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WP 3 the Tisza River Basin Characterisation-SW

Activity 3.5 Evaluation of the significant water management issues and proposal of effective measures

Evaluation Abstract of the Implementation and Results of the Four Water Management Projects Carried out Along the Tisza River

Part 2

Annex 7.2

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DANUBE REGION strategy

Acknowledgements

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Contents

Summary of the projects examined

Complex flood control and revitalization development of flood basin in the Bereg area (EEOP-2.1.1-2009) and the development of landscape management infrastructure in Bereg and in the area of the Bereg flood-reducing reservoir (KEHOP-1.3.0-15-2015-00004)

General assessment criteria

Abstract– Phase I.

The representatives of the Central Bureau of Water (VKKI) and Environment and the Upper-Tisza Regional Environmental and Water Directorate (FETI-KÖVIZIG) of the Environment and Energy Operational Program (Code: EEOP-2.1.1-2009), published in the framework of the "Complex flood control and revitalization development of flood basin in the Bereg araea" a Consortium known as "Reservoir in the Bereg area" (Consortium) has no legal personality in order to achieve a successful task.

Table 1. The main data of the project. (Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009)

Project title	Complex flood control and revitalization development of flood basin in the Bereg area
Project administrator name	Central Bureau of Water and Environment
Address of the project administrator	1012 Budapest, Márvány street 1/d
VAT can be recovered (yes, no)	no
Number of affected settlements (pcs)	164
Population concerned (thousand people)	252 797
Planned date for submission of the 2nd round (month, year)	November 2010
Planned date of completion of project implementation (month, year)	November 2014
Total investment cost (HUF)	26 847 000 000
Eligible investment costs (HUF)	26 847 000 000
Non-eligible investment costs	0
Beginning of project preparation (month, year)	June 2008
Planned completion of project preparation (month, year)	January 30, 2011

During the design of the reservoir, the main aim was to flood the flood waves between the protective lines set up to the required size below the standard flood level. It can be used to reduce peak wave velocity over the most critical section of the Tisza stenosis in Tivadar area. The planned 58 million m^3 reservoir is expected to reduce the flood level by 40-80 cm. In addition, reservoirs are designed to serve ecological and land use needs, and to create ecological and economic interests. Regarding the Bereg reservoir, it is written that: “beyond the achievement of the primary objective, it is possible to

exploit surface water resources in a natural way to support border rural development and to preserve natural values. The construction of the planned reservoir would increase flood protection costs, thus significantly reducing the probability of flooding of agricultural areas, protected ecosystems, residential architectural relics in the area, and resolving Bereg's water supply, which would promote the economy's growth and population resilience improvement. "

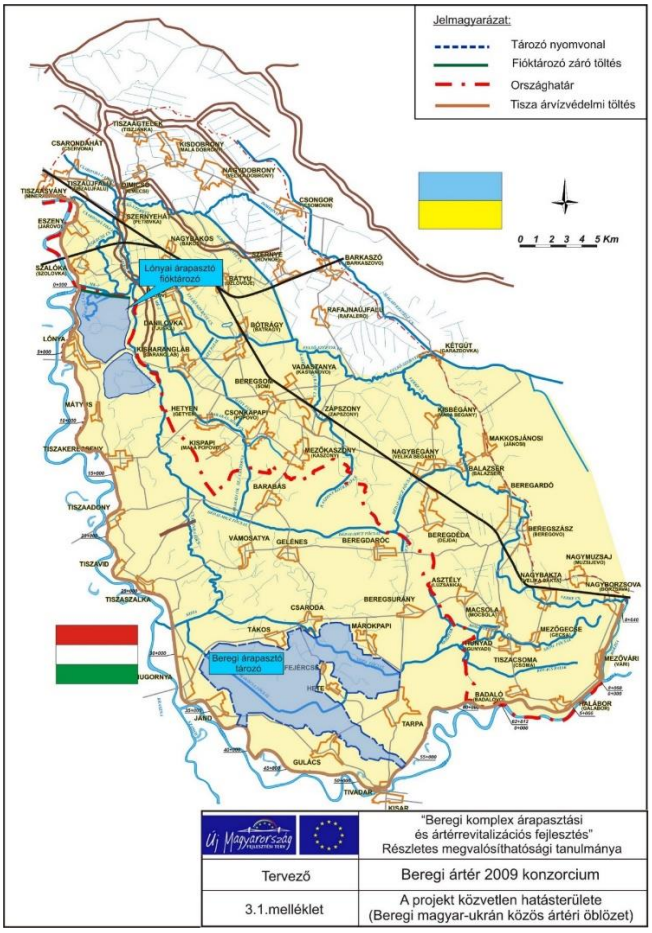

Figure 1. The area affected by development.

Abstract– Phase II.

The New Bereg Water Management Association has won support in November 2011 for the project preparation of "Improvement of landscape management infrastructure in Bereg and in the area of Bereg flood-reducing reservoir EEOP-7.2.1.3 / 10-11-2011-0003". During the process in 2012 and 2013, a detailed feasibility study, preliminary archaeological documentation, landscape management plan and management program concept, preliminary inspection documentation and NATURA2000 impact assessment, a water rights building permit plan, were completed. The water rights establishment plan was obtained, and tender dossier and land use planning documentation were completed. Subsequently, in February 2013, the Association submitted a grant application for implementation, for which a decision was approved on 30 January 2014, the project EEOP-2.1.3 / 11-2013-0002 got 907 487 776 HUF grant.

Regarding the 2013 amendements to the Act No. LVII of 1995 on water management, the New Bereg Water Management Association and the Upper-Tisza Regional Water Directorate (FETIVIZIG) responsible for development have agreed to become FETIVIZIG's beneficiary and project manager of

the landscape management project and, as far as possible, the landscape management project will be implemented in parallel also the project **"Complex flood control and revitalization development of flood basin in the Bereg area EEOP-2.1.1 / 2F / 09-2010-0007"** managed by FETIVIZIG. Considering the opportunities and dangers and other institutional-organizational issues involved in the joint implementation of the two projects, FETIVIZIG has decided not to conclude a grant agreement for the implementation of the landscape management project in 2014 but, of course, looks for and looking for funding resources to be opened in the near future so that a project prepared in full detail can be realized as soon as possible. By the end of 2015, when the KEHOP resources were available, the General Directorate of Water Management (OVF) and FETIVIZIG submitted a grant application for implementation.

Table 2. Key project facts (Phase II)

Project title	Landscape management infrastructure development in Bereg and in the Bereg flood-reduction reservoir
Project administrator name	Landscape Management Consortium in Bereg
Address of the project administrator	1012 Budapest, Márvány street 1/d
Location of the project, matching the New Vásáhelyi Plan (VTT) design location	Aranyosapáti, Jánd, Csaroda, Márokpapi, Tarpa, Hetefejércse, Gulács, Tákos, Beregsurány, Vásárosnamény-Gergelyiugornya, Vámosatya, Lónya, Mátyus, Tiszakerecseny, Tiszaszalka, Tiszavid, Tiszaadony, Barabás, Gelénes
Area affected by water management development (ha)	862
Number of affected farmers / number of consenting statements (pcs), (ha)	148/143 pcs, 862/782 ha
Length of the sewerage network (km)	3,2
Number of works (pieces)	26
Reservoir Capacity (m^3)	~7 million
planned cost of the project (HUF)	1 200 000 000
Estimated cost of operation of the implemented project depending on pumping (HUF/year)	21 000 000-34 000 000
Eligibility of the project administrator to reclaim VAT	no regard for Articles 85 and 86 of the Act No. CXXVII. of 2007 on VAT

The project is implemented in the **Bereg floodplain (also called water management system), on the one hand, in the area of the Bereg flood reservoir, and on the other, in the area of the detouring depot of Lónya**, which is organically connected. **In addition, it covers mosaic the whole area of the floodplain.** Consequently, the presentation of the background and environment covers the 378 km^2 area of Bereg, referring tangentially to the cross-border areas, in view of the division of the Beregi floodplain and water system with the borders.

Primary and other objectives of the project

Phase I.

The project is aimed at the complex development of the water management and water damage management system of Bereg, with the aim of nature conservation, settlement development and economic development. The untouched landscape values of the area can be increased by the development of wetlands, watercourses and revitalization of the floodplain. Current developments

within the framework of the project can reduce the damage caused by increasing weather extremes - floods, inland waters and droughts. The complex nature of the development is important for the facilities to be built simultaneously to perform more functions (water damage prevention, water supply, better water management), and interfaces with developments on both sides of the border.
The development is realized in the unestablished 2.01 Bereg floodplain where
-the main flood protection lines in total: 62,182 km,
-the length of defective lines: 27,750 km
-the remaining defective protection lines length after the completion of the project: 27,750 km. (*Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009*)

Phase II.

One of the main goals of the Bereg flooding reservoir, as the present landscape management projects, is that **these areas can be used for overflow retention and, in the case of droughty years, to ensure their survival and revitalization by water supply**.
Occasional rinsing of deeper and larger backwaters in the Bereg reservoir is an important objective as it can serve as a spawning place for natural fish stocks and increase the natural stock of the Tisza.

The **objectives of the landscape management system** to be set up can be summarized as follows:
1. To facilitate the realization of land use that best suits natural conditions and land use abilities, taking into account their expected changes as well.

2. Developing landscape management in which the state intends to improve the environment by means of farmers, while improving the living conditions of farmers (by creating a compensating payment support system).

3. Landscape management based on water retention (land use and cultivation methods) should contribute to the quantitative and qualitative conservation of recoverable water resources,
a., to improve the water management of soils (to improve the water storage capacity of soils)
b. to preserve the quality of the waters that are generated in and out of the area.
4. Better adaptability of land use to the flood control function, both the quality of water recycled after flood storage and the better manageability of storage tasks. Changing uses would help improve adaptability, and the system to be built would have water steering.

Flood protection objectives

The preparations for the complex development of the Bereg reservoir and the associated water system were carried out in the framework of the Hungarian-Ukrainian joint Interreg project between 2005-2007.
In spite of the finished and ongoing flood protection charge developments, the flood safety of the area remains unsatisfactory, and the water levels and discharges in the upper Tisza can continue to increase in the future, which can be inferred from the following studies:
- Analyze the negative effects of accelerating Ukrainian flood protection charge developments;
- Simulation model examinations of possible future flood waves;
- Examinations of the decline in mountainous forests;

- An examination of the presence of anomalies other than general hydrological statistical rules on the Vásárosnamény-Záhony section of Upper Tisza;
- Analyzes of the extent and effects of the replenishment of the river basin. (*Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009*)

With the construction of the reservoir, the flood load is reduced. Indicators of reduced impact on floods for all flood protection sections:
- total flood plain building deficit: ΣÖKÁT = 6299 cm * km
- after the completion of the project, the reduction of the total flood pressure of the flood protection area of the flood plain: ΣÖVÁTP = 6142 cm * km.

Table 1. Results of the project. It does not contain data beyond the country (Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009)

Name of the result indicator	Unit	Initial value	Date	Target value	Date
As a result of the development, the number of protected residents is adequately protected against flood damage	thousands of people	0	2010	161	2014
Change in the number of people who are adequately protected against flooding	thousands of people	0	2010	161	2014
The proportion of people who are adequately protected against floods compared to the number of people affected	%	0	2010	100	2014
Hydraulic efficiency (Hh)	not relevant				
Inequality Index (Em)	not relevant				

Water management goals and development needs

In addition to the flood control function, the emphasis should be placed on the inland water storage and the development of the inland water drainage system, which is necessary for the safety of settlements endangered by inland waters and arable farming.

Measures applied

Measures for flood control

Bereg flooding reservoir and its related facilities

The reservoir is designed to allow flooding as low as possible in the largest possible area. There are defensive lines along the roads linking the Gergelyiugornya-Jánd-Gulács-Tivadar, Gergelyiugornya-Tákos-Csaroda-Márokpapi-Tarpa settlements, and between Hetefejércse Tarpa are high-altitude boundaries of the reservoir. The main parameters of the reservoir are:

- Volume: 58 million m^3,
- the legal area of a reservoir: 60 km^2,
- water outlet location: Over Tivadar, Tisza 707 rkm,
- water abstraction capacity: 600-1000 m^3/s,
- Hungarian flood level (MÁSZ): 114,90 mBf,
- maximum storage level: 109,60 mBf,
- reservoir charging crown level: 110,60 mBf,
- static flooding surface: 52,3 km^2,
- average water depth: 1,11 m.

Other measures, related facilities:

- Flood reservoir chargings, crown pavement, chargings accessories and substrate sites;
- Planned forest band;
- The inlet of the reservoir;
- The drainage of the reservoir;
- Building bridges with road sections;
- Inland facilities connected to the Flood Reservoir;
- Construction of new channels;
- Reconstruction of existing state and corporate channels;
- Renovation of new dirt roads, construction of new ones
- Lónya detouring depot. *(Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009)*

Further development of the water management system for water supply

The complex nature of the development of the reservoir in Bereg lies in the fact that it is able to supply water discharge functions in addition to the tidal function. To this end, the following measures were taken:

- Construction of a water replacement channel with culverts and engineering structures connected to the major drainage structures in Bereg;
- Discharge of water at Tiszaszalka;
- Development of the Csaronda, Dédai-Mitz Depositions;
- Partial dredging and cleaning of the Main Channel Csaronda;

- Construction of bottom lines in Csaronda and Szipa;
- Renewal of existing water management works, construction of new ones in Bereg water system.

In the operation of the facilities, priority must be consider the nature conservation and landscape management aspects, and must be given to great emphasis discharging of inland waters from settlements and meeting the water demand of the agricultural areas.

From a conservation point of view, water retention and short-term, shallow flooding on the salvaged side floodplain areas are beneficial, with which some of the beneficial effects of river regulation and flooding prior to the construction of the reservoir can be given somewhat back to the local ecosystem.

Natura 2000 compensatory measures

The Natura 2000 sites affected by the investment:

Natura 2000SAC	HUHN200001 Upper-Tisza
	HUHN200045 Kaszonyi mountain-Dédai forest
	HUHN200047 Vámosatya-Csaroda
	HUHN200048 Tarpa-Tákos
	HUHN200049 Lónya-Tiszaszalka
Natura 2000SPA	HUHN100001 Szatmár-Bereg

On the basis of preliminary analyzes, **areas suitable for compensating** habitat types for flat and hilly meadows (89,6 ha) and areas suitable for compensating habitat types of Hardwood forests and Pannon hornbeam oaks (46,2 ha) **were designated**. "The proposed level of compensation for the habitat types of the" Flatland and hilly meadows "(code 6510) is a minimum of 60 ha for new habitats" *(Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009)*

Flatland and hilly meadows

Following the purchase of a suitable area, habitat reconstruction and post-treatment (min. 3 years) is recommended. Recommended steps for **habitat reconstruction**:

- Procurement of propagating material;
- In the framework of soil preparation, a series of dialing followed by two rows of ring tones;
- Granting seed mixtures to soil surface in an amount of 20 to 25 kg / ha;
- Two rows of rings following sowing;
- Machine mining to reduce the spread of weed species;
- Grassland with grazing and mowing for at least 3 years. *(Complex flood control and revitalization development of flood basin in the Bereg area. Detailed feasibility study, 2009)*

Hardwood forests and Pannon hornbeam oak trees
*Recommended steps for **habitat reconstruction**:*
- Soil preparation;
- Sapling planting or acorn sowing;
- Post-processing works.
Within the framework of the project, a total of 58,5 ha of new forest planting was installed, the main purpose of which is to protect the charges against the waves.

Equal opportunities measures

The Central Bureau of Water and Environment (VKKI) and the Upper-Tisza Regional Environmental and Water Directorate (FETI-KÖVIZIG), the following equal opportunities measures are undertaken:

- apply equal opportunities,
- the existence of an equal opportunity plan (employment EOP)
- involve the target group of equal opportunities or its representatives in the design of the project.

Presentation of the planned measures of the II. Phase

The project is realized in Bereg flood plain in Szabolcs-Szatmár-Bereg county, and the settlements concerned are Gulács, Tivadar, Jánd, Tákos, Csaroda, Márokpapi, Tarpa, Hétfejércse, Beregsurány, Beregdaróc, Gelénes, Vámosatya, Barabás, Tiszaszalka, Tiszaadony, Tiszakerecseny, Matthias, Lónya, Vásárosnamény-Gergelyiugornya. The population concerned is over 22,000.
The technical content of the selected "B" version is:
- Creating **temporary pumping stations** in the 706.94 and 715.45 rkm sections of the Tisza.
- Construction of 26 water retention and water management structures in the Bereg water system,
- Arrangement of stock, conversion into wetland,
- Reconstruction of canals (56 km),
- Depot extraction 332 m,
- Construction of new water replacement channels (3),
- Development of a monitoring and operational control system.

Water recovery and water management of works of the flooding reservoir works, alignment of the operation and operation of the elements of the existing reservoir system with the developments planned in the project.

Beneficiaries and stakeholders of the intervention

In the first round of the competition, the project promoter (project administrator) - and thus the beneficiary - was the Upper-Tisza Regional Environmental and Water Directorate (FETI-KÖVIZIG). For the second round, for the implementation phase FETI-KÖVIZIG will establish a consortium with the Central Bureau of Water and Environment (VKKI), jointly developing project management. Local stakeholders are Local Governments, County Defense Committees and NGOs.
The project involves about 1400 land users, mostly small-scale farmers. The area designated for territorial water retention is 862.3 hectares, which affects almost 300 farmers on 300 plot numbers (*Kovács, 2016*)
The construction of the Bereg flooding reservoir has affected 14 settlements in Bereg and its inhabitants, since it has been transferred to 19 settlements, serving the people and property security

of more than 23,000 people. The construction works of the Bereg reservoir were carried out by a Consortium of Colas-Alterra Zrt., Kötiviép'B Kft., Ke-Víz 21 Zrt. and Bridge Construction Specialist Kft.
The protective effect of the reservoir affects between Tisza-Szamos, between Tisza-Túr, Upper-Szabolcs, the right part of the Tisza, including Ukraine Bereg, the Slovak and Hungarian Bodrogköz. The indirect impact area covers, among other things, the area of the Csap-Záhony-Ágcsernyő border crossing junction, which is very significant for the passenger and freight traffic of Eastern Europe.
The water-leveling effect of the Bereg flood reservoir is illustrated in Figure 2. The graph shows that the water level control of the reservoir can be detected up to 508.78 rkm. Absorption takes place over Tivadar at 707 rkm, at 701 rkm the water level drop reaches maximum efficiency (40 cm). This efficiency is effective up to ~ 691 rkm, with only 26cm water drop. From 690 rkm to ~ 570 rkm, the efficiency (~ 3cm / 40km) decreases at a slower rate, and the water level lowering effect of the reservoir is 2,5 cm from 16 cm in the last 60 km.

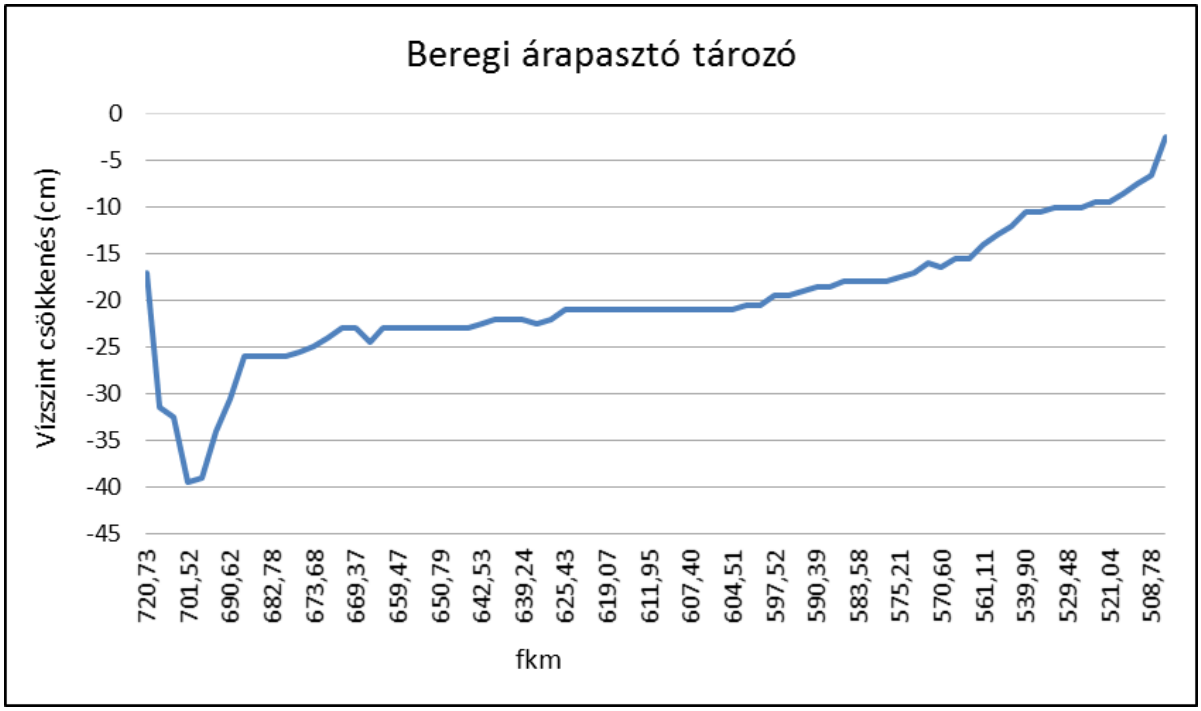

Figure 2. The Bereg flooding effect on the water level of the Tisza between 508.78 and 720.73 rkm

Stakeholders of the II. Phase

The Bereg landscaping area affects **1374 land owners** (farmers), while 72.4% of farmers manage less than 10 hectares (992 farmers).
The farmer's program largely deviates from the practice of the current agri-environment program so as to more effectively encourage territorial water retention. The area designated for territorial water retention is **862.3 hectares**, with about 315 geographic numbers affecting 148 farmers.
Number of declarations of intent to support territorial water retention during the planning process 2012-2013 and affected areas:
- **143 land users**, area **781.8 hectares**.

Involvement of farmers, leaseholders and other stakeholders involved in the investment - in the elaboration of the basic concept of the landscape management system, in the planning and "execution" of the system – was **90.7%.** The involvement of stakeholders was supported by the Declarations of Intent attached to the EEOP Second Round of the 2013 Call for Proposals. (Based on these, the support decision was born)

Maintenance tasks

The tasks related to the maintenance of water and public water facilities are set out in Government Decree No. 120/1999. (VIII.6.) . In the interpretation of the Regulation, the reservation is to be carried out on water and public water facilities, which must be carried out on a regular or occasional basis for safe operation and normal use, including partial replacement of essential elements of the constituent part of a building or other tangible property, as well as directly related to breakdown and recovery on other tangible assets. (*Bereg Flood Reduction Reservoir - Operation, Handling and Maintenance Manual, 2015*)

Government Decision No. 2005/2000 (I.18.) On the Revised Development Plan of Hungary's Flood Protection Works considers the issue and tasks of flood protection as part of the country's disaster security policy and accordingly maintains and develops state-owned flood protection works.

Chapter I. “Flood protection works” of the Annex “Maintenance works on public water and water damage facilities” of the Government Decree No. 120/1999. (VIII.6.) contains the following maintenance tasks:

1. Maintenance of flood protection charging, backwater basins and their drainage channels:

- emboss of crown,
- the design of the tilt angle of slope according to the original dimension of the protection plan,
- elimination of faults in the coverings, up to 100 m in length,
- creation of reserve reservoir and alternative option,
- grassland cultivation: mowing at least twice a year, weeding, in addition sowing, sowing again, irrigation,
- degassing, dredging of channels,
- writing rodents,
- snow removal.

2. Maintenance, replacement and removal of charging accessories (such as barriers, stairs, high-water marks, ramps, gauge blocks used for fixing blanks (V.O. stones), expropriation stones, road signs and other signs).

3. Correction of defects in the flood protection wall, flood gate and other flood protection works, maintenance of the state of the permit plan and necessary work due to deterioration:
- replacement, shut-off, lifting and moving structures,
- elimination of leaks and cavities,
- restoration and partially rebuilding of claddings and support walls,
- removal of icing.

4. Work required to achieve original protection as a result of deterioration in the charge, flood protection wall or subsoil thereof, in particular:
- elimination of altitude deficiencies,
- control and elimination of leaks,
- watertight charge protection,
- filling material pits and other pits.

5. Creation of a charge-side floodplain and salvaged side bar: clearing of terrain, replacement of overlay, drainage, lawn care, cutting of trees and bushes.

Handling and maintenance

Periodic and continuous review and maintenance of realized facilities and equipments must be carried out in accordance with the operating and maintenance manuals as described in the operating instructions.
The operator of the facilities is the Upper-Tisza Regional Water Directorate (FETIVIZIG).
In addition, the facilities have an on-site operator recorded in the Operation, Handling and Maintenance Manual.

The flooding structures should be kept under regular control, maintaining their consistency and efficiency, maintaining their operational capabilities, preventing emergencies and damages from their failure, repairing any necessary repairs and periodically maintaining their technical maintenance.
The facilities to be built and upgraded are under state control and have been put in place. FETIVIZIG has the necessary professional staff to operate.
The premises of the completed system for water management (charges, depots, wacky charge sections, channels, sluices, inlaying and drainage structures, monitoring elements) are operated, operated and maintained by FETIKÖVIZIG. The task of the management organization will be the operation and maintenance of crossing bridges and roads of the canals. The management of the state-owned and corporate management channels is the New Bereg Water Management Company. The company undertook a statement to ensure the preservation of the channels it manages and renovates.

Phase II.– maintenance and operation

The maintenance and operation of the project will be guaranteed by the Beneficiary for a mandatory 5-year period. Operation will be carried out directly by FETIVIZIG. The Operating Regulation will contain the operating rules and options. Operations will have to be carried out in line with the requirements of farmers and the nature conservation manager.

Strategic fit for related strategies and directives

The project, in addition to the water damage prevention function, is closely aligned with the conservation of natural values. It contributes to enhancing biodiversity, climate change policy.

Hungarian-Ukrainian Transboundary Waters Convention:
The international legal basis of the present Hungarian-Ukrainian transboundary cooperation is the Convention between the Government of the Republic of Hungary and the Government of Ukraine, signed in Budapest on November 11. 1997. (Government Regulation No. 117/1999 (VIII.6.) The exchange of notes on approval was made on 16 April 1999)

The Convention consists 17 articles and two annexes. Each article relates directly or indirectly to the common tasks of preparing for flood disasters, most directly concerned by Article 6 (Planning Works), Article 9 (Flood and Inland Water Protection), Article 10 (Information Exchange).

The **Water Framework Directive** (WFD) intends to put water management planning and water management on an ecological basis. Its objective is the quantitative and qualitative protection of waters while at the same time preserving and improving the status of water-dependent ecosystems. ie the creation of a framework for sustainable water management. The project fits in to this goal, as it seeks not only to achieve flood safety, but also to retain water and thus use of available water resources in a precipitation gap that contributes to sustainable water management.

According to the evaluation of the **"Complex Tisza"** program, the basic condition for the development of tourism is the adequate existence and potential of the potential areas of living in the potential areas, and can therefore only be treated in the context of other economic activities. These principles also meet the development ideas of the Bereg area, as the already complex flood protection-water management-floodplain revitalization plan provides space/opportunity for land use change, rural development and tourism development. The Feasibility Study on Flood Safety focused on the **"New Vásárhelyi Plan" (VTT)** to fit the program.

The developments are well suited to the **Floods Directive,** the II. National Development Plan for Environment and Energy (**EEOP**) and the Regional Operational Program (**ROP**). Within the EEOP, the "Good Flood Protection Practice" is described separately within the "Good Water Management" priority axis. Within this they want to provide resources for the realization of VTT's goals and other flood protection developments on the other. KEOP's primary objective is to reduce flood risks. Risk reduction here means reducing the likelihood of a given severity flood event, thereby reducing the likelihood of the associated damage in human health, the environment and economic activity. As far as society and farming are concerned, the changes need to create better and safer living conditions and long-term management opportunities in the affected areas, increasing the population's retention power. Because of global climate change, the aim is not only the preservation of flood safety, but also the retention of water and thus the use of available water resources during the drought period. To achieve this, right land use and complex water management are required. As part of the Environmental and Energy Operational Program, this plan is also linked to the priority axis "Good management of our natural resources", primarily through the rehabilitation, reconstruction and sustainable use of the site. As part of the National Development Plan, plans are also connects to the "Improving the Earning Capacity of Tourism" priority axis of the Regional Operational Program.

Catching to regional plans

Integrated regional development, rural development and environmental protection program of the Vásárosnamény micro-region (2005): The aim of the program is to harmonize the development of micro-regional and VTT-related developments, in particular the opportunity to live up to regional development opportunities opening up flood protection development. (See eg increasing local tourism opportunities, developing tourism infrastructure, creating Bereg-Szatmár Nature Park.
The concept of the bicycle network development of Szabolcs-Szatmár-Bereg County (2005): The concept includes bicycle paths between Tiszamogyorós - Lónya (national border) (T-65), between Gergelyiugornya - Beregsurány (national border) (K-3) and between Nyíregyháza - Vásárosnamény, which is designed along the main road No. 41. The concept includes links to cross-border areas, and identifies bicycle paths that can be built on the top of the charges of flooding reservoirs.

Sewage Placement Program of Szabolcs-Szatmár-Bereg County (2002): In the program prepared for the request of the Regional Development Council of Szabolcs-Szatmár-Bereg, the most important directions of settlements' sewage drain and treatment tasks were determined simultaneously with the possibilities and conditions.
Communal waste management development program: The municipalities of Szabolcs-Szatmár-Bereg county (229) and 11 settlements of Borsod-Abaúj-Zemplén county have signed a consortium agreement for the joint implementation of the municipal solid waste management system. The program corresponds to the Regional Waste Management Plan of the Northern Great Plain Region. The Bereg settlements will be members of the Regional Waste Management Association of Upper-Szabolcs and Bereg Region.
Programs for the protection of water quality in groundwater and the quality of drinking water: Implementation of the National Drinking Water Protection Program launched in 1996 in the region. In most areas of vulnerable water resources in the region, drinking water baseline protection diagnostic jobs funded from the central budget have been completed. As a result of drilling excavations, water quality analyzes, tests, etc. and the groundwater hydraulic modeling based on them, for preventive protection purpose the hydrogeological protection areas of the water bases have been designated for the protection of the population with high quality drinking water. (Government Decree No. 123/1997. (VII.18.)) At the end of 2008, the local government association was established, which in the settlements with inadequate water has implemented drinking water quality improvements.

Legal framework

EU policy background

- EU Water Framework Directive
- EU Floods Directive

Domestic policy background

- Legislation on water damage prevention is based on the **Law No. LVII 1995 on Water Management**. Based on the authorization of the Act, the **Government Decree No. 232/1996. (XII.26.)** provides for rules on the protection of waters against the damage of water, which requires that the owner of the facility be responsible for management and develomnent of the protection facilities. The applied development facilities are owned by the Hungarian State, managed by the Upper-Tisza Regional Environmental and Watre Directorate.
- The law and the Decree were made based on the **KHVM Decree No. 15/1997. (IX.19.)** *on the Flood Levels of Rivers.* The decree defines the standard water level of the Hungarian rivers and the security of construction.
- **Government Decision No. 2005/2000 (I.18.)** on the Revised Development Plan of Hungary's Flood Protection Works includes the necessity of development.
- The Government has taken more decisions to increase flood safety, including the Tisza Valley. **Government Decision No. 1022/2003. (III.27.)** decided on the concept of increasing the flood risk of the Tisza Valley (further development of the Vásárhelyi Plan), **Government Decision No. 1107/2003. (XI.5)** aimed to increase the flood safety of the Tisza valley and the regional and rural development program of the area concerned.
- In 2004, the Parliament established the **Low No. LXVII of 2004** on the public interest and implementation of the program for territorial and rural development of the area concerned (the further development of the Vásárhelyi plan) in increasing the flood safety of the Tisza valley. The law incorporated the elements of the concept contained in the above resolutions.
- After the extraordinary floods in the Tisza and Danube valleys in 2006, on the basis of Government Decision No. 1003/2007. (I 24.) Law No. LXVII of 2004 was amended by the Law No. CXLIX. It requires ... "to be implemented in VTT ... the construction of the flood control

works of the Tisza Valley as prescribed, in line with the increase of the water supply capacity of river basins, with interventions to facilitate drainage, ensuring the change of landscape and land use of rivers of floodplains ..."

- The relationship between the National Spatial Planning Plan and the Bereg Project: **The Law No. XXVI. of 2003** provides the National Spatial Planning Plan (OtrT). Its adement is the **Law No. L. of 2008**, of which Annex 1/11. provides for "National Reservoirs, Flood Reservations and New Water Works". In the course of the amendment it came into law under reservoir Jánd-Gulácsi name the Bereg flooding reservoir.

Phase II. relevant regulatory environment:

- The reconstruction of the inland water drainage system and the irrigation system as well as the construction of a new drainage system for water supply and drainage are subject to a water permit, which is regulated under **KHVM Decree No. 18/1996 (VI.13)** on the application and annexes to the water permitting procedure.
- The envisaged activity regulated the **Governmental Decree No. 147/2010 (IV.29.)** on general rules for activities and facilities for the use, protection and damage prevention of waters.
- When drawing up the Water Permit Licensing Plan, it should be taken into account that, in view of the surface of the highly sensitive water base protection area classified as "1a" for groundwater is not possible to establish a permanent or periodic water-covered area or a "stagnant water" area. (According to **Governmental Decree No. 123/1997 (VII.18)** on the protection of water basins, long-term water bases and the protection of water installations for the supply of drinking water.)
- **The Law No. LIII. of 1995** on the General Rules for the Protection of the Environment (Ktv.) **the Act No. XLIII. of 2000** on Waste Management (Hgt.) should be taken into account during implementation.
- According to the handling of dredging mud which is generated during development work, if placed slope of the rebuilt backwater, is not covered by **Decree No. 20 of 2006 (IV. 5.) KvVM** of the Ministry of Environmental Protection and Water Management on certain rules and conditions concerning waste tipping and landfills. KvVM decree does not apply in accordance with Article 1 (2) (c) thereof.
- The regulations of the **Decree No. 98 of 2001 (VI. 15.)** Korm. of the Government on the requisites for activities related to hazardous wastes must be followed for hazardous waste generated. Particularly with regard to the collection of hazardous wastes from other wastes, which are not endangered by the environment.

Geographical Description

Sub-basins of the Bereg inland water system

The Bereg inland water system was created as a series of artificial interventions. The territorial delimitation of the current sub-basins can be done by affiliation with each main reception site. Depending on the operational status of the intermediate water management facilities, some areas may be linked to two or more subsystems.

Characteristics of Bereg flood plain

The boundaries of the Bereg bay are: The southern and western boundaries of the floodplain bay is between Vári and Ásvány and right bank charge of the Tisza (from Tarpa to Lónya in Hungary). In the north the left bank charge of the Latorca (between Ásvány and Csongor in Ukraine) between Csongor and Gát (separating Bereg bay from the Szernye boulder), the left bank depot of the Magasparti channel, the munkács-Beregszász connecting driveway between Gát and Beregdaróc, the western foot of the Beregszász mountain between Beregdaróc and Bene, the right bank charge of the Borsa between Bene and Vári. The total area of this demarcated area is 930 km^2, the Hungarian part is 376 km^2, and 40% of the whole battalion.

Flood risk management (ÁKK) planning unit	Flood plain
Upper-Tisza planning unit	2.01 Bereg flood plain

Water Management Plan (VGT) sub-basin	Water Management Plan (VGT) sub-unit	Related watercourse(s)	Geographical location
Tisza sub-basin	2.1	Lower szernye main channel	The affected area is located under the 60/200 Council Directive (Water Framework Directive, WFD) in the area of the Danube river basin, Tisza Sub-basin 2.1 Upper-Tisza design sub-area
	2.1	Upper szernye main channel	
	2.1	Csaronda-Tisza main channel	
	2.1	Csaronda-Latorca main channel	
	2.1	Szipa-Csaronda main channel	
	2.1	Vérke main channel	
	2.1	Magasparti main channel	
	2.1	Dobrony main channel	
	2.1	Barabás-Micz main channel	
	2.1	Kaszony-Bótrágyi main channel	
	2.1	Dédai-Micz main channel	
	2.1	Szipa main channel	
	2.1	Gáty creek	

Scale and scope of measure:

	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
The scale of the measure				√		
Description	The protection system is capable of accommodating 58 million m³ of water in a 60 km² area, with a mean water depth of 1,11 m, which is supplemented by a 12 million m³ reservoir in the Lónya area. The 50.7 km long new charge that surrounds the reservoir, directly adjacent to the 19 protect settlements, was built. A total of 69 water protection works were built. Bereg has a mosaic landscape structure. Meanwhile, on the other hand (48%) field cultivation is taking place. The variability of the landscape is due to the relatively high proportion of arable fields (28%), natural grasslands (13%) and natural forests (11%). On the Bereg Plateau land use is characterized by the creation of permanent crops around the settlements, the varied location of small and big arable fields, the high proportion of mosaic natural areas created by natural forests and grasslands.					

Phase II.	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
The scale of the measure				√		
Description	The project is realized in the Bereg floodplain (also known as the water management system), on the one hand, in the area of the Bereg flood control reservoir, on the one hand, and on the other, in the area of the detouring depository of Lónya, which is organically connected.					

	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
Measure effect area					√	
Description	The indirect protection of the reservoir affects the whole of the Upper Tisza valley (Tisza-Szamosköz bay, Tisza-Túr bay, Felső-Szabolcsi bay), and the Ukrainian part of the Bereg flood plain and the entire Bodrogköz flood plain (both Hungarian and Slovak. (Annex 3.2) Apart from the 19 Hungarian settlements in Bereg, there are also further 145 settlements (Hungarian, Ukrainian, Slovak) directly affected by the development. The indirect impact area covers, among other things, the area of the Csap-Záhony-Ágcsernyő border crossing junction, a large part of European passenger and freight traffic is involved. The water level reducing effect of the reservoir can be detected up to 508.78 rkm. Water intakes place over Tivadar at 707 rkm, at 701 rkm the water level drop reaches maximum efficiency (40 cm). This efficiency is effective up to ~ 691 rkm, with only 26 cm water drop. From 690 rkm to ~ 570 rkm, the efficiency (~ 3cm / 40km) decreases at a slower rate, and the water level lowering effect of the reservoir is 2.5 cm from the last 60 km, 2.5 cm from 16 cm.					

Phase II.	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
Measure effect area					√	
Description	The project is realized in the Bereg floodplain (also known as the water management system), on the one hand, in the area of the Bereg flood control reservoir, on the one hand, and on the other, in the area of the detouring depository of Lónya, which is organically connected. In addition, it covers the entire area of the floodplain mosaic. Based on the above-defined objectives of the project, the direct impact area of the project can be considered at least once every 10 years endangered by inland water. The estimated area of this is 10,000 ha on the basis of the FETIVIZIG landfill data series. The indirect effect of the project is, in a broader sense, the whole area of the Bereg floodplain bay, as it contributes mosaic to the preservation and conditioning of the landscape.					

Rehabilitation of Öreg-Túr Phase I. - II. (NOGPOP (ÉAOP)-2009-5-1-2/D1-09, EEA C3-9)

Summary

In the 1920s, in the 70 km of the Túr started with the river bed arrangement and charge building for flood and inland water protection. Investments were necessary for the safety of the population, but the adverse impact on the unique wildlife of Túr was unfavorable, which can be eliminated by raising the water level in such a way that the safety of the population is not endangered. Planning and implementation were implemented through a number of projects built up together. The source has been created from various EU and EEA funds. In this evaluation, we examine the actions of the projects **"Rehabilitation of Öreg - Túr 2010 Phase I"** (NOPGPOP-2009-5-1-2 / D1-09) and **"Rehabilitation of Öreg - Túr Phase II"** (EEA C3-9).

The main goal of the project is to organize, revitalize and revitalize the Öreg-Túr, from the village of Sonkád to Olcsvaapáti, to adapt to the settlements developmental plans, so that their ecological values will not be damaged or further enriched. The basic philosophy of the project is that **Öreg-Túr should not be rejuvenated, but to provide a beautiful old age**.
The project's history is the HU-RO-SCG 1/142 project entitled "The Comprehensive Rehabilitation and Development of the Túr Water System (Öreg and Élő Túr)" in the Hungary-Romania INTERREG CBC Program (2006-2007), where complex water damage prevention, water management, nature conservation development concepts have been developed and in accordance with ecological status survey, water quality survey and completed a feasibility study of a large scale complex investment.

The Upper-Tisza Regional Environmental and Water Directorate (FETI-KÖVIZIG) received funds to develop plans for a water rights building permit holder of large-scale complex investment project. The title of the project is the **"Complex Program for the Conservation of Nature Values and Increasing Flood Safety in the Túr's Floodplain"** Registration Number: INTERREG III/A Hungary - Romania Cross-Border Cooperation Program HUSKUA/05/01/139. The complex rehabilitation of the Túr water system is aimed at increasing flood safety, combining flood remediation and tourism development. At the end of the project, plans for water replacement and water regulation

facilities for the complex rehabilitation of the water system Túr were completed. On the basis of the plans, the acquisition of water rights and environmental permits was also started.

The rising of the Öreg-Túr water levels was designed to be built by dams, by the transformation and rebuilding of existing structures. There was also a need to take care of river bed arrangement in some places, paying close attention to preserving and improving ecological conditions. By transforming the order of business, harmoniously aligned the aspects of inland water drainage, water utilization, tourism recreational utilization and conservation of ecological values.

The implementation of the tasks in the plans was divided into two phases. **"The Rehabilitation of Öreg-Túr 2010 Phase I"** Project NOGPOP-2009-5-1-2/D1-09 in the lower section of Öreg-Túr has led to water level raising and the ecological water replacement of oxbows in 2010-2011.

Implemented by the Project: Upper-Tisza Regional Water Directorate

Project duration: May 2010 – December 2011

Project Total Cost: 318 195 484 HUF

Interventions in the upper section of Öreg-Túr are carried out in the **"Rehabilitation of Öreg-Túr II. Phase**" project in the period 2015-2016. The financial source was provided by *the EEA Financial Mechanism 2009-2014 Adaptation to Climate Change program*.

Implemented by the Project: Upper-Tisza Regional Water Directorate

Project duration: May 2015- April 2016

Project Total Cost: 894 617,42 €

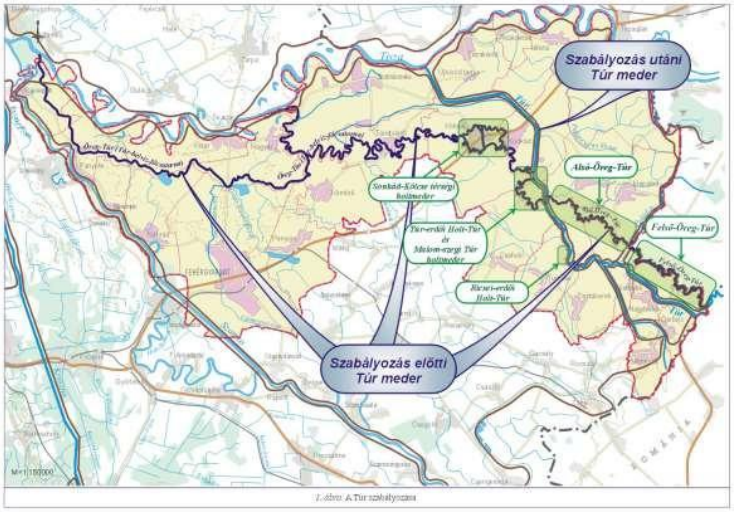

Figure 1. Overview map of the project area

Primary and other objectives of the project

The improvement of the water conditions of Öreg-Túr was to be solved in order to improve the landscape value. Arrange and revitalize the Öreg-Túr from Sonkád to Olcsvaapáti, to create conditions adapted to the settlement development goals, so that their ecological values will not be damaged or even further enriched and maintained by the Öreg-Túr's inland drainage function. Within the project, three specific objectives have been defined:

1. Increasing the security of the inland water damage prevention in the Tisza-Szamosköz.
2. Establishing habitats and watercourses that are typical of aging water bodies in the Öreg-Túr basin as well as establishing similar conditions for connecting dead riverbeds.
3. Supporting the settlement and regional development goals through the development of the two previous activities.

The following goals have been designed to achieve these goals:

Construction of water management facilities in the Öreg-Túr basin and its surroundings to ensure small water regulation. The concrete elements of construction:

- spillover construction at Nábrád,
- construction of a sluice for the water supply of the Báka-szeg dead-riverbed
- Construction of a control structure on the channel that get around of the water mill at Túristvánd,
- Establishment of 4 water level meter distance signaling stations at the Kövessy sluice, the Petőfi sluice, the Nábránd spillover and the Kömörő sluice,
- Installation of 1 ultrasonic -flowmeter monitoring station at the Sonkád clamping sluice
- Assurement approaching road of Kömrő flow splitter

Reconstruction of some existing facilities to ensure water management and inland water discharge.

- reconstruction of the Kövessy sluice,
- rebuilding of the Báka-Szeg Channel, exchange of existing culvert,
- the reconstruction of the trap door culverts (2 pieces) of Nagyar,
- the reconstruction of the clamping sluice (63 + 415 km), which forms part of the distribution sluice of Sonkád,
- In the left bank 11 + 300 km section of the Túr river, renovation of a small spill structure, a part of Sonkád distribution sluice

Arrangement of river basin and riverside in some places with a view to increasing the water transfer capability and increasing the landscape values.

- elimination of sloughing at Öreg-Túr left bank depot between section 0 + 000-0 + 130 km
- rebuilding deep river bed which hampers higher water level in downtown of Kölcse,
- arrangement of the channel bank that get around of the Túristvánd water mill
- river basin arrangements at Kölcse and Túristvánd in section 2-2,

Developing new management solutions, **creating the necessary monitoring system and obtaining tools**

- Provisional operational regulations and then elaboration of a new operational plan with a detailed breakdown detailing the entire length of the 63 km long Öreg-Túr with the basic detailed geodetic survey data.
- Engineering workstation with IFIX process control software for process control of data of monitoring stations
- Laptop purchasing for site readout and calibration
- The FETIKÖVIZIG is preparing a new plant management plan for its own construction to obtain Topcon HiPer + RTK GNSS Receiver and VC200 Field Controller for field measurements as a complement to our existing workstation.

Measures applied

Environmental Impact Assessment Documentation prepared in 2008 for water and environmental permits. Natura 2000 Impact Assessment Study was not prepared.

Győző Kövessy sluice:
After small changing the current status of the sluice can be used to maintain the required level of water
(Up to 400-420 cm)

Construction of a new dam in Nábrád
The new bottom dike (reinforced concrete or mixed construction).

Reconstruction of the Kömörő flow splitter
According to the examinations, the existing structure can provide the desired afflux (0.5-0.8 m) without reconstruction, so it is only necessary to change the operating order.

Construction of a new dam in Túristvándi
The new bottom dike (reinforced concrete or mixed construction).
Construction of a new dam at Sonkád (instead of existing "Zombory weir")
The new bottom dike is reinforced concrete structure.

Improving the water supply of the Túr oxbows
Municipal and inter-municipal developments will be assisted in ensuring the water replacement of the oxbows in the Túr.

Oxbows that can be incorporated into water replenishment and rehabilitation:
Báka-szegi oxbow
Construction of water intake and water retention sluice structure.

Tarpai-szegi oxbow
Construction of water intake and water retention sluice structure.

Szoros-szegi oxbow
Construction of water intake and water retention sluice structure.

Sonkád-Kölcse regional Öreg-Túr
By rebuilding the "Zombory Dam", water replenishment can be provided.
It may be necessary to rebuild culverts.

Túr-erdői Holt-Túr
Construction of a water inlet sluice (existing demolition).

Malom-szegi Holt-Túr
Construction of a water inlet siphon (Ø800), construction of a culvert with gate at the Kálnok-Borza canal mouth.

Ricsei-erdői Holt-Túr
Construction of a water inlet siphon (Ø600).
The institutional background of the implementation of the plans is represented by the state bodies (environment and water management directorates, water management associations, national park directorate, rural development office) and local government associations.

Beneficiaries and stakeholders of the intervention

The preparation of the project was implemented by the Municipality of Szabolcs-Szatmár-Bereg County under the INTERREG program. The "Rehabilitation of Öreg-Túr Phase I and II." projects were implemented by FETIKÖVIZIG. The construction works were done by Békés Drén Ltd. and KELETÉPVÍZ Ltd. selected in public procurement.

The beneficiary of the project is the affected area, the population of 13 settlements in Öreg-Túr region, a total of 18,600 people, the state and local authorities responsible for environmental protection, including inland water safety and the management of operational defenses.

The project is supported by the Chairman of the General Assembly of Szabolcs-Szatmár-Bereg County, the Hortobágy National Park Directorate, the Municipalities of Olcsvaapáti, Panyola, Kömörö, Túristvándi, Nagyar and Kölcse and the Szamos Bazár Association.

Maintenance tasks

The technical, construction part of the 1st phase was completed on May 30, 2012. As a result of the construction work, the system is operational. In 2012, financial closure took place. The water

rights management permit was dated December 28, 2012, No. 11478-13 / 2012. was issued by the for Upper-Tisza Regional Environmental Protection, Nature Conservation and Water Management Inspectorate. The licensee is the Upper Tisza Region Water Directorate (FETIVIZIG), valid until 31 December 2027.

The owners of the facilities are the Hungarian State, while FETIVIZIG is responsible for the maintenance tasks, thus ensuring the long-term maintenance of the structures. Ecological monitoring should be carried out every 3 years to maintain natural systems and to follow-up the impact of interventions. The first report should be submitted to the Hortobágy National Park and the licensing authority in 2015. The report concludes that the stabilization of re-colonized creatures is relatively slow in the sections affected by reconstruction, river basin and shore insurance, and the river basin insurance is a barrier to the formation of a zonation characteristic of the watercourse. The regeneration of damaged vegetation has started. After the intervention, new habitats were created and water resources improved. The next survey will be due in 2018, the impact of measures implemented at a Phase II will also be examined.

Strategic fit for related strategies and directives

Rehabilitation of the Öreg-Túr could be realized from the interconnection of several projects between 2006 and 2016. Preparatory work and planning started in the framework of the Hungarian-Romanian cross-border INTERREG project, in line with the EU Water Framework Directive and the recommendations of the Hungarian-Romanian Border Committee. As part of the National Development Plan, plans are also included in the Regional Operational Program "Improving the return on the economy of tourism". Within the EEOP, the project is linked to the priority axis "Good water management".

Jenő Kvassay Plan (2015) and Surface Water Management Plans (VGT1 2010) were created during the project implementation phase, but they are in line with their goals. The water management also plays a major role in the UN Sustainable Development Goals (SDGs) adopted in 2015.

<table>
<tr><td rowspan="2">Jenő Kvassay Plan, Surface Water Management Plan, Sustainable Development Goals</td><td colspan="2">Is in line with the objectives of the Rehabilitation of Öreg-Túr project</td></tr>
<tr><td>Yes</td><td>No</td></tr>
</table>

improving water quality	√	
increasing the efficient use of water	√	
implementation of integrated water management		√
protection of aquatic ecosystems	√	
extending international cooperation	√	
involving local communities in water management	√	

Legal framework

For the construction of hydraulic structures, a water permit is required, which is based on Act No. LVII of 1995 on water management should be obtained.
Additional legislation:
Act No. XCIII of 1995 on restoration of protection levels in protected areas
Act No. LXXXI. of 1995 on the Convention on Biological Diversity
Act No XXVIII of 1998 on the protection and welfare of animals

Geographical description

The project area is located in the Great Plain great landscape (1), in the Upper-Tisza Region middle landscape (1-6) within the **Szatmári-sík small landscape (1-6-12)**. The small landscape is located in the territory of Szabolcs-Szatmár-Bereg County, with an area of 1200 km^2. It essentially covers the catchment area of the river Túr. The area is flat, with a slight southeast-northwest slope. The terrain height at the Hungarian-Romanian border is 119.50 - 120.00 mBf, at Olcsvaapáti 109.50 - 110.00 mBf. (mBf=meters above Baltic Sea level)

The area of the project is 1,700 km^2, its height is 80 to 105 mBf. It is an alluvial plain covered with loose sediment. The relative relief value of the area is small (1 m/km^2), it is a flood plain that covered by a dense network of abandoned and filled river beds. Soggy meadows have evolved in poorly run-off areas. Apart from Tisza and Túr, there are significant rivers of Szamos and Kraszna.

The small landscape is covered by holocene river bed sediments 1 to 12 m thick, and the pleistocene layers turn up to a large thickness of up to 100 m, which also contain rough and pebbly layers of good water-proof properties. The annual rainfall is 610-670 mm due to the nearby Carpathian tracts.

Typical forest communities are the willow, willow-poplar mixed gallery forests, oak-ash and elm gallery forests and the alder swamps. Dominant plant communities of the meadows are wet alluvial meadow (Alupecuretum pratensis) and tall-sedge communities (e.g. Caricetum acutiformis-ripariae, Caricetum gracilis, etc.)

The table below identifies the Surface Water Management Plans (VGT) territorial delimitations, complemented by the Flood Risk Management (ÁKK) demarcation.

The floods of the Túr endanger three flood basins: Palád-Csécsei 2.55, Szamosközi 2.57 and the Upper-Túri 2.56

Surface Water Management Plans (VGT) sub-basin	VGT-sub-unit	Related watercourse (s)	Geographical location
Tisza	2-1 Upper-Tisza	Öreg-Túr, Élő-Túr,	The area of the project is located in the Upper-Tisza valley. Most of the surface is filled plains, formed by rivers.

Flood Risk Management (ÁKK) design unit	Flood plain
Upper-Tisza	Palád-Csécsei 2.55, Szamosközi 2.57 and the Upper-Túri 2.56

The table below shows the area affected by the intervention.

	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
Scale of measure		√				
Description	**Construction of water management facilities in the Öreg Túr basin and its surroundings to ensure water regulation. Reconstruction of some existing facilities to ensure water management and inland water decontamination. Arrange the basin and its banks on a periphery to increase the water transfer capability and increase the countryside values. Development of a monitoring system**					

The results of the measures have a significant impact on the water level, flow rate and discharge of the Öreg-Túr.

	0-0.1 km² / km	0.1-1.0 km²	1-10 km²	10-100 km²	100-1000 km²	>1000 km²
The scope of the measure				√		
Description	It has an impact on the water supply of the Túr oxbows and on the groundwater level and the inland risk of the surrounding areas. Élő-Túr 31 km, Öreg-Túr 63 km section affected.					

Evaluation of measures

For the evaluation of measure we applied the methodoly described in chapter 3. We have used the "natural water retention measures" project results (presented at chapter 3.5), which results are also part of the 2nd phase of water-management planning. The mentioned project assessed measure types in a solid structure.
The viewpoints can also be applied for the assessment of realized measure and can be applied as a check list. This way a concentrated, essential evaluation was prepared in a unified structure. Main aspesct are nature protection, water management, social and financial aspects. The evaluation doesn't consist a flood riks management evaluation. The nature protection aspects are biophysival impacts and ecosystem services benefits. For the assessment of Water Framework Directive perspectives we have applied the elaboration of water management meaures prepeared at the 2nd phase of water management planning, which consists a thourougly prepared analyse of the possible affects of measures. These possible affects are examined through the evaluated projects.
The statements are grouped and summarized in the frame of SWOT-analyeses. The SWOT-analyses are prepared for measures, based on the evaluated projects.
Through the evaluation we followed the solid structure of assessment, where the first two colomns are the evaluation criteria. Third colomn is the scale of the impact of the measure, the fourth embraces the justification.

MEASURE: Establishment of a lowland reservoir with complex utilization

Biophysical effects

Biophysical effects spillway system – flood storage		Rating	Evidence
Slowing and storing Runoff	Store Runoff	**Low**	Its opportunity is prepared; the realization is hampered by practical obstacles.
	Slow and store runoff	**Low**	Its opportunity is prepared; the realization is hampered by practical obstacles.
	Store river water	**High**	Along River Tisza the ice-free flood level decreases by at least 1.0 m compared to the current standard flood level.
	Slow river water	No effect	
Reducing Runoff	Increase evapotranspiration	**Low**/ Medium/ High	It has created an opportunity to improve water supply, and its exploitation is hampered by practical obstacles.
	Increase infiltration and/or groundwater recharge	**Low/ Medium/ High**	It is high in case of flooding but this can only happen sporadically and is temporary. In case of non-flood mode, the enhancement of the area's water supply is low due to its limited implementation.
	Increase soil water retention	No effect	
Reducing Pollution	Reduce pollutant sources	No effect	
	Intercept pollution pathways	No effect	
Soil Conservation	Reduce erosion and/or sediment delivery	Low/ Medium/ **High**	It is high during flood retention; the retained water deposits its sediment. It is minimal in normal operation mode.
	Improve soils	Low/ **Medium/** High	As a result of flood retention, the deposited sludge improves the soil condition while other sediments can worsen it. The transported propagation materials make the area weedy and support the spread of invasive species. It does not have an effect in case of normal operation mode.

Biophysical effects spillway system – flood storage		Rating	Evidence
Creating habitat	Create aquatic habitat	Low/ Medium/ High	Flood retention does not have an effect. The improvement of water supply of aquatic habitats existing during normal operation mode may happen.
	Create riparian habitat	No effect	
	Create terrestrial habitat	No effect	
Climate change	Enhance precipitation	No effect	
	Reduce peak temperature	No effect	No effect, or only at local level and only at the time of water cover.
	Absorb and/or retain CO_2	No effect	

Ecosystem Services Benefits

Ecosystem services spillway system – flood storage		Rating	Evidence
Provisioning	Water storage	Low/ Medium/ **High**	In case of flood retention, 58 million m3 capacity.
	Fish stocks and recruiting	No effect	It does not have an effect either in case of flood retention or normal operation mode.
	Natural biomass production	Low/ Medium/ High	No effect. In normal operation mode, due to practical reasons water replenishment at the area may only happen incidentally and it only affects a small area and the growth of biomass production is minimal.
Regulatory and maintenance	Biodiversity preservation	**Low/** Medium/ High	In normal operation mode, the established water replenishment system makes possible the improvement of water supply at a limited area.
	Climate change adaptation and mitigation	Low/ Medium/ **High**	The construction of a flood reservoir is necessary, inter alia, because of more frequent floods and rising levels of flood propagation due to extreme weather conditions.
	Groundwater/aquifer recharge	**Low/** Medium/ High	In normal operation mode, the established water replenishment system makes possible the improvement of water supply at a limited area, so ground water replenishment is limited.
	Flood risk reduction	Low/ Medium/ **High**	Reduction of the flood level by 1 m.
	Erosion/sediment control	Low/ Medium/ High	It is high during flood retention; the retained water deposits its sediment. It is minimal in normal operation mode.
	Filtration of pollutants	No effect	No effect
Cultural	Recreational opportunities	No effect	No effect

Ecosystem services spillway system – flood storage		Rating	Evidence
	Aesthetic/cultural values	Low/ Medium/ High	The dams spoil the landscape.
Abiotic	Navigation	No effect	
	Geological resources	No effect	
	Energy production	No effect	

Analysis according to the Water Framework Directive

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization	Evaluation / Measure	Description

Achieve Good Surface Water Status	Identification of river basin management measures	6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands 23.4 Water retention with storage in lowland excess water reservoirs, or bed storage in bay-like widened sections	The measure is typically applicable to large rivers or lowland small and medium watercourses. Elements: flooding of deep floodplains, water replenishment of oxbows, and local restoration of floodplains. The application is subject to the modification of land use. This is carried out by the change of land use and cultivation branch (2.4) related to the measure, which allows the development of utilization methods complying with the changed circumstances. This can ensure proper maintenance as well. River basin management planning does not investigate the possibility of lowland bank-side reservoirs. This is a deficiency because water replenishment on the protected side is also feasible in the area of a flood reservoir, as long as its technical, operational and management planning is carried out. In the first phase of the project, the construction of the complex reservoir of Bereg was realized, which resulted in the creation of a reservoir area on the protected side, surrounded by a ring levee. Flooding of the reservoir can be accomplished under planned and controlled circumstances. One of its aims is to reduce the level of flood waves, and another goal is regular water replenishment for landscape management purposes. The possibility of water replenishment on the protected side is realized for the latter purpose. This latter aim was achieved in Phase 1 by providing technical conditions for regular water replenishment, i.e. the possibility of water replenishment was created, but no regular water replenishment was carried out within the measure. The establishment of a reservoir with complex utilization can affect the Bereg drainage system in the area, which is one of the country's most exposed areas to excess water. According to the Pálfai assessment system, the area typically falls within category IV. and III. Risk of excess water is caused by agricultural lands and settlements affected by excess water. Accordingly, the aim of the development was the conversion of agricultural land. It should be noted that the occurrence of excess water and floods often coincides. This makes the operating procedure difficult with which smaller flood waves are released to the area for water replenishment, as this often involves inland inundation. The establishment of the reservoir and the

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization		Evaluation / Measure	Description
			structures necessary for its operation will, however, allow excess water retention, thus improving the water regime of the area. To achieve this, the conversion of agricultural land is also necessary.

	Improving status of biological quality elements	Medium (locally)	The construction of the technical facilities of the Bereg reservoir in Phase 1 did not improve the quality status of the biological elements. The measure aiming at landscape management must be taken into account when considering the measure, and the two measures must be interpreted together. Ecological impacts are extremely complex due to the size of the intervention and the diversity of the nature conservation areas concerned. Ecological impacts have been studied by the Natura 2000 impact assessment, which presents the adverse effects in detail, while hardly mentioning the expected favourable impacts. Statements of the document present that the intervention can be significant locally. In view of this, the maintenance and operational plans should be formulated in such a way as to reduce the adverse impacts presented in the impact assessment, and retain the benefits. In summary, the Natura 2000 impact assessment makes the following findings: “From the point of view of nature conservation, it is preferable to retain water of the Bereg area in the channel system, in the oxbows and in the deeper areas (see Figure 65) (hence increasing groundwater level or reduce its fluctuation, and improving the microclimate). For this reason, the revitalization of the oxbow system, i.e. establishing the possibility of regular water replenishment, water change in as many places as possible, is of the utmost importance for nature conservation. It is also important to reduce the risk of rapid drainage in both the river bed system and the drainage system by the construction of appropriate water retention structures.” The Environmental Permit also makes the following statements: there is a significant risk of the emergence and spread of invasive species on the meadows (*6510*), against which a management plan is required, and a proposed condition is to ensure the operator’s interest in maintenance. The rare floods do not have a significant impact on hardwood gallery forests (*91F0*), but the expected formation of sediment hills during the operating period means a local negative effect. Periodic flooding of butterfly habitats can cause significant

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization		Evaluation / Measure	Description
			damage to internationally protected stock. (Source: Environmental Permit). In case of butterfly habitats, the date of flooding is a major consideration. This typically coincides with the time of the spring floods, resulting in an expected conflict between nature conservation and flood protection. Flooding of habitats can be harmful even at low water depths, therefore it is necessary to handle conflicts that may arise even in the case of flooding aiming at landscape management.
	Improving status of physico-chemical quality elements	None	The quality status of the physico-chemical elements has not improved. *
	Improving quality status of specific pollutants	None	The quality status of specific pollutants has not improved. *
	Improving status of hydromorphological quality elements	None	The status of hydromorphological elements has not improved. *
	Improving chemical status and priority substances	None	The chemical status has not improved. *

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization		Evaluation / Measure	Description
Achieve Good Groundwater Status	Improved quantitative status	Low	In the case of flood storage, the amount of water released to the reservoir means groundwater recharge depending on residence time. How regular this effect is depends to a great extent on the frequency of storage. According to the operational regulations, the opening of the reservoir occurs only in rare floods (i.e. floods exceeding 1% flood waves), so only in rare cases. *
	Improved chemical status	None	The chemical status has not improved. *
Prevent Deterioration	Prevent surface water status deterioration	Low	The measure does not have a significant impact on the prevention of surface water deterioration. Long-lasting lowland storage with low water levels can result in water quality deterioration, which means that the effect of storage on water quality may even be unfavourable. *
	Prevent groundwater status deterioration	None	It has no significant impact on groundwater quality status.
** The evaluation of the measure must take into account the interventions aiming at landscape management, as a measure, and the two measures must be interpreted together.*			

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization	Evaluation / Measure	Description
Additional impacts expected by river basin management planning	Natural resources and natural environment	(+) increase of natural habitats and biodiversity, expansion and quality improvement of ecosystem services (e.g. ecological corridor function), (+) creating semi-natural habitats, restoring previously existing wetlands, increasing landscape ecological values – **IN GENERAL, REGULAR WATER REPLENISHMENT AIMING AT LANDSCAPE MANAGEMENT IS FAVOURABLE FOR THE ECOSYSTEM, BUT BOTH OPERATION AND MAINTENANCE MUST BE DETERMINED CONSIDERING IMPACTS ON NATURE CONSERVATION.** (+) the restoration of close-to-nature floodplain ecosystem and the conditions of floodplain management – **REGULAR WATER REPLENISHMENT, AND THE RETENTION OF EXCESS WATER IMPROVES THE WATER MANAGEMENT OF THE PROTECTED SIDE, THUS THE CONDITIONS OF FLOODPLAIN MANAGEMENT AS WELL.** (+) controlled drainage reduces drought sensitivity – **BOTH WATER REPLENISHMENT AND RETENTION OF EXCESS WATER REDUCES DROUGHT SENSITIVITY.**

	Economic	(+) creating opportunities for landscape management better suited to the local conditions – **THE CONSTRUCTION OF RESERVOIRS IMPROVES THE POSSIBILITIES OF LANDSCAPE MANAGEMENT, BUT IT HAS TO BE CONSIDERED TOGETHER WITH THE INTRODUCTION OF LANDSCAPE MANAGEMENT MEASURES.** (+) expansion of utilization opportunities (recreation, tourism, etc.). – **THE CONSTRUCTION OF RESERVOIRS IMPROVES THE POSSIBILITIES OF RECREATION AND TOURISM, BUT IT HAS TO BE CONSIDERED TOGETHER WITH THE INTRODUCTION OF LANDSCAPE MANAGEMENT MEASURES.** (+) decrease in irrigation demand, positive impact on agricultural production. – **IT CAN HAVE A POSITIVE IMPACT ON FARMING OF HIGHER AREAS.** (+) change in the exposure to excess water – **RISK OF EXCESS WATER IS REDUCED BY LAND USE CHANGES, BUT THIS IS SUBJECT TO THE CORRESPONDING REALIZATION OF PHASE 2.** (-/+) widening the floodbed entails the depreciation of previously protected land, and limitations of use; (-/+) abandonment of agricultural land or land use change may be necessary (lost revenues, disadvantages) – **THE APPLICATION OF THE "GREEN POINT-BASED SUPPORT SYSTEM" PROPOSED FOR THE RESERVOIR AREA WAS PROPOSED FOR PHASE 1. OF THE DEVELOPMENT. WITH ITS INTRODUCTION, THE SUPPORT SYSTEM CONSISTENT WITH LANDSCAPE MANAGEMENT CAN LEAD TO FAVOURABLE RESULTS FOR FARMERS, ON THE BASIS OF PREPARATORY STUDIES. ITS REALIZATION IS NOT KNOWN.** (-) the operating cost of the solution – **THE OPERATION COSTS OF THE RESERVOIR'S STRUCTURES ARE BORNE BY THE WATER DIRECTORATE. THE OPERATION NEED TO BE FINANCED FROM THE INCOMES RESULTING FROM THE OPERATION AIMING AT LANDSCAPE MANAGEMENT.**

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization	Evaluation / Measure	Description
	Social	(+) reducing drought sensitivity by the drainage and retention of water – **BOTH WATER REPLENISHMENT AND RETENTION OF EXCESS WATER REDUCES DROUGHT SENSITIVITY.** (+) reducing flood risks – **FLOOD RISK IS SIGNIFICANTLY REDUCED BY THE OPERATION OF THE RESERVOIR, ITS EXTENT IS DETERMINED BY THE OPERATIONAL REGULATIONS.** (+) the utilization methods provided by the system can create new forms of livelihood – **NEW FORMS OF LIVELIHOOD DEPEND ON THE FLEXIBILITY AND ENTREPRENEURIAL ABILITY OF FARMERS AND THE SUPPORT SYSTEM. THERE IS NO RELATED EXPERIENCE WITH THE IMPLEMENTATION OF PHASE 1.** (+) it requires production methods which are more demanding concerning work, expertise and cooperation – **THERE IS NO RELATED EXPERIENCE WITH THE IMPLEMENTATION OF PHASE 1.**

Analysis according to the RBMP Establishment of a lowland reservoir with complex utilization		Evaluation / Measure	Description
Maintaining the measure	Maintenance of the structures of the complex floodwater reservoir:	High	The maintenance of the technical facilities is carried out by the Water Directorate. In addition to maintenance, operation is an essential activity.
Summary of effects from the viewpoint of river basin management planning		**The possibility of water replenishment is ensured, but it has not been realized**	The reservoir with complex utilization has improved the connection between the river and the protected side. The degree of improvement is fundamentally dependent on the operational regulations, in particular with the implementation of regular water replenishment. If water replenishment takes place regularly and with adequate levels, the water replenishment on the protected side is beneficial for the water management of the area and the ecosystem affected by the flood. Operation should be based on local nature conservation considerations. The operation of the reservoir aiming at flood risk management also significantly influences how often the planned water replenishment is achieved. If the reservoir is opened only in the case of “extreme” rare floods of 1 % or less, the impact of drainage can be ecologically harmful due to the high water level and the persistence of inundation. This may be necessary for flood risk management, but there is also a need to strive to open the reservoir in case of more frequent floods with lower levels. The measure can have a positive impact on increasing retention of excess water, reducing drought sensitivity, and implementing and improving landscape management and related management methods. When evaluating the reservoir, it is necessary to take into account the related landscape management measure.

Expenditures

Cost category	Cost range (EUR)	Description
Purchase of land	961 million HUF	583 ha land acquisition
Preparation of surveys and studies	345 million HUF	Archaeological excavation and professional surveillance 295 million HUF
One-off compensation	510 million HUF	Land with 60500 Gold Crown value
Construction costs	18 684 million HUF	58 million m^3 of reservoir capacity and its connected structures 1,9 million m^3 material of levee is needed Two bridges with 200 m bridge span at the Tivadar-Tarpa and Gulács-Tarpa junction A bridge with 30 m bridge span between Jánd and Gulács Transfer of inland excess water crossing a reservoir dike requires sluice construction at 25 places 33 km new channel construction 61 km channel reconstruction 26 km new dirt road and 10 km existing dirt road renovation Lónyai reservoir and 3,7-km-long dike 58,5 ha of forest in a 20-meter stripe
Maintenance costs	76,2 million HUF /year	Spillway reservoir 50,3 million HUF/year Water system 20,9 million HUF/year The operational and maintenance costs are defined as per structures Renovation of structures every 6 years at the spillway reservoir 160 m HUF at the water system 25 m HUF

		Flood control costs are halved Recovery cost after floods drop to one third Renovation of dike pavement every 15 years is gross 170 million HUF
Additional costs	848 million HUF	PM cost 130 million HUF Technical inspector 601 million HUF
Reserve	470 million HUF	
VAT	5 029 million HUF	
Investment cost from this	26 847 million HUF	

SWOT analysis

Establishment of a lowland reservoir with complex utilization	
Strengths	**Weaknesses**
It has a significant flood risk mitigation impact. In some parts of the spillway area it creates possibility for water replenishment. Ecologically more favourable habitats may be established by water replenishment. Drought sensitivity may decrease. Provides opportunity for water replenishment on the protected side and improvement of floodplain habitats. By land use change, risk of excess water inundation, and the related damage and compensation costs can be reduced.	In case of flooding, compensation claim will be significant. Promotes spreading of weeds and invasive species. May become underused due to the water levels of the Tisza and the disadvantages caused to the farmers. The possibility of providing water replenishment covers only part of the area. Addressing the land use conflicts and the economic disadvantages of farmers is a prolonged process. Interest relations are not balanced.

Opportunities	Threats
Improvement of the flood protection of settlements. Creating an opportunity for agricultural transformation. Development of recreational opportunities and tourism.	Unrealistic assessment of secondary adverse effects, shortcomings in preparation for adverse impacts. Unrealistic assessment of needs and adverse interests. Favourable effects are not realized due to adverse interests. Maintenance is hindered due to the unavailability of operating and maintenance costs. Without land-use measures and an appropriate support system, the beneficial effects cannot be realized.

MEASURE: Development of landscape management infrastructure

Biophysical effects

Biophysical effects water retention, water replenishment		Rating	Evidence
Slowing and storing Runoff	Store Runoff	**Medium**	The development of landscape management infrastructure creates the possibility for storing inland excess water and withdrawing water from River Tisza by pumping even during lower water level. However, its applicability has two prerequisites: the farmers' approval and financing the costs of pumping. For these reasons, making use of the possibilities is limited.
	Slow and store runoff	**Medium**	Runoff is slowed by water storage at planned lowland areas, oxbows, river beds and clay pits.
	Store river water	**Low**	Water for storage and replenishment can get out into the Bereg reservoir through gravity during the floods of River Tisza, and by pumping at lower water level. Its degree can only be judged on the basis of practice. Its application is subject to certain conditions.
	Slow river water	No effect	
Reducing Runoff	Increase evapotranspiration	**Medium**	Flooding of clay pits and inland excess water retention in the channels increase water supply and thus the rate of evapotranspiration. The water replenishment in summer and the flooding of lowland areas is a possibility, and depending on the degree of its implementation the effects and the increase in evapotranspiration may be high.
	Increase infiltration and/or groundwater recharge	**Medium**	Flooding of clay pits and inland excess water retention in the channels already increase water supply and the rate of infiltration into the groundwater. Water replenishment in summer and flooding of lowland areas is a possibility, and depending on the degree of its implementation the effects and the groundwater recharge may be high.
	Increase soil water retention	No effect	
Reducing Pollution	Reduce pollutant sources	**Low**	The landscape management project aimed to better adapt agricultural production to landscape conditions, the realization of which is uncertain.

Biophysical effects water retention, water replenishment		Rating	Evidence
	Intercept pollution pathways	**Medium**	By establishing water retention possibilities, certain sections can be closed, water can be controlled, which allows the possibility of retaining any potential pollution. During water retention, nutrient use start in water and aquatic habitats, thus water quality improves.
Soil Conservation	Reduce erosion and/or sediment delivery	**Medium**	The sediment is deposited in the stored water, which may cause silting of the channels.
	Improve soils	**Low**	At temporarily flooded areas, the organic matter content of the settled suspended solids may have a positive effect on soil quality.
Creating habitat	Create aquatic habitat	**Medium**	The landscape management project creates the possibility of establishing aquatic habitats. However, only a part of this will be realized certainly.
	Create riparian habitat	**Medium**	The further development with the landscape management project will establish new water replenishment channels and provide water supply for oxbows, where riparian habitat will be created.
	Create terrestrial habitat	No effect	
Climate change	Enhance precipitation	No effect.	In principle, the improvement of water supply and the increase in evapotranspiration cause precipitation surplus, but this is not significant.
	Reduce peak temperature	**Low**	Local temperature decreases.
	Absorb and/or retain CO_2	**Low**	The aquatic habitat and the better water supply produce greater plant biomass, which increases CO2 binding.

Ecosystem Services Benefits

Ecosystem services water retention, water replenishment		Rating	Evidence
Provisioning	Water storage	**Medium**	The development of landscape management infrastructure creates the possibility for storing inland excess water and withdrawing water from River Tisza by pumping even during lower water level. However, its applicability has two prerequisites: the farmers' approval and financing the costs of pumping. For these reasons, making use of the possibilities is limited.
	Fish stocks and recruiting	**Medium**	Its possibility is created by establishing the water supply and water drainage of clay pits, but the real effect is only in practice.
	Natural biomass production	**Medium**	The biomass production of the natural vegetation is growing.
Regulatory and maintenance	Biodiversity preservation	**Medium**	The development project provides the opportunity for biodiversity conservation at a high level, but the extent of its exploitation is made uncertain due to the limitations of its implementation. The introduced dredging and their regular repetition for maintenance may cause damage to the wildlife.
	Climate change adaptation and mitigation	**High**	The development project provides the opportunity for retaining water at the area and replenishing it, and by this the opportunity to adapt to the effects of climate change, which will be exploited by farmers as a result of the strengthening of constraining circumstances.
	Groundwater/aquifer recharge	**Medium**	Flooding of clay pits and inland excess water retention in the channels already increase water supply and the rate of infiltration into the groundwater. Water replenishment in summer and flooding of lowland areas is a possibility, and depending on the degree of its implementation the effects and the groundwater recharge may be high.

Ecosystem services water retention, water replenishment		Rating	Evidence
	Flood risk reduction	**High**	The principle objective of the Bereg Complex Flood Reduction and Floodplain Rehabilitation Project is flood management, and the implementation of a complex landscape management is also planned. However, high water levels are not only reduced by the flooding of the reservoir, but also with the functions of gentle flooding and water retention in case of large waters.
	Erosion/sediment control	**Low/High**	In case of flood retention it is significant, otherwise it is low.
	Filtration of pollutants	**Low/**	Nutrients in the retained water are used by the vegetation.
Cultural	Recreational opportunities	**Low/**	It plays a role in preserving the natural values of the area, thus promoting the development of ecotourism.
	Aesthetic/cultural values	**Medium**	The fresh vegetation developed due to good water supply improves the aesthetic value of the landscape.
Abiotic	Navigation	No effect	
	Geological resources	No effect	
	Energy production	No effect	

Analysis according to the Water Framework Directive

DEVELOPMENT OF LANDSCAPE MANAGEMENT INFRASTRUCTURE	Measure / Evaluation	Description

Achieve Good Surface Water Status	Identification of river basin management measures	6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands 2.4 Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion) 7.1 Modification of the excess water drainage system 23.4 Water retention with storage in lowland excess water reservoirs, or bed storage in bay-like widened sections 32.2 Compensation of groundwater level decrease caused by low surface water levels due to the diversion and downcutting of rivers, by water replenishment or by bottom dikes in the river bed. 33.2 Special hydromorphological measures to improve the status of protected natural areas, including special regulation of water abstractions, water regulation and water replenishment to meet the needs of nature conservation	Measures planned to be implemented within the Bereg landscape management project and their relationship with the measures proposed by river basin management planning *(source: WFD 4.7 assessment)*: Establishment of new water replenishment channels (3 pcs.) – 6.12.1, 2.4 Water regulation – measures 6.12.1, 7.1, 33.2 Channel reconstruction (25 pcs.) – 6.12.1, 7.1, 32.2, 33.2 Establishment of structures for water retention and regulation (total of 26 pcs.) – 6.12.1, 7.1, 32.2, 33.2 Reconstruction of structures – 6.12.1, 7.1, 23.4, 32.2, 33.2 Establishment of pumping stations – 6.12.1, 7.1, 33.2 Water withdrawal (130,000-150,000 m^3/day) – 6.12.1, 33.2 Rearrangement of spoil banks – - Conclusions of WFD 4.7 assessment: "The project does not compromise the achievement of the WFD objectives, but rather contributes to the achievement of the objectives. During the implementation of the project elements, there is no significant negative impact on the water bodies or the protected areas. During the implementation of the project, several measures aimed at achieving the WFD objectives will be realized."

	Improving status of biological quality elements		Measures for watercourses aiming at nature conservation, in addition to other measures; special hydromorphological measures to improve the status of protected natural areas: Modification of the excess water drainage system – Dédai-Mitz channel, Makócsa main channel, River Tisza from the Szipa main channel to the Belfő channel Water replenishment for ecological purposes, including special regulation of water abstractions, water regulation and water replenishment to meet the needs of nature conservation – Dédai-Mitz channel, Makócsa main channel, River Tisza from the Szipa main channel to the Belfő channel Implementation of the RBMP measures to reach the good status of Natura 2000 sites by the project: Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion); Modification of the excess water drainage system – Szatmár-Bereg (HUHN10001), Gelénes–Beregdaróc (HUHN20046), Vámosatya-Csaroda (HUHN20047), Tarpa-Tákos (HUHN20048), Lónya-Tiszaszalka (HUHN20049), Felső-Tisza (HUHN20001) Protection of damaged aquatic, wetland and land habitats against impacts influencing flow regime, in

			addition to other measures – Kaszonyi-hegy–Dédai-erdő (HUHN20045), Csaholc–Garbolc (HUHN20054), Felső-Tisza (HUHN10008) Loads of protected areas, where action to reduce the load is proposed: Channel reconstruction (25 pcs.) – 171/TK/82 Szatmár-beregi landscape protection area, HUHN20048 Tarpa-Tákos, HUHN20047 Vámosatya-Csaroda, HUHN20049 Lónya-Tiszaszalka, HUHN10001 Szatmár-Bereg
	Improving status of physico-chemical quality elements	None	No measures are planned in the project for the improvement of the physico-chemical conditions.
	Improving quality status of specific pollutants	No data	
	Improving status of hydromorphological quality elements		Planned hydromorphological measures for watercourses: Measures to improve flow regime and protect ecological low water levels on the Csaronda main channel. Water retention with storage in lowland excess water reservoirs, or bed storage in bay-like widened sections – Csaronda main channel, Dédai-Mitz channel, Makócsa main channel Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion) – River Tisza from the Szipa main channel to the Belfő channel

	Improving chemical status and priority substances	None	No measures are planned in the project for the improvement of the chemical status and priority substances.
Achieve Good Groundwater Status	Improved quantitative status		Planned measures to improve the quantitative status of groundwater: Modification of the excess water drainage – Beregi-plain Special hydromorphological measures to improve the status of protected natural areas, including special regulation of water abstractions, water regulation and water replenishment to meet the needs of nature conservation – Beregi-plain
	Improved chemical status	None	No measures are planned in the project for the improvement of the chemical status of groundwater bodies.
Prevent Deterioration	Prevent surface water status deterioration	None	
	Prevent groundwater status deterioration	None	

Additional impacts expected by river basin management planning	Natural resources and natural environment (expected impacts)	(+) the improvement of not only the water body but also the whole water system is expected (+) the living conditions of the habitats directly and indirectly connected to the water body concerned will improve (+) development of a more favourable, more natural landscape (+) creation of semi-natural habitats, increase of landscape ecological values (+) improving the conditions of natural habitats (+) growth of the area of natural habitats, improvement of the ecological corridor function, changes in landscape heterogeneity, landscape becoming more natural (+) significant improvement in drought sensitivity, water retention in the area, increase in groundwater resources, change of flood risk (+) more favourable landscape structure, increasing biodiversity, the status of wetlands and the chance of establishing wetland habitats may improve

	Economic (expected impacts)	(+) improving opportunities for utilization of the whole system concerned (+) growth of real estate value, increasing possibilities for recreation and tourism (+) widening opportunities for utilization (recreation, tourism, etc.) (+) land use better suited to the natural conditions (+) decrease in irrigation demand, positive impact on agricultural production (+) tourism, reed management (+) change in exposure to excess water (+) the possibility of farming that is in cooperation with, and is better suited to the natural conditions (+) is also favourable for plant health, the need for pesticides and fertilizers will decrease (-) the economic competitiveness of water users may decrease due to more expensive solutions (-) agricultural production may need to be modified (-) entails significant costs, which need to be financed mainly by grants (from the state budget), and a smaller part would be the farmers' own contribution (0) maintenance task requiring appropriate expertise (requires proper planning)

	Social (expected impacts)	(+) the utilization methods provided by the system can mean new forms of livelihood (+) improvement of the public access to the river, growth of green areas, improvement of the quality of life (+) has a positive impact on employment and the population retaining ability of the area due to its labour demand (-) jobs may be eliminated

Maintaining the measure	Maintenance of the measures of the landscape management project, operation		For the sake of sustainability, in the case of a measure aiming at water replenishment, it is recommended to define the stakeholders interested in maintenance, and to investigate their interests. It is necessary to investigate the interventions that reduce maintenance costs and tasks, which reduce operational tasks. In the operational phase, in dealing with social and economic risks during the cooperation with farmers, I believe forums, public hearings, project presentations, press releases are inappropriate measures. To address emerging ownership conflicts, specific procedural alternatives need to be defined and mediated between the parties. The procurement plan presents the process of land acquisition, with which conflicts management should be brought into line. To ensure the smooth implementation of the operational plan, the exploration of interests and the assessment of risks are necessary. Institutions that carry out maintenance and operation need to be prepared for conflict management between parties of adverse interests. Possible conflicts include legal risks, for which the planner needs to be prepared.

Summary of effects from the viewpoint of river basin management planning	**Favourable impact is expected**	Overall, the implementation of the project contributes to the achievement of the good status of the water bodies and the related protected areas. The project does not compromise the achievement of the WFD objectives, but rather contributes to the achievement of the objectives. During the implementation of the project elements, there is no significant negative impact on the water bodies or the protected areas. During the implementation of the project, several measures aimed at achieving the WFD objectives will be realized. The technical solutions mean a minimal burden on water bodies, but the environmental benefits significantly outweigh the negative impacts. *(Source: WFD 4.7 assessment)*. The utilization of the project is fundamentally dependent on the implementation of land use changes, the maintenance of the area affected by periodic flooding and the implementation of the operation aiming at landscape management.

Expenditures

Cost category	Cost range (EUR)	Description
Purchase of land	16 362 thousand HUF	Land acquisition 8 ha
Preparation of surveys and studies	47 244 thousand HUF	Planning of construction 36 844 thousand HUF
Other plans	34 018 thousand HUF	Implementation plan and operational manuals, policies

Site preparation	13 800 thousand HUF	Archaeology, decontamination of ammunition and soil work
Total construction	701 457 thousand HUF	- Creating temporary pumping platforms at profiles 706.94 and 715.45 river km of River Tisza. Water replenishment at Tisza, - Construction of 26 water retention and water management structures at the Bereg water system for landscape management purpose, - Arrangement of clay pits, conversion into wetlands, - Reconstruction of cannels (56 km), - Lifting the spoil bank 332 m, - Construction of new water replacement channels (3), - Development of a monitoring and operational control system.
Purchase of equipments	51 860 thousand HUF	Grass mower, towed loader, stem crusher, truck, software and hardware
Maintenance costs	33 346 thousand HUF/year	Mowing of weeds with equipment and by hand, mowing of reed, shrub cleaning Maintenance of structures Water replenishment pumping Maintenance of machines and equipments
Renovation costs	38 785 thousand HUF/year	Maintenance of structures and sludge removal of the channels, management of spoil banks
Additional costs	58 346 thousand HUF	
Reserve	30 000 thousand HUF	
VAT	246 912 thousand HUF	
Investment cost	1 200 000 thousand HUF	

SWOT analysis

Development of landscape management infrastructure	
Strengths	**Weaknesses**
Inland excess water retention and the introduction of water into the area is possible even in the case of low Tisza levels. Almost individual handling of the needs of farmers is possible. Elaboration of the foundation of a support system to transform agricultural activity. Several measures aimed at achieving WFD objectives are realised during the implementation of the project. Clearly a positive measure from the aspects of WFD.	Flooding of lowland areas and oxbows can be carried out with the consent of the farmers. In the case of low Tisza levels, the cost of pumping water is high, the cost bearer is unclear. The system is not operational, the cost bearer or intention statement are not known. There is little focus on land use changes and related measures, which should be an integral part of the landscape management project. Lack of restructuring of the support system (green point system).
Opportunities	**Threats**
Excess water retention can greatly improve water supply in the area. Adapting agricultural activity to local water management and other farmland conditions.	Resistance and unpreparedness of farmers. Operational difficulties due to the complexity of the operation. The new support system is not implemented, the existing systems are not sufficient for the transformation. If land use changes are not realized, the beneficial effects will be significantly damaged. Lack of conflict management. For the sake of sustainability, in the case of a measure aiming at water replenishment, it is recommended to define the stakeholder(s) interested in maintenance, and to investigate their interests. The flood of the river may coincide with the period of inland excess water. In this case, water retention will be emphasized, not the discharge of the water surplus from the river. In the case where animal husbandry is not economical in the agricultural system, it will not work in the floodbed either, even if favourable habitats are established.

MEASURE: Ensuring the water replenishment of oxbows

Biophysical effects

Biophysical effects water replenishment of oxbows		Rating	Description
Slowing and storing Runoff	Store Runoff	**Medium**	As part of the inland excess water drainage or storage system, it has a role in storing the runoff, the size of which is proportional to the extension of oxbows with water cover.
	Slow and store runoff	**Medium**	The runoff slows with water storage.
	Store river water	**Medium**	Storing the water of River Túr is possible.
	Slow river water	**Medium**	The river bed of Öreg-Túr and the vegetation of the connected oxbows are diverse, their conservation was an objective of the project.
Reducing Runoff	Increase evapotranspiration	**High**	The connected meadows increase the area with water cover and the water-rich aquatic habitats, resulting in rich vegetation and increased evopotranspiration. Its degree is proportional to the size of areas supplied with water.
	Increase infiltration and/or groundwater recharge	**High**	Due to the water supply of oxbows, the infiltration area has increased considerably and the duration with water cover has been extended.
	Increase soil water retention	No effect	
Reducing Pollution	Reduce pollutant sources	No effect	
	Intercept pollution pathways	**Medium**	Water input into the oxbows can be controlled. In the oxbows, the nutrient content of water is utilized by the vegetation. The ratio of nutrient retention and nutrient utilization depends on the size of the oxbows and the vegetation.
Soil Conservation	Reduce erosion and/or sediment delivery	**Medium**	The sediment is deposited in the oxbows.

Biophysical effects water replenishment of oxbows		Rating	Description
	Improve soils	**Low**	Periodic flooding increases the nutrient content of the soil, but their spatial extent is small.
Creating habitat	Create aquatic habitat	**High**	By providing water supply or its possibility for the drying or dry oxbows, they have the potential to create aquatic habitats with significant size. Despite the ownership difficulties, the process continues to progress.
	Create riparian habitat	**Medium**	By reconnecting the oxbows, waterside habitats are also created. However, due to ownership problems, the number of reconnected oxbows is currently low, but the process continues progressively.
	Create terrestrial habitat	No effect	
Climate change	Enhance precipitation	Low/ Medium/ High	Evapotranspiration increases by increasing water surfaces and water-rich areas as well as by richer vegetation at these areas, which in principle increases the amount of rainfall. However, this can be practically so minor that no significant impact can be declared.
	Reduce peak temperature	**Low**	Evaporation may reduce the temperature, which can be observed at local level.
	Absorb and/or retain CO_2	**Low**	The increased size of green areas and volume due to good water supply increases CO_2 use.

Ecosystem Services Benefits

Ecosystem services water replenishment of oxbows		Rating	Evidence
Provisioning	Water storage	**Medium**	The possibility of water storage is high, but this potential is not exploited exhaustively.
	Fish stocks and recruiting	**Medium**	Oxbows may have a great role in the reproduction and maintenance of fish population; currently the built-in possibilities and the number of oxbows reconnected to the water supply are limited.
	Natural biomass production	**Medium**	Natural biomass production is growing in proportion to water-rich areas.
Regulatory and maintenance	Biodiversity preservation	**High**	Reconnected oxbows lead to significant habitat increase for many species.
	Climate change adaptation and mitigation	**High**	Oxbows provide water supply to the affected area during drought periods.
	Groundwater/aquifer recharge	**Medium**	Water draining out from the oxbows raises the groundwater level.
	Flood risk reduction	**Medium**	It reduces the risk of flooding by inland excess water and also serves as water storage capacity during floods.
	Erosion/sediment control	**Low**	The sediment is deposited in the oxbows, but the reservoirs, sluices and bottom dikes along the river also promote the depositing of sediments, and thus the sediment content of water flowing into the oxbows is no longer high.
	Filtration of pollutants	**Medium**	In the oxbows, the nutrient content of water is utilized by the vegetation. The ratio of nutrient retention and nutrient utilization depends on the size of the oxbows and the vegetation.
Cultural	Recreational opportunities	**High**	Oxbows with continuous water supply are attractive for rowers and eco-tourists.

Ecosystem services water replenishment of oxbows		Rating	Evidence
	Aesthetic/cultural values	**High**	The aesthetic value of the restored oxbows is high.
Abiotic	Navigation	No effect	
	Geological resources	No effect	
	Energy production	No effect	

Analysis according to the Water Framework Directive

Affected party under assessment Water replenishment of oxbows RBMP-based evaluation	Measure/ Evaluation	Description

Achieve Good Surface Water Status	Identification of river basin management measures	6.12.1 Water replenishment on the protected side: for oxbows, branches, floodplain wetlands	The measure is typically applicable to large rivers or lowland small and medium watercourses. Elements: flooding of deep floodplains, water replenishment of oxbows, and local restoration of floodplains. The application is subject to the modification of land use. This is carried out by the change of land use and cultivation branch (2.4) related to the measure, which allows the development of utilization methods complying with the changed circumstances. This can ensure proper maintenance as well. Within the framework of the project, the water replenishment of a total of seven oxbows was planned. These are the following: Báka-szegi oxbow, Tarpai-szegi oxbow, Szoros-szegi oxbow, Öreg-Túr in the Sonkád-Kölcse area, Holt-Túr at Túr-erdő, Holt-Túr at Malom-szeg, Holt-Túr at Ricsei-erdő. With regard to the water replenishment of the oxbows, the following measures received water operating permit until 31 December 2027: Báka-szeg structure with sluices and culvert. In the first phase of the rehabilitation of the Öreg-Túr, the water replenishment of the Báka-Szegi oxbow was made possible. The oxbow is not managed by any water directorate. In order to ensure water replenishment, an inlet sluice and a water replenishment channel were built and dredged, respectively. Water replenishment can be ensured either from the Öreg-Túr, or from excess inland water retention. However, water replenishment was not implemented due to the disorderly relations of the properties in question. Water replenishment was implemented on the Nagyari oxbow, outside the project concerned with the water system of the Öreg-Túr. The oxbow is managed by a national park, and out of the 5-hectare oxbow, fishing is allowed on 1.5 hectares. The license is privately owned.

	Improving status of biological quality elements	No impact (conditional low and medium improvement)	The water replenishment of the Báka-szegi oxbow was ensured by the implemented measures (inlet sluice and water replenishment channel), but due to the disorderly ownership relations of the properties in question, water replenishment has not taken place. The status of the biological elements therefore remains unchanged. If water replenishment takes place regularly and with adequate levels, the biological conditions will improve slightly and moderately in the medium to long term. A project monitoring station (macroscopic water invertebrates, fish) was built on the Báka-szegi oxbow. Based on preliminary biological studies, the expected result would be: as a result of the measure, the water level of the river bed (which currently often dries out) might increase, therefore the proportion of standing waters or swamps would increase alongside species and communities tolerating desiccation. An increase in the proportion of tangle species as well as reed and cane beds is to be expected. The transforming habitat generally generates more favourable conditions for water-related vertebrate species, with a positive effect primarily for certain water birds (cranes, ducks, grebes), amphibians and reptiles (Rana sp., Bombina bombina, Emys orbicularis, and as a breeding site for amphibians in general), and possibly for otters (Lutra lutra). Naturally, the increase / partial stabilization of the water level is generally favourable for fish, but the proliferation of the adventive Amur sleeper is to be expected, as this fish species likes shallow waters thickly grown with similar vegetation. If the project succeeds in creating a permanent river bed of the Báka-Szegi-Holt-Tisza, then it is expected to have a stable fish fauna with predatory species, e.g. the Northern pike (Essox lucius), which will stabilise the stock of adventive and indigenous species alike.

	Improving status of physico-chemical quality elements	None	The measure does not result in improved physico-chemical conditions.
	Improving quality status of specific pollutants	None	The measure has no positive impact on specific pollutants.
	Improving status of hydromorphological quality elements	Medium	The oxbow is located behind a high bank, so that there is practically no water replenishment on the protected side, but a reconnection of the floodplain into the life of the watercourse.
	Improving chemical status and priority substances	None	The measure does not result in the improvement of chemical status.
Achieve Good Groundwater Status	Improved quantitative status	None (Conditionally Low)	If water replenishment is implemented, a recharge of excess inland water is to be expected in the oxbow's immediate vicinity.
	Improved chemical status	None	The measure does not result in the improvement of chemical status.
Prevent Deterioration	Prevent surface water status deterioration	None	
	Prevent groundwater status deterioration	None	

Additional impacts expected by river basin management planning	Natural resources and natural environment	(+) increase of natural habitats and biodiversity, expansion and quality improvement of ecosystem services (e.g. ecological corridor function), (+) creating semi-natural habitats, restoring previously existing wetlands, increasing landscape ecological values – THE IPLEMENTED MEASURES (INLET SLUICE AND A WATER REPLENISHMENT CHANNEL) ENSURED THE WATER REPLENISHMENT OF THE A BÁKA-SZEGI OXBOW, BUT WATER REPLENISHMENT WAS NOT IMPLEMENTED DUE TO THE DISORDERLY OWNERSHIP RELATIONS OF THE PROPERTIES IN QUESTION. THEREFORE THE OXBOW'S BIOLOGICAL CONDITION REMAINS UNCHANGED. THE LANDSCAPE ECOLOGICAL VALUE WOULD IMPROVE SIGNIFICANTLY. (+) the restoration of close-to-nature floodplain ecosystem and the conditions of floodplain management – IF THE MEASURE IS IMPLEMENTED: LOW - MEDIUM-LEVEL IMPROVEMENT OF FLOODPLAIN ECOSYSTEM, POSSIBILITY OF FISHING. (+) controlled drainage reduces drought sensitivity – IF THE MEASURE IS IMPLEMENTED, LOCAL REDUCTION OF DROUGHT SENSITIVITY; WATER CAN BE RETAINED ALL YEAR ROUND WITH THE HELP OF THE SLUICE.

	Economic	(+) creating opportunities for land management better suited to the local conditions – CURRENT AGRICULTURAL LAND WOULD MAKE PLACE FOR AN OXBOW SUITABLE FOR FISHING, WHICH IS MORE BENEFICIAL LAND USE FOR LOW-LYING AREAS. (+) expansion of utilization opportunities (recreation, tourism, etc.) – TOURISM CONNECTED WITH THE ÖREG-TÚR WOULD BE EXPANDED WITH A VALUABLE LANDSCAPE ELEMENT. (-) widening the floodbed entails the depreciation of previously protected land, and limitations of use, (-) abandonment of agricultural land or land use change may be necessary (lost revenues, disadvantages) – LAND USE CHANGE WOULD BE NECESSARY, WHICH IS MADE MORE DIFFICULT BY THE CURRENT UNDIVIDED JOINT PROPERTY OWNERSHIP. OFFERING OTHER PIECES OF LAND IN RETURN OR TAKING THE AREAS IN THE OWNERSHIP OF THE LOCAL GOVERNMENT WOULD MAKE IT POSSIBLE TO INUNDATE THE AREA. (-) the operating cost of the solution – THE WATER DIRECTORATE MAINTAINS AND OPERATES THE SLUICES AND CHANNELS AS PART OF THE EXCESS WATER DRAINAGE SYSTEM.

	Social	(+) reducing drought sensitivity by the drainage and retention of water – LOCAL IMPROVEMENT OF DROUGHT SESITIVITY IF MEASURE IS IMPLEMENTED. (+) reducing flood risks – THE MEASURE HAS NO IMPACT ON FLOOD WATER STORAGE. (+) the utilization methods provided by the system can create new forms of livelihood – THEY TYPICALLY DO NOT. FISHING PROVIDES A RESTRICTED FORM OF LIVELIHOOD. (+) it requires production methods which are more demanding concerning work, expertise and cooperation – THE OXBOW'S MAINTENANCE REQUIRES MORE EXTENDED COOPERATION; SPECIALISED KNOWLEDGE IS NEEDED FOR ITS MAINTENANCE AND MANAGEMENT. (-) decrease of the feeling of public safety, deterioration of the population's living conditions – NOT RELEVANT

Maintaining the measure	To what extent has land use change and extensive farming been maintained after project closure	High	The inlet structure and the water replenishment channel are maintained by the Water Directorate.
Summary of effects from the viewpoint of river basin management planning		**The possibility of water replenishment is ensured, but it has not been realized**	If water replenishment takes place regularly and with adequate levels, the biological conditions will improve slightly and moderately in the medium to long term. A positive measure is the construction of the monitoring station (aquatic macroscopic invertebrates, fish) on the Báka-szegi oxbow. Settling the ownership relations of the properties in question is necessary, which means spatial planning and spatial development tasks. A necessary condition is the development of a cooperative relationship with spatial planning. The measure would have several beneficial impacts if it was implemented.

Expenditures

Cost category including all measures of Chapters 2.3 and 2.4	Cost range (EUR)	Description
Preparation	7 529 thousand HUF	Feasibility study, revision of technical plans, tender plan, public procurement, administrative procedural charges
Total construction	272 649 thousand HUF	Water level control works 74 103 thousand HUF

Cost category including all measures of Chapters 2.3 and 2.4	Cost range (EUR)	Description
		Monitoring development 65 883 thousand HUF Reconstruction of existing structures 72 421 thousand HUF River basin management 41 039 thousand HUF Road stabilization 7 950 thousand HUF Plans related to construction 11 250 thousand HUF
Purchase of equipment	5 769 thousand HUF	Workstation, software, laptop, measuring equipment
Operational costs	-3 650 thousand HUF/year	Saving is planned compared to the project-free version. Characteristically variable costs arise at the structures. Maintenance works are carried out with their own employees and public employees.
Replacement	-71 000 thousand HUF/6years	Replacements are scheduled every 6 years Sluice 7pcs Barrage 1 piece Sluiceway 1 piece
Additional cost	32 248 thousand HUF	PM, planning works management, plant management plan, technical inspector, PR, auditing
Investment cost	318 195 thousand HUF	

SWOT analysis

Ensuring the water replenishment of oxbows	
Strengths	**Weaknesses**
Creating and improving the quality of wetlands by water replenishment of oxbows. Gravitational water inlet. Operation of fishing lake.	Private ownership of land, undivided joint property ownership – difficulties of agreement with landowners. It is necessary to settle property ownership on the affected properties, which means spatial planning and spatial development tasks. Creation of appropriate technical conditions (broken culverts). In the absence of a governmental professional management organization, its long-term operation is not ensured. It may harm neighbouring business or residential interests.
Opportunities	**Threats**
Tourist attraction. Living and breeding site of valuable species. Economic utilization. If water replenishment takes place regularly and with adequate levels, the biological conditions will improve slightly and moderately in the medium to long term.	Advancing alternative exploits, eradicating the near-natural state, changing the order of operation promoting a near-natural state. Maintenance and operating costs arise. In the absence of specific economic benefits or other professional interest, operation and maintenance is not ensured.

MEASURE: Water retention in the riverbed with structures, riverbed control and dredging

Biophysical effects

Biophysical effects Water retention in the riverbed with structures, riverbed control and dredging		Rating	Evidence
Slowing and storing Runoff	Store Runoff	**High**	It is part of the inland excess water drainage system of Öreg-Túr, water storage has become possible at several locations with the help of the constructed structures.
	Slow and store runoff	**Medium**	With water storage, the runoff is also getting slower.
	Store river water	**Medium**	In addition to inland excess water storage, water storage of River Túr is also possible in the Öreg-Túr water system.
	Slow river water	**Medium**	The Öreg-Túr riverbed and the vegetation of the reconnected oxbows are rich; their conservation was an objective of the project.
Reducing Runoff	Increase evapotranspiration	**High**	Water retention in the Öreg-Túr system allowed the water supply of a relatively larger area and it extended the duration of water periods.
	Increase infiltration and/or groundwater recharge	**High**	Together with making possible the water cover of the riverbed and the oxbows, the infiltration area has increased considerably and the duration of water cover has extended.
	Increase soil water retention	No effect	
Reducing Pollution	Reduce pollutant sources	No effect	

Biophysical effects Water retention in the riverbed with structures, riverbed control and dredging		Rating	Evidence
	Intercept pollution pathways	**Low**	At the sluices the way of water can be temporarily closed at the time of potential pollution. The nutrient utilization of the developing rich wetland or aquatic habitats reduces the amount of N, K, P and other plant nutrients in the water. Riparian and aquatic vegetation takes up toxic metals and different materials and build them into their bodies, and as a consequence this may reduce certain types of pollution in the water.
Soil Conservation	Reduce erosion and/or sediment delivery	**Low**	Structures reduce sediment transport. However, the reservoir in Romania fundamentally reduces sediment transport.
	Improve soils	**Low**	Periodic flooding increases the organic matter content of the soil.
Creating habitat	Create aquatic habitat	**High**	As a result of the project, aquatic habitats again receive regular water replenishment and their constant water cover may be provided with the increase of water levels and water retention.
	Create riparian habitat	**Medium**	The riparian habitats of Öreg-Túr will be in better status due to the restoration of permanent water cover. By reconnecting the oxbows, waterside habitats are also created. However, due to ownership problems, the number of oxbows is low.

Biophysical effects Water retention in the riverbed with structures, riverbed control and dredging		Rating	Evidence
	Create terrestrial habitat	No effect	
Climate change	Enhance precipitation	Low/ Medium/ High	Evapotranspiration increases by increasing water surfaces and water-rich areas and by the richer vegetation at these areas, which in principle increases the amount of rainfall. However, this can be practically so minor that no significant impact can be declared.
	Reduce peak temperature	**Low**	Increased evaporation may reduce the temperature, which can be observed at local level.
	Absorb and/or retain CO_2	**Low**	The increased size of green areas and volume due to good water supply increases CO_2 use.

Ecosystem services Water retention in the riverbed with structures, riverbed control and dredging		Rating	Evidence
Provisioning	Water storage	**High**	Water is stored in the riverbed of Öreg-Túr and in the connecting oxbows.
	Fish stocks and recruiting	**Medium**	The retention of riverbed water creates their living conditions, but the regulatory structures are obstacles to their longitudinal spread.
	Natural biomass production	**Medium**	By improving the water supply, biomass production is growing.
Regulatory and maintenance	Biodiversity preservation	**High**	Biodiversity is significantly increased by ensuring the water supply of Öreg-Túr, raising the very small water levels, reconnecting oxbows, improving the quality of wetlands and creating new habitats. Zoological ecological surveys also show that the number of species has increased and valuable protected species have emerged compared to the pre-development status.
	Climate change adaptation and mitigation	**High**	The project also provides water supply for the area during drought periods.
	Groundwater/aquifer recharge	**Medium**	Water draining out from the system raises the groundwater level.
	Flood risk reduction	**Medium**	It reduces the risk of flooding by inland excess water, and it is a water intake capacity during floods.
	Erosion/sediment control	**Low**	Sluices and bottom dikes affect the water flow, thus they have a role depositing the sediment.

Ecosystem services Water retention in the riverbed with structures, riverbed control and dredging		Rating	Evidence
	Filtration of pollutants	**Medium**	Pollutants can be deposited with suspended matter, plant nutrients are utilized by the vegetation.
Cultural	Recreational opportunities	**High**	Öreg-Túr has become an excellent place for aquatic tourism and rowing.
	Aesthetic/cultural values	**High**	Certain parts of Öreg-Túr with diverse vegetation and different types and openness are very spectacular. They represent a high aesthetic value.
Abiotic	Navigation	No effect	
	Geological resources	No effect	
	Energy production	No effect	

Analysis according to the Water Framework Directive

Affected party under assessment RBMP-based evaluation Water retention in the riverbed with structures, riverbed control and dredging	Measure/ Evaluation	Description

Project co-funded by the European Union (ERDF, IPA funds)

Partners: General Directorate of Water Management, Hungary | Global Water Partnership Central and Eastern Europe, Slovakia | International Commission for the Protection of the Danube River | Ministry of Water and Forests, Romania | Ministry of Foreign Affairs and Trade, Hungary | National Administration "Romanian Waters", Romania | National Institute of Hydrology and Water Management, Romania | Public Water Management Company "Vode Vojvodine", Serbia | Regional Environmental Center for Central and Eastern Europe, Hungary | The Jaroslav Černi Institute for the Development of Water Resources, Serbia | Water Research Institute, Slovakia | World Wide Fund for Nature Hungary

Associated Partners: Interior Ministry, Hungary | Republic of Serbia Ministry of Agriculture and Environmental Protection – Water Directorate | Secretariat of the Carpathian Convention (SCC), Austria | State Agency of Water Resources of Ukraine | Tisza River Basin Water Resources Directorate, Ukraine

DANUBE REGION strategy

Achieve Good Surface Water Status	Identification of river basin management measures	6.7 Regulating the dredging which increases the size of the river bed and the disposal of dredging material, with special emphasis on ecological aspects and the protection of water resources 6.11 Creating artificial channels that indirectly help to achieve RBMP goals – e.g. flood control channel or water replenishment channel 6.12.1 Water replenishment on the	6.7 The purpose of the measure is to develop a maintenance practice where dredging takes place only to the extent absolutely necessary for the river bed section to function. As a basic principle, dredging improving (maintaining) water flow and facilitating navigation is permitted, but dredging for materials is not. 6.11 Improvement purposes of artificial channels: A new or modified channel connected to the drainage basins of the drainage system that can carry the collected excess water into an inland water reservoir. This may increase local water retention (execution of 23.4 water retention measure), or, if the excess water recipient is a canalised natural watercourse, the lower discharge to be drained makes it possible for the watercourse to become less heavily modified and to achieve good ecological status (6.3 and 6.4 rehabilitation measures). The artificial water replenishment of ecologically degraded areas due to water scarcity (7.3.5, mitigation of the effects of groundwater level reduction by water replenishment and 33.2, execution of water replenishment measures for ecological purposes) may require the construction of new connecting channels. 6.12.1 The measure is typically applicable to large rivers or lowland small and medium watercourses. Elements: flooding of deep floodplains, water replenishment of oxbows, and local restoration of floodplains. The application is subject to the modification of land use. This is carried out by the change of land use and cultivation branch (2.4) related to the measure, which allows the development of utilization methods complying with the changed circumstances. This can ensure proper maintenance as well. - The rehabilitation of the Öreg-Túr involves a section of 70 km, where higher water levels and a larger water mass is provided in the watercourse by barrages of the river bed, chutes, sluices, and the formulation of their operating regulation. Water is let out from the Túr by a water distribution structure, dividing the Túr's water discharge by means of a flood control channel. As per

		protected side: for oxbows, branches, floodplain wetlands 7.1 Modification of the excess water drainage system	the operating regulation, no water is let out into the flood control channel in the case of low water discharge (Q<0,5 m3/s). Increasing the water level was necessary because low water flow from the upper water catchment does not provide sufficient water supply to maintain favourable water levels. Without the measures, in the summer water shortage period the system would not be able to meet the simultaneous, touristic and ecological needs of national importance in connection with the improvement of the Öreg-Túr's water regime and the weir at the mouth of the Túr river. The implementation of the project also serves drainage interests, where the goal was the creation of dual-purpose channels. During excess water control, inland excess waters are collected, retained and then returned to the Öreg-Túr by gravitational drainage. The retention of inland excess water is only carried out in case of floods, however. If there is no flood, the retention of inland excess water is not achieved by the sluices.

	Improving status of biological quality elements	Medium - High	Overall, the installations do not affect significant areas; the size of the direct impact areas is negligible compared to the project volume. Restoration and installation measures on the structures do not endanger significant stocks of valuable plant and animal species. Their harmful effect is low. Afflux and the rise in water levels result in higher groundwater levels along the Öreg-Túr's river bed. This improves the habitats of riparian woodlands and grasslands along the river bed. As a result of the afflux, the river's flow velocity slows down, changing the habitat from being favourable to species preferring flowing water to the dominance of species preferring standing water. "Therefore, the not yet developed backwater levels are to be defined so that the backwater levels above the structures do not abut, and that the Öreg-Túr have sections where flow conditions correspond to the natural slope conditions" *(Source: Environmental Permit)* Overall, in the case of Öreg-Túr, the aim is to promote water retention rather than to increase water replenishment. This process had a favourable effect on water supply, solving the question of the Öreg-Túr's water supply. The extent of the effect is moderate, given that the water supply of the oxbows was realised only at the level of "providing opportunity".
	Improving status of physico-chemical quality elements	None	
	Improving quality status of specific pollutants	None	

	Improving status of hydromorphological quality elements	Low	
	Improving chemical status and priority substances	None	
Achieve Good Groundwater Status	Improved quantitative status	Low	
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	None	
	Prevent groundwater status deterioration	None	
Additional impacts expected by river basin management planning		Natural resources and natural environment	Dredging: (+) semi-natural river bed design, possibly functioning as part of the ecological network (+) the increase of habitat diversity and, in connection with this, species diversity (-) local and temporary negative effects on the wildlife The creation of artificial channels: (+) semi-natural river bed design, possibly functioning as part of the ecological network (+) decrease of water scarcity phenomena, better microclimate (+) the possibility of creating new wetlands

		Economic	Dredging: (+) possible upswing in nature and water related tourism (+) expansion of utilization opportunities: recreation, fishing, tourism; growth of green areas The creation of artificial channels: (+) better opportunities for land use: recreation, tourism development, (+) decreasing drought sensitivity, growth of irrigation possibilities, demand might decrease (+) appearance of new wetlands (-) there is a need for maintenance; failure to do so may result in weeds and endangers the function
		Social	Dredging: (+) favourable area development impact (+) clearing away the sludge enlarges the sections which has a favourable effect on the river's flood discharge draining capacity (+) flood risk reduction (+) improved public access to the watercourse, more aesthetic environment of the settlement, growth of green areas, improved quality of life The creation of artificial channels: (+) improved quality of life, better microclimate
Maintaining the measure	To what extent has land use change and extensive farming been maintained after project closure	High	
Summary of effects from the viewpoint of river basin management planning		**Low**	

Expenditures

Cost category including all measures of Chapters 2.3 and 2.4	Cost range (EUR)	Description
Preparation	7 529 thousand HUF	Feasibility study, revision of technical plans, tender plan, public procurement, administrative procedural charges
Total construction	272 649 thousand HUF	Water level control works 74 103 thousand HUF Monitoring development 65 883 thousand HUF Reconstruction of existing structures 72 421 thousand HUF River basin management 41 039 thousand HUF Road stabilization 7 950 thousand HUF Plans related to construction 11 250 thousand HUF
Purchase of equipment	5 769 thousand HUF	Workstation, software, laptop, measuring equipment
Operational costs	-3 650 thousand HUF/year	Saving is planned compared to the project-free version. Characteristically variable costs arise at the structures. Maintenance works are carried out with their own employees and public employees.
Replacement	-71 000 thousand HUF/6years	Replacements are scheduled every 6 years Sluice 7pcs Barrage 1 piece Sluiceway 1 piece
Additional cost	32 248 thousand HUF	PM, planning works management, plant management plan, technical inspector, PR, auditing
Investment cost	318 195 thousand HUF	

SWOT analysis

Water retention in the riverbed with structures, riverbed control and dredging	
Strengths	**Weaknesses**
Provides water supply to the Öreg-Túr and water retention, water replenishment of oxbows. It forms a part of the drainage system, it has a positive effect on the retention of excess water, and hence its maintenance is ensured. It operates according to operational regulations. It has a beneficial effect on the related ecosystem, it improves the habitats of riparian woodlands and grasslands.	Operating and maintenance costs, labour demand. The retention of inland excess water is only carried out in case of floods. If there is no flood, the retention of inland excess water is not achieved by the sluices.
Opportunities	**Threats**
Drainage, retention, storage of excess water. Tourism development.	Advancing alternative exploits, eradicating the near-natural state, changing the order of operation promoting a near-natural state. Maintenance and operating costs arise. In the absence of specific economic benefits or other professional interest, operation and maintenance is not ensured.

Summary

The evaluation of water management projects was commissioned by WWF Hungary under the JOINTISZA project. In the JOINTISZA project, 17 partners from five countries (Hungary, Romania, Ukraine, Slovakia, and Serbia) cooperate to find answers to the common challenges of water management. The project's actions are contained in six work packages. WWF Hungary contributes to Measure 3.5 "Evaluation of the measures' effectiveness and proposals for effective measures" as a project partner.

The contractor was responsible for evaluating the four projects included in the contract, for which we developed and applied a multi-criteria analysis process. The task was unusual in that no project evaluation had to be carried out, but the measures implemented had to be assessed in themselves. Therefore, we did not aim at a comprehensive assessment of the projects; rather, they were broken down into measure elements and their implementation and efficiency were analysed element by element. Another unusual feature is that the evaluation is concerned with projects that were

implemented between 2004 and 2014, so that for three of the four projects even the five-year maintenance period had passed. Therefore we were able to see what measures were maintained and under what conditions after the mandatory maintenance period. By evaluating the projects from this aspect, new and interesting conclusions were reached.

It was our aim to explore the benefits and disadvantages of the measures, to highlight those critical points and conditions that will help prevent the repetition of past mistakes and make the implementation of the actions more effective in the future. With this approach we can argue the conditions under which the measures under consideration should be implemented and what results can be expected from them. Within the framework of JOINTISZA, efforts are made to develop coordinated plans for flood risk management measures and river basin management measures, and therefore, by evaluating the measures, we aim to contribute to supporting the favourable measures and formulating the conditions. We had no opportunity to analyse all river basin management planning measures; only those were analysed that were included in the projects. This is a clear shortcoming in the preparation of a comprehensive baseline study, but given that such an evaluation has not yet been carried out, emphatic demand for such has not yet arisen.

On the basis of the evaluation, it is possible to get a picture of the operation of the measures implemented, and based on this, observations and suggestions can be formulated whose application at strategic level might be justified. To support strategic planning, SWOT analyses have also been prepared, based on which, processing the experiences of the implemented projects, we may get a more subtle picture of the types of measures and their possibilities and limitations of application.

Based on the SWOT analysis, it is possible to define critical points for certain actions, set conditions, and make recommendations for their effectiveness and efficiency. By solving critical points, we can help to ensure that measures prove to be beneficial in the long term and are incorporated into the environment affected by them.

Projects with complex utilization are characteristic of both water management and flood risk management, and so is the recognition that these should be assessed and evaluated in a complex manner. An appropriate solution for this is multi-criteria analysis, where including comprehensive, multi-criteria assessments is not sufficient, but these assessments have to be sufficiently detailed and thorough as well. We consider it necessary to analyse complex projects individually, with one project element in focus at a time. The next step is identifying the persons responsible for the project elements, which is not necessarily evident in every case, considering that complex projects involve several areas of expertise.

The executive summary contains a summary of the assessment. In order to achieve an understanding of the results and the process, it is necessary to get acquainted with the detailed analysis.

On the basis of the results of the evaluation, it can be concluded that, during the implementation of the measures, more beneficial results were achieved when the institutions, organizations and farmers involved in the project cooperated in planning, implementing the plans, or monitoring their implementation. Those measures that made it possible to accomplish some goals, but did not accomplish them, are still the rule rather than the exception. This is generally due to the lack of co-operation between the fields of expertise, the lack of agreed-on objectives, and the lack of funding. Maintaining measures is almost entirely dependent on stakeholder relations. If a measure has been implemented as part of a project but its maintenance does not constitute a material or technical interest, it is highly probable that it will not remain in the long term after project closure. In addition to the question of interests, the lack of local conflict management appears to be a very serious question. Conflict avoidance is often considered a way of dealing with conflicts, and in most cases this results in temporary solutions or only the appearance of a solution. Particularly important is the settlement of legal relations and interests in the areas affected by the measures.

The measures and projects under consideration also illustrate the extent to which measures on the upper sections of the river basin, over the Hungarian borders, can influence a river's features. Adapting to a changed situation, or the preparation for it is one of the challenges facing integrated water management. The impact of climate change further aggravates problems. Cross-border cooperation is crucial. At the same time, it is to be expected that all measures, which are important and beneficial for the given area, will be realised sooner or later in the upper section of the river basin. The advantages and disadvantages of these measures appear on the lower sections of the watercourse, within our borders. An objective assessment of the effectiveness of the responses to climate change, human interventions, and the natural processes of watercourses is necessary to make our financial resources work effectively and efficiently.

During the application of the measures, more emphasis should be placed on implementing proposed land use changes. A prerequisite for this is closer cooperation with spatial planning and spatial development, the examination and, where necessary, modification of territorial regulations, in parallel with the review of subsidy systems.

During project preparation and the planning of the measures, it is necessary to involve the relevant fields of expertise at the planning phase, instead of consulting them only afterwards. In the case of these measures, the areas concerned are water management, hydraulic engineering, nature conservation and agriculture, as well as local governments and non-governmental organizations representing local interests. Realistic assessment of conflict situations, as well as their clash and solution is necessary during the planning phase. There may be conflicts of interest even within the subject of the protection of natural values, such as returning fish juveniles to the river, or the protection of nests. Subsisting conflicts of interest jeopardize the effectiveness and survival of the project. The most difficult task is harmonising the measures with the farmers' interests. In order to achieve this, a change of the interest system is necessary.

The present analysis in the JOINTISZA project contributes to the partners' knowledge of the measures' effectiveness. We recommend the methodological proposals to all partners working on the work packages during the preparation of the Joint Program of Measures. Within the framework of work package 6, we see the opportunity to benefit from the experiences of the practical implementation of the measures and for the conclusions of the analysis to be used in the compilation of the new Program of Measures. Another possible and recommended direction is the harmonisation of the packages of the measures of the Tisza plans (at national level) and the Integrated Tisza River Basin Management Plan (at international level). In addition to the Tisza river basin management planning at international level, the experiences of this analysis should be taken into consideration during national level planning as well. The multi-criteria methodology prepared in the present analysis can be used for the further development of the measure packages of the two plans at different levels. It may also be used as a basis for development of new methods. In addition to river basin level planning, we recommend applying the lessons drawn from the analysis at project level preparation and implementation as well. The conclusions of the analysis may be useful in planning the measures in the case of future habitat rehabilitation and flood protection projects on the Tisza.