain-forests in Europe, covering 18,000 hectares. It covers an area 4-5 kilometers (km) wide and 30 km long, on the right bank of the river (Figure 1). The floodplain was created during river regulation works in the 19th Century, when the big meanders of the Danube were cut off and flood control dikes were erected. Today, these dikes form the western boundary of Gemenc.

Alluvial forests fragmented by different types of water bodies cover the floodplain. These side arms, oxbow lakes and temporary water bodies are in a hanging position compared to the main channel. The Gemenc is subject to periodic inundations of the Danube that refresh the water bodies, ensure lateral connectivity between the floodplain and the river, and supply water and nutrients to the forests. The Gemenc is part of the Danube-Drava National Park (DDNP) and is protected under the European Union's Natura 2000 network. It is also listed under the Ramsar Convention on Wetlands.

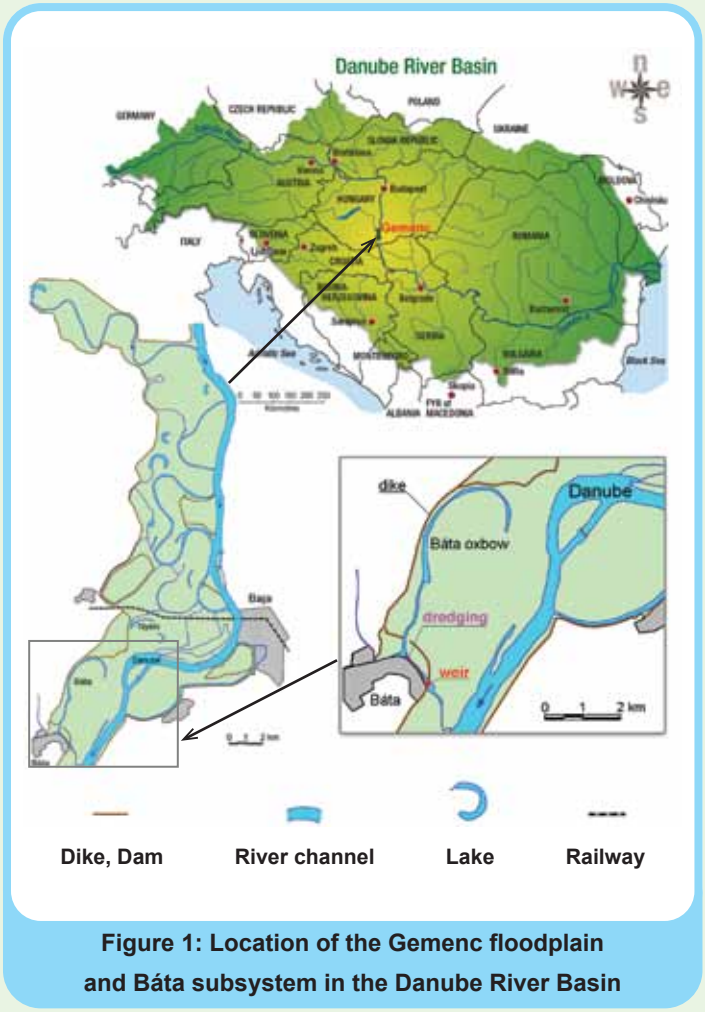


Figure 1: Location of the Gemenc floodplain and Báta subsystem in the Danube River Basin

An array of stakeholders

At a local level, the DDNP Directorate, as the highest priority wetland manager, has the largest influence on all of the stakeholders, their activities and interventions on the Gemenc wetland system. The DDNP Directorate is also responsible for maintaining and enforcing the requirements for Natura 2000 in the Gemenc wetland. The Gemenc Forest and Game Co. Ltd., is a 100% state-owned company, which manages almost 90% of the Gemenc floodplain. It is the most important manager and user of wetland services such as forest and game.

The Environment and Water Authorities of the three counties encompassing the wetland are important in enforcing the laws in relation to water management, environmental protection and nature conservation; and the three Environment and Water Directorates manage the waters and riverbank forests. Other interested parties are 12 settlements (from three counties), fishing companies, angler unions, and small forest and game management companies.

On a national level, the Ministry of Rural Development is responsible for water management and protection of the environment in the Hungarian Danube River Basin. The International Commission for the Protection of the Danube River (ICPDR) is the main organization responsible for the development of the Danube River Basin Management Plan on an international level, according to the requirements of the European Water Framework Directive.

A wealth of ecosystem services

Important ecosystem services of the Gemenc floodplain are:

- **Habitat and supporting services:** Gemenc provides habitats for endangered species, and is an important nesting, feeding and resting habitat for migratory birds such as the black stork.
- **Regulating services:** Contributes to improving the quality of the Danube's water, by retaining nutrients on the floodplain. The hydrological buffer capacity of the floodplain helps to reduce the peaks of extreme floods for the benefit of locations downstream.
- **Provisioning services:** The wetland supports forests for intensive wood production, as well as commercial fisheries and hunting (Figure 2, over page).
- **Cultural services:** Tourism and ecotourism (hiking, visiting study trails and bird-watching towers, canoeing, small-boat cruising, biking and travelling by forestry railway), recreational and traditional fisheries and hunting.

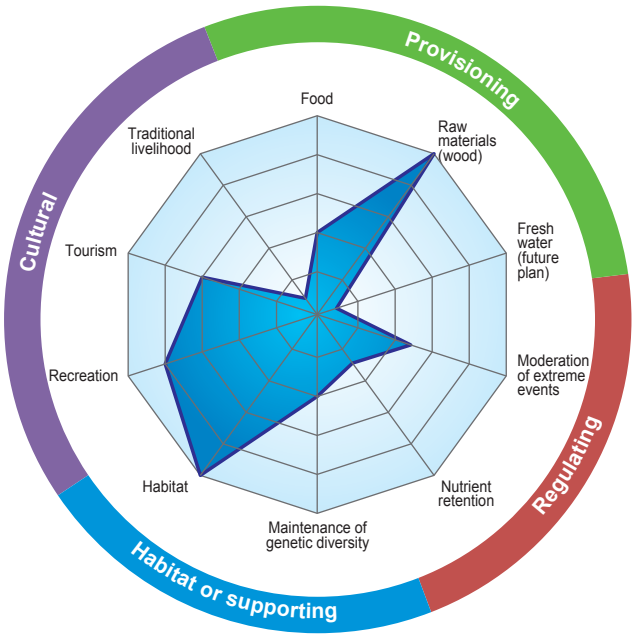


Figure 2: Relative importance of ecosystem services in the Gemenc floodplain, in its present state

Major management issues of the Gemenc floodplain

River training works have shortened and narrowed the river channel, resulting in significantly increased water velocities. Barrages built on the Upper Danube reaches are retaining sediments in their reservoirs. The higher water velocities and lower sediment transport lead to the incision of the riverbed. At the same time, the sedimentation process has caused aggradation on the floodplain surface. Ongoing incision and aggradation processes have significantly reduced the frequency and duration of inundations of the wetland. This, in turn, has triggered a desiccation process; the typical alluvial wet flora has gradually been replaced by dry vegetation.

Managing the floodplain forests is an important issue

The most important management issue from an economic perspective, is how the floodplain forests are managed. The recent intensive wood production, with inclusion of alien species, is not in line with the goals of nature conservation. This also threatens ecotourism and recreation, services that are becoming increasingly important. The threats to the Gemenc, in general, and to the Báta subsystem, in particular, and their causes are illustrated in Figure 3.

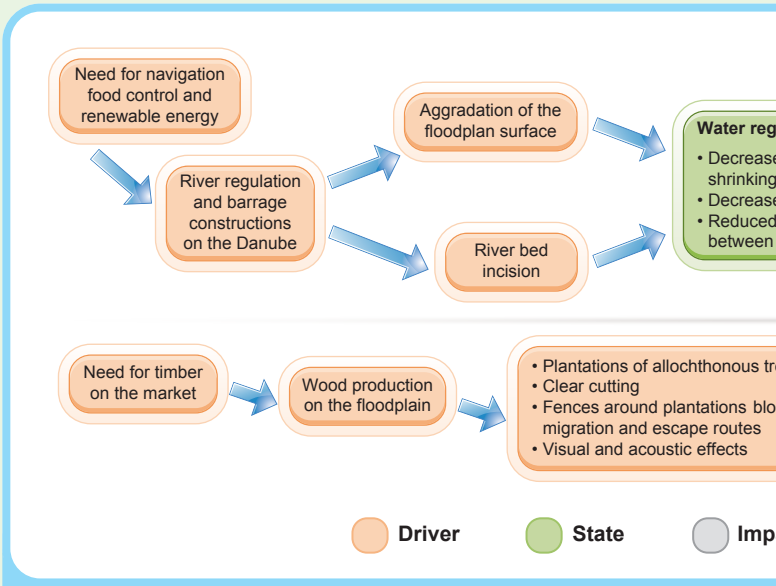


Figure 3: Driver-Sta chains for the Geme

Identifying actions that will reverse detrimental changes

To counteract the harmful impacts of the hydro-morphological and ecological changes, the following technical restoration options were identified by a project under the Global Environmental Facility (GEF) (VTK Innosystem, VITUKI, 2010):

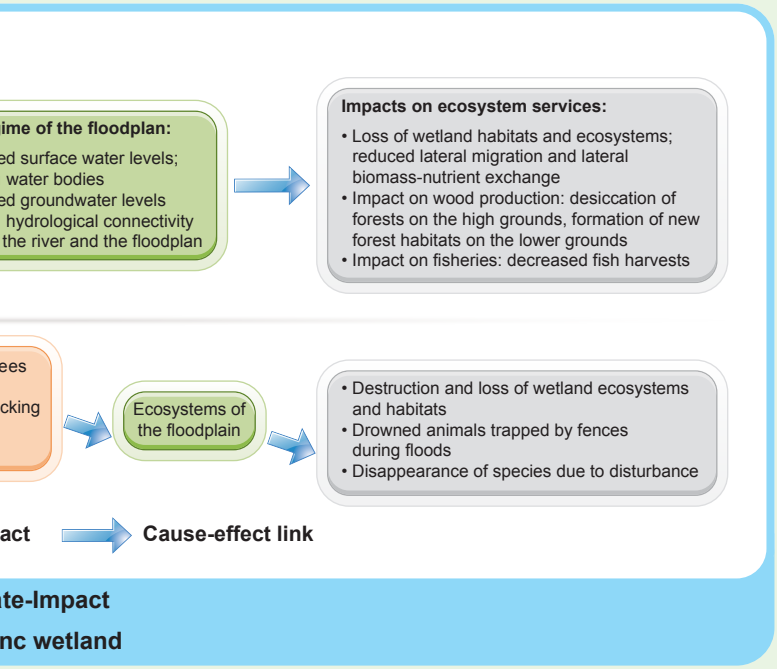
1. Improve lateral hydrological connectivity by dredging and cleaning the connecting channels
2. Increase the size of water bodies by means of weirs or bottom sills that retain water on the floodplain after the floods
3. Dredge the beds of the water bodies to increase depth and water volume
4. Restore the alluvial forests by replacing the present intensive wood production with ecologically sound forest management. In practice this means thinning instead of clear-cutting, no plantations, no fences and no allochthonous species.

With regard to the Báta sub-system of Gemenc, the second and third restoration options from the above list have been implemented within the frame of the GEF project.

Assessing the vulnerability of the Gemenc wetland

Ecosystems of the Gemenc floodplain are subject to long-term changes, driven by riverbed incision, floodplain aggradation and climate change. These drivers influence the hydrological

conditions of the floodplain by altering (directly or indirectly) floodplain topography, river water levels and local conditions of precipitation and evaporation. Investigating vulnerability requires quantitative predictions of these boundary conditions



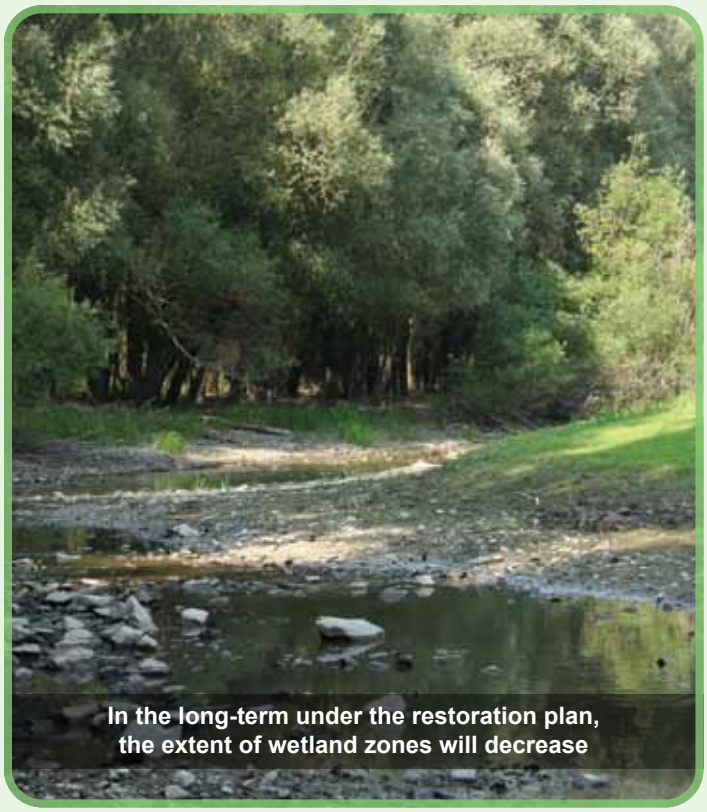
well into the future. Scenarios, covering the time period 1990-2050, were generated with the help of morphological and climatic models.

A hydrodynamic model was used to assess the impacts of scenarios and restoration measures on the water regime of the floodplain. Results of hydrodynamic modeling that simulated water levels in the Báta sub-system were input to hydro-ecological analyses, which quantified the ecological indicators used for the evaluations (Table 1).

A 21-year time series of daily water level was generated and analysed to derive statistical indicators, based on which the impacts on eco-hydrological conditions can be assessed and compared.

Ecological indicators		Status quo 1990-2010	GEF plan, moderate impoundment, 1990-2010	GEF plan, moderate impoundment, 2030-2050	GEF plan, maximum impoundment, 2030-2050
Habitat zones with dominant vegetation (% of total area)	No surface water influence: hardwood forests	81.7	81.7	93.5	93.9
	Periodic surface water influence: poplar forests	11.4	11.3	4.3	2.7
	Permanent surface water influence: willow forests	2.2	2.2	0.5	0
	Water logged: willow bushes	1	0.9	0.1	0.1
	Lasting water cover: pioneer vegetation	1.9	0.3	0.1	0.7
	Permanent water cover: water plants	1.9	3.7	1.4	2.6
Lateral hydrological connectivity (days in growing season)		158	96	32	16

Table 1. Combined impacts of changing boundary conditions (riverbed incision, floodplain aggradation, climate change) and restoration measures of the GEF project on the ecological conditions of the Báta sub-system



In the long-term under the restoration plan, the extent of wetland zones will decrease

The models indicate that implementing the proposed restoration plan will double the area of the 'permanent water zone' in the short-term, benefitting aquatic ecosystems at the expense of the 'lasting water cover' zone and its ecosystems. No significant changes will occur in the areas of the other zones. In the long-term, however, the spatial extents of all the wetland zones will dramatically decrease compared to the status quo even with implementation of the restoration plan. Even the option with maximum impoundment of the Báta system cannot counteract the ongoing hydrological degradation. Eventually the changing boundary conditions, as well as the restoration measures, will degrade the lateral connectivity between the floodplain and the main channel.

Valuable lessons for the future

Model-based investigations show that the Báta subsystem of the Gemenc floodplain is highly vulnerable to the external drivers of sedimentation, riverbed incision and climate change. The

ongoing restoration project is capable of restoring the desired aquatic habitats only in the short-term, even if water retention is pushed to its limit. In the long-term, conditions will deteriorate and, 30-40 years from now, the areas of aquatic, semi-aquatic and wet habitats will be smaller than before the implementation of the restoration plan. Within 60-70 years, the Báta oxbow will no longer provide habitats for aquatic species and the entire area will be covered by terrestrial communities. This will be harmful, not only for the aquatic species, but also for terrestrial species feeding on fish and amphibians. Living conditions for the black stork, the symbolic animal of the Gemenc, will deteriorate seriously. Only the wood production business would benefit from this desiccation process, as more and more areas will become available for planting trees.

These conclusions are valid not just for the Báta subsystem, but also for the other water bodies of the Gemenc floodplain. Thus, decision makers and stakeholders interested in the management of the Gemenc floodplain have two choices. They can accept the fact that the positive effects of the restoration project will prevail only in the short-term; in the long–term, the terrestrialization process will inevitably turn the entire Gemenc into dry habitats. Alternatively, they can look for auxiliary management options to ensure the sustainability of the envisaged ecological conditions, for example, dredging the bed of the oxbow every 30-40 years.

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References

VTK Innosystem, VITUKI, 2010. GEF - Nutrient Reduction Project, Duna-Dráva National Park, Baseline study and licensing support component, Environmental impact study. Final Report. GEF-Nutrient Reduction Project (TF 055 978) Contract Registry No. 1-33/2009.

About WETwin

The WETwin project aims to enhance the role of wetlands in integrated water resources management for twinned river basins in the European Union (EU), Africa and South America in support of EU water initiatives. The objective is to improve community service functions while conserving good ecological status.

Partners

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Potsdam Institute for Climate Impact Research, Germany
WasserCluster Lunz, Austria
UNESCO-IHE Institute for Water Education, the Netherlands
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