

# 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 1

## Annex 7.1

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## Executive 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 cooperation 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.

## Introduction of JOINTISZA project

The over exploitation, water regime modification, contamination and growing flood events amplified by climate change negative effects require harmonized, integrated actions from countries in shared river basins. The project will focus interactions of two key aspects, the river basin management (RBM) and flood protection, taking into account the relevant stakeholders who have pivotal role in the Tisza RBM planning process. The main aim of the project is to further improve the integration of the water management and flood risk prevention planning and actions in the next RBM planning cycle, in line with the relevant EU legislations. The project ensures better embedding of flood risk management planning into the RBM planning process and also encourages the involvement of relevant sectors (such as flood risk management, water resource management, urban hydrology management, drought management) and interested stakeholders. In long term the project initiates the change of better contribution to the implementation of the Flood Risk Directive and Water Framework Directive. The project involves four types of target groups, the national water administrations, water research institutes, international organisations and other interested stakeholders, NGOs. The project is elaborated by means of joint actions of five countries (UA, RO, SK, HU, RS) sharing the TRB. The bridge between stakeholders is ensured via the ICPDR Tisza Group and EUSDR PA4 platforms, where the information is transferred from the experts level to policy level. The management and communication plan ensures the wide range involvement of target groups. More over the pilot actions give specific platform for information sharing and learning interactions. As the result of the transnational cooperation the main output of the project is the final draft updated Integrated Tisza RBM Plan, which already includes the main aspects of the Flood Risk Directive.

The project fully addresses the programme objective to strengthen transnational cooperation on water management and flood risk prevention aiming at creating new and updated plan for water management and flood risk prevention/protection elements using a common umbrella including relevant partners of the region. As a significant added value the project specially focuses on the integration of flood and water management issues taken into account the relevant EU legislation and macro-regional processes.

The evaluation of measures of completed projects in the past, is mainly connected to the JOINTISZA project Work Package 6, which is the synthesis of the whole project. It contributes to the integrated joint programme of measures to reach good status of the waters.

## Methodology for Evaluating the Measures

The multi-criteria analysis carried out in the evaluation was based on a new methodology, one of the two pillars of which is a comprehensive and multi-faceted evaluation form designed to demonstrate measures. "Evaluation System for Natural Water Retention Measures" (NWRM project, prepared for the Directorate-General for Environment of the European Commission, 2013), has been instrumental in the compilation of the evaluation process; it is effectively the framework used for the multi-criteria analysis. However, we turned its logic around by applying it to the evaluation of implemented measures. The other pillar was an evaluation form of the types of river basin

management measures, detailing the applicability and impact of the measures, also aiming at a multi-criteria assessment.

As part of the evaluation, we carried out document analyses, visited the planners and stakeholders of the projects, and conducted on-site visits. The contributors of the evaluation are primarily experts in nature conservation, water management and financial evaluations. The results are presented in two volumes where the first volume contains a description of the task, a presentation of the method used, and an evaluation of the measures included in two projects. The second volume contains the evaluation of the measures of two other projects, as well as the conclusions drawn from the evaluation.

When designing the evaluation system, we sought to incorporate a comprehensive set of criteria, to make evaluation an easy task, and to make the evaluation easily understandable for all concerned. At the same time, we endeavoured to examine and present the data and information that provide sufficient groundwork for the assessment of the measures. The point of the multi-criteria analysis thus developed is to provide an evaluation environment for a comprehensive assessment, based on substantive information.

The evaluation was unusual in the respect that no project evaluation in itself was carried out, but the measures implemented by each project were evaluated. To this end, we identified the main measure types and proceeded to evaluate them. There are several sub-measures, interventions, structural or non-structural measures that can be covered by one measure type. These were considered one group if their aim was the implementation of the measure type in question.

After the document analyses, on-site visits were conducted, and the experience gained on these visits was included in the evaluation.

The procedure itself is also assessed as to whether it is suitable for prior version evaluation and a conceptual evaluation of planned measures.

## Multi-criteria Analysis

A guideline of multi-criteria analysis titled: *Multi-criteria analysis: a manual* was prepared by the Department for Communities and Local Government: London in 2009. The manual provides a thorough description of the role, application and relevance of multi-criteria analysis. In the following, we present ideas from this manual, and then continue with further areas of application and possibilities.

Multi-criteria analysis (MCA) is both an approach and a methodology, which is designed to sort variants. However, these variants do not necessarily fulfil a single goal, but may have effects in a number of areas, and conflicts may arise in the evaluation aspects of the variants. For example, the most profitable option can be the most expensive one. Costs and benefits are generally in conflict, but short-term versus long-term impacts may conflict as well.

MCA is intended to approach complex problems, which state financial and non-financial goals. This approach breaks down the problem into manageable units so that the assigned data and perceptions can be interpreted in the individual parts. These parts can be re-assembled into a unified whole for decision-makers after interpretation, elaboration and judgement. Thus the aim is not to make a decision, but to prepare the decision and provide a decision support system.

The study compares and presents a number of methods; these will not be discussed at this point. In this present evaluation, we propose a simplified approach that presents, explores, examines and evaluates the relevant aspects of the professional field, but does not compare them with regard to their significance or relevance.

The manual is about techniques which do not necessarily rely on monetary valuations. It therefore complements guidance on those techniques which primarily use monetary valuations, namely financial analysis, cost effectiveness analysis (CEA), and cost-benefit analysis (CBA). MCA is in many respects an alternative to defining monetary values for all the major costs and benefits when this is impractical.

However MCA must not be seen as a short cut, nor as an easier technique for inexperienced people to use. The use of these techniques is in important ways more demanding of experience and good training than the use of CEA or CBA, considering, for example, the multiple test criteria and the different units of the parameters.

Good decisions need clear objectives, which should be specific, measurable, agreed, realistic and time-dependent. It is sometimes useful to classify objectives as ultimate, intermediate and immediate objectives. Ultimate objectives are usually framed in terms of strategic or higher level variables, such as the level of economic growth, sustainable development, or even a national or international directive or strategy. Intermediate objectives are the direct impacts and results of the project. Immediate objectives are those impacts that occur before the project could fully achieve the expected results.

Water management developments typically cover interventions that have economic, environmental and social impacts, and should therefore be treated as complex interventions. The significance of each impact group may vary, but its examination should be emphasized, for example, in order to cope with cumulative effects. Multi-criteria analysis can be applied for a completed or planned project, but also for principles of action, packages of measures, national or international planning and development guidelines.

## Identifying objectives of the multi-criteria analysis

The multi-criteria analysis is a complementary document of the JOINTISZA Interreg CE project, which aims to provide background information for the coordination (synthesis) of flood risk management and river basin management measures. We examine realized projects during the analysis and aim to support the process of synthesis with the resulting experience and conclusions.

Our goal is also to create a multi-criteria analysis version of integrated river basin management and flood risk management planning, which examines and presents the measures and interventions comprehensively, while highlighting the essential information. Therefore, it is also considered as a development of evaluation methodology, although its potential is limited and is not the main subject of the task, similar analyses should be a part of the above mentioned synthesis.

## Data used for the assessment

For the evaluation of measures, project documentation of implemented projects is elaborated.

Projects documentation

- Water Rights Implementation Permit
- Operating License
- Environmental Permit
- Natura 2000 Impact Assessment
- Detailed Feasibility Study
- Implementation Plan
- Environmental Impact Assessment

In addition to the project documentation, additional data and information may be needed for the assessment and in this relation we rely on the involvement of stakeholders included in the evaluation.

## Assessment process and scope of participants

Evaluation process and determination of the participants

### 1. Preparation

Data and information necessary for the preparation of the assessment are collected. The result is a document map listing the documents received and used and referring to the previously prepared plans, studies and other documents used.

*Evaluators* are doing this with the involvement of the *Client*.

### 2. Evaluation of documents – Evaluation Phase I.

In the first phase of the evaluation, based on the project documentation the measures applied there are sorted and presented.

Based on the evaluation method, the document evaluation of the measures is carried out.

This is done by *Evaluators* in consultation with the *Planners*, if necessary.

During the evaluation, the *Evaluator* in cooperation with the *Client* highlights measures for which an on-site visit is being conducted and the persons affected by the measure are contacted.

### 3. Site visit – Evaluation Phase II.

In the second phase, the site visit of the measures selected was carried out during the evaluation.

*Evaluators* will be involved with the designers if necessary.

This is done by *Evaluators* in consultation with the *Planners*, if necessary.

### 4. Consultations and stakeholder involvement – Evaluation Phase III.

The contacting of stakeholders is done through personal consultations or questionnaires.

This is done by *Evaluators* in consultation with the *Planners*.

### 5. Conclusions

The conclusions drawn from the evaluation are prepared by the *Evaluator*.

## Procedures and methods used for the development of the evaluation method

The following methodologies and procedures applied have been used for the elaboration of a multi-criteria evaluation process:

- Multi-criteria analysis: a manual - January 2009 Department for Communities and Local Government: London

The manual was commissioned by the Department for the Environment, Transport and the Regions in 2000 and remains, in 2009, the principal current central government guidance on the application of multi-criteria analysis (MCA) techniques. Since 2000 it has become more widely recognised in government that, where quantities can be valued in monetary terms, MCA is not a substitute for cost-benefit analysis, but it may be a complement; and that MCA techniques are diverse in both the kinds of problem that they address (for example prioritisation of programmes as well as single option selection) and in the techniques that they employ, ranging from decision conferencing to less resource intensive processes.

- Natural Water Retention Measures project results

The report was prepared by the NWRM project, led by Office International de l'Eau (OIEau), in consortium with Actéon Environment (France), AMEC Foster Wheeler (United Kingdom), BEF (Baltic States), ENVECO (Sweden), IACO (Cyprus/Greece), IMDEA Water (Spain), REC (Hungary/Central & Eastern Europe), REKK inc. (Hungary), SLU (Sweden) and SRUC (UK) under contract 07.0330/2013/659147/SER/ENV.C1 for the Directorate-General for Environment of the European Commission. The information and views set out in this report represent NWRM project's views on the subject matter and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

- Considerations of the Water Framework Directive

The results of the Water Management Plan 2 (WMP2) project have been used for the assessment of river basin management planning. These are used to identify the measures needed to achieve good ecological status or good ecological potential (WMP2, Annex 8.4). The assessment that analyses flood protection and flood risk management measures from river basin management planning point of view have also been used.

## List of evaluation criteria groups

The examined criteria groups of multi-criteria evaluation we have compiled are:

1. general assessment criteria
2. compliance with related strategies and guidelines
3. connection with the legal environment
4. water management assessment criteria
5. environmental assessment criteria
6. nature conservation assessment aspects
7. flood assessment criteria
8. economic evaluation criteria
9. landscape ecology assessment criteria
10. cultural heritage and tourism goals, principles and aspects
11. qualitative assessment
12. site visit

The criteria are briefly described below.

### General assessment criteria

In the general evaluation criteria, the methodology of the mid-term review assessment of the Environment and Energy Operational Program has been used.

Summary

- Summary of the intervention
- Primary and other goals of the project

Coherence of the measure

- How and to what extent does the measure contribute to the goals set?
- How and to what extent does the measure contribute to related strategies and programmes?

Relevance of the measure

- Name and list of affected and target groups

Added value, expected results

- How and to what extent does the measure contribute to the objectives of stakeholders?

Maintenance and management of measure

- Is maintenance necessary in case of the measure and how?
- Is the economic, institutional and practical-professional maintenance is guaranteed after the 5 year-period, which is in the project contract?

### Strategic connection with related strategies and directives

The Jenő Kvassay Plan encompasses domestic, national water management, flood protection, flood risk management and water resource management issues. It is considered essential that the interventions take place in compliance with the goals and principles contained therein, and support the implementation of the strategy as soon as possible.

However, the alignment and contribution to river basin management planning is especially emphasized, given that this is a priority of this study.

### Connection with the legal environment

When presenting the legal environment, the alignment with the objectives of the related legal regulations is assessed, with special regard to the following:

### Geographical description

Identification of the geographical location of the measure, identification of the associated water bodies, WMP sub-units.

### Illustration

Illustration of photo documentation prepared based on the site visit.

### River basin area affected by planning parameters and measures

The scale of the intervention and the size of the affected area of the documents received are determined.

## Summary of the projects examined

### Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (LIFE03 ENV/H/000280)

#### Summary

In the Middle Tisza region, south of Szolnok, on the territory of Rákóczifalva, Tiszavárkony and Vezenseny, flows the section of the Tisza known as the Vezensenyi bend, which is an area of great natural value and

is of the utmost importance concerning flood protection. A section of 4 river kilometres (319.27 RKM - 323.36 RKM) have been designated as the project area of the LIFE project.



Figure 1: Overview of the project area

A new approach to floodbed landscape rehabilitation was sought here, which could later serve as a guideline for planning and implementing further interventions to achieve complex goals. In case of the Vezenyi bend, the objectives of the floodbed interventions were to preserve the ecological values of the area, to increase water retention ability, to reduce flood risk and to create possibilities for a new land management approach that, in addition to the abovementioned objectives, provides work and livelihood for local people, thus increasing the population retaining ability of the area.

Project implementer: Hungarian consortium led by KÖTIKÖVIZIG

Project duration: 1<sup>st</sup> December 2003 – 31<sup>st</sup> March 2007.

Total project cost: 1,399,116.00 €

### Primary and other objectives of the project

During the planned floodbed landscape rehabilitation, the implementation of sustainable water management is supported by the following three main objectives:

- Habitat rehabilitation
- Water retention
- Creating jobs, increasing the population retaining ability of the area

Following the mitigation of the flood risk, the security of the local population's life (Vezenseny 647 inhabitants, Rákóczifalva 5,307 inhabitants, Tiszavárkony 1,518 inhabitants) will increase and ecological values will be preserved. The project aimed at reducing the flood level through the development of water retention capacity, rehabilitation of barrow pits, floodbed regulation and improvement of roughness conditions (floodplain forest rehabilitation). A number of similar floodbed management programs were implemented along the Tisza, but the specialty of this project was that the rehabilitation process was a complex and comprehensive program, where floodbed rehabilitation was combined with nature conservation and regional development.

#### Rehabilitation of barrow pits

The barrow pits were created 150 years ago at the time of the river's regulation works. These were borrow areas of materials used for dam construction, thus they are located along the dam line. During flooding, these pits fill with water and their shallow, warm water is an ideal spawning ground for fish. However, after flood propagation, the juveniles are trapped, and by the end of the summer the water evaporates from the pits, causing the fish to die, and giving the wading birds plenty of nutrition. The project aims to retain enough water during the spring floods so that the juveniles can develop and return to the Tisza in the autumn. Other objectives: local people supplement their income by scour channel management ("fokgazdálkodás", traditional floodplain farming), but non-indigenous fish (brown bullhead) are not released back to the Tisza.

#### Opening of scour channels

The dredging of the Northern floodbed channel in 250 m length allows water at level 82.0 metres above Baltic Sea level to flow from the Tisza to the barrow pits on the floodbed, which is controlled by a culvert equipped with a backwater gate. It is planned that this will occur at the Tisza level of 4.10 m at the Szolnok staff gauge. The Southern floodbed channel was also dredged in 370 m length, creating a bottom level of 82.1 metres above Baltic Sea level, also controlled by a culvert equipped with a backwater gate.

#### Grassland rehabilitation, control of adventive, invasive species

Control of the false indigo bush (*Amorpha fruticosa*) and other non-native tree species in the 40-hectare area by mowing. The dense, impenetrable thickets formed by false indigo bush cause flood protection problems. Conservationists consider such areas as "deserts", because the false indigo bush does not provide shelter to any living creature. The aggressively spreading plant also supersedes rich grasslands, so it is necessary to control its spreading by regular mowing.

### Land use changes

The floodbed area covered by the project is 54 hectares, on which the original floodbed grassland with scattered trees had been replaced by a characterless, mixed forest with adventive species. The natural levees on the shoreline and the sedimentation of the inner areas led to the formation of undrained areas. The condition is unfavourable both ecologically and for flood management. The final cutting of the poplar plantation is carried out on 4.2 hectares and the native grassland is restored. The natural levees on the shoreline are partially demolished and transected. With the establishment of a periodic water management area, 5 hectares shall be withdrawn from cultivation.

### Nature trail

The nature trail presents the wildlife of the Tisza floodplain. The 6 km long path stretches along the left bank of the river Tisza at Rákóczifalva. It can be explored on foot or by bicycle. Among the natural values found here, the most valuable are the willow and poplar groves, the barrow pit forest, the oak forest of the Bivaly Lake, the marshy meadow of the floodplain and the plant associations of the dike. The information boards along the nature trail provide useful information for tourists, presenting individual floodbed habitats, the status before and after human intervention, and the habitat regeneration processes. A lookout tower with a wonderful sight has also been built.

## Measures applied

### Rehabilitation of barrow pits

The earth beams between the barrow pits were cut, and the pilot cuts and connecting ditches were established. Currently, a considerable amount of water is present in the barrow pits with few spawn and poor wildlife. A large number of aquatic snails can be observed. The measure does not serve to increase the income-generating activity of the locals; it plays a major role in achieving nature conservation goals.

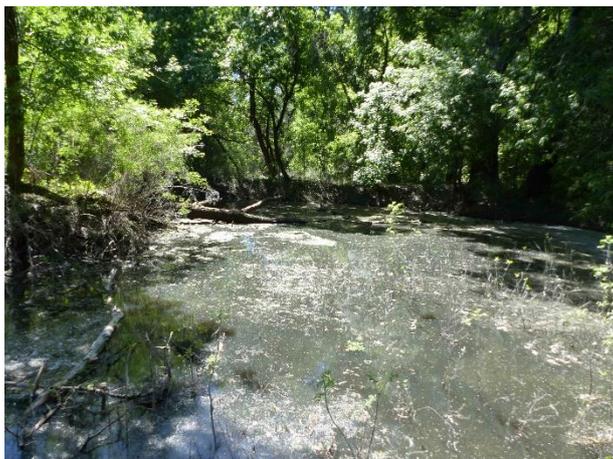


Figure 2: Wildlife of a barrow pit

#### Opening of scour channels

The drain channels are well maintained and the culverts are in operation. The backwater gates were temporarily disassembled, because nature conservation criteria meant that this part of the floodbed should be covered with water during this period. Scour channel management has not been implemented because fishing is now prohibited by law, and with the reduction of livestock farming, there is no need for rich pastures.



Figure 3: Culvert without backwater gate

#### Grassland rehabilitation, control of adventive, invasive species

The 40-hectare area is still mowed twice a year even after the end of the maintenance period of the project, to ensure that the roughness of the drainage zone is reduced. Thanks to regular mowing, invasive species have been reduced, false indigo bush only appears in a small patch.



Figure 4: False indigo bush appears in a smaller patch

#### Land use changes

In the area of 54 hectares affected by landscape rehabilitation, 4.2 hectares of poplar plantations were cut and the grassland vegetation was restored. The natural levees on the shoreline were partially demolished by moving 2,800 m<sup>3</sup> of soil, thus eliminating the undrained areas. The floodplain habitat rehabilitation, which meant the establishment of wetlands with periodic water management typical of the floodbed was carried out on 5 hectares. Land use change and withdrawal from cultivation took place on nearly 10 hectares. The very thick undergrowth in the forests of the drainage zone had a significant barrage effect during floods. The indigenous trees remained, but the dense undergrowth was cleared, which has not been able to regrow since because of the dense canopy of the forests. This favourable status is self-sustaining, no further maintenance is required. Due to the drainage zone cleared as part of the project, the reduced barrage effect resulted in a 4 cm lower level at Szolnok during the floods in 2006.

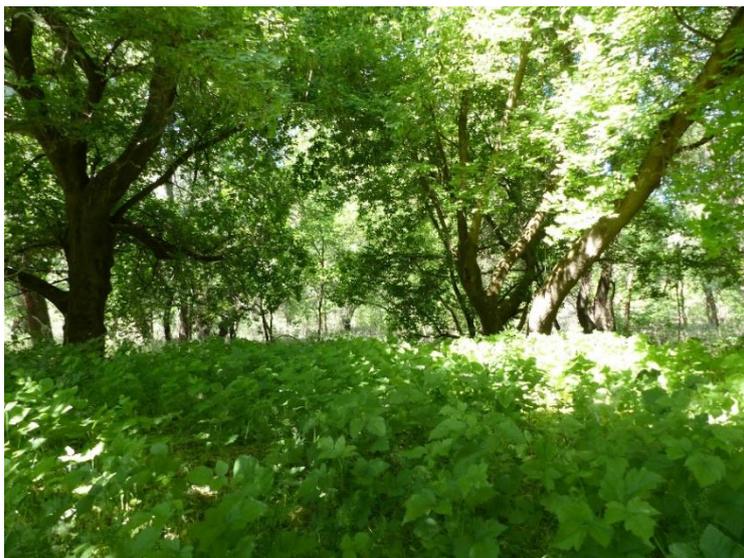


Figure 5: The cleared undergrowth in the drainage zone is not able to regrow

### Nature trail

The nature trail is still in a well maintained condition. It is regularly visited by school groups, and provides a day-long hiking program. The information boards were replaced in 2010, the wooden benches and the lookout are regularly painted, and repaired as necessary. The Water Directorate provides its own resources to ensure preservation. The maintenance of the nature trail would not be its duty, but there is no other organization capable of taking this task over.



Figure 6: A station of the nature trail

## Beneficiaries and stakeholders of the intervention

Project partners:

The project was implemented by a Hungarian consortium led by KÖTIKÖVIZIG, whose members and their tasks are the following:

- KÖTIKÖVIZIG (Middle Tisza Region Environment and Water Directorate): Integrated floodplain management, morphological examination of the floodbed, nature trail development
- VITUKI Consult Rt.; Budapest
- Károly Róbert College, Gyöngyös: Socioeconomic study, agro-economic potential and forestry study
- Hortobágy National Park, Debrecen: Ecology and nature conservation status evaluation
- VIZITERV Consult Kft., Budapest
- Eurosense Kft., Budapest: Remote sensing tasks, aerial photographs, multispectral images
- Municipality of Tiszavárkony
- Municipality of Vezeny
- Municipality of Rákóczifalva
- General Assembly of Jász-Nagykun-Szolnok County

Organizations involved in the project in regular cooperation with the Water Directorate:

**II. Rákóczi Ferenc Fishing Association:** observing the spawning of fish and the development rate of juveniles; proposing water level regulation measures for the growth and survival of fish

**Bird Protection and Nature Conservation Club of Rákóczifalva:** observation of breeding periods to determine the date of mowing, which is especially important in case of ground-nesting birds

**Club of Entrepreneurs and Farmers of Rákóczifalva:** organization of informative meetings for the utilization of grasslands

**Hunting Organization of Bivalytó, Rákóczifalva:** Game is sparse in the area, but the appearance of wild boars causes great damage in the area, their control would be desirable

### Maintenance tasks

Among the maintenance tasks, grassland management is the biggest. The maintenance of nearly 40 hectares after the end of the project's maintenance period (2013) is carried out by the Water Directorate (VIZIG) with the help of public workers. Grazing has not begun in the area, as no farmers are willing to start it in the absence of resources and expertise (in the field of organic farming). As animal husbandry is minimal in the villages, there is no demand for hay either. The maintenance of the nature trail (maintenance of information boards, benches and the lookout, garbage collection and mowing) is also a significant task. Maintenance of barrow pits and connecting channels, operation and

maintenance of sluices and backwater gates are periodical tasks. Overall, maintenance tasks mean the continuous work of 10-15 VIZIG personnel. The work need be coordinated with the National Park on a daily basis to ensure that mowing and water level controls are carried out without damaging the wildlife. There are a number of conflict points (the juveniles' safe access to the Tisza requires opening of the sluices, but this would leave the wading birds without food), so compromise solutions are needed. There is not a significant number of juveniles in the barrow pits, because the spawning takes place on the flooded meadow and after the propagation of flood the fish move back to the Tisza. A few of them are trapped in the barrow pits, providing food for the birds. Maintenance is still carried out because it is in VIZIG's interest to maintain the drainage zone, and the wages can be covered from the public works program. Our experience is that those measures will sustain in the long term, which are in the common interest of a number of stakeholders and/or the activity has economic benefits or serves flood protection purposes.

### Complementarity with related strategies and directives

In parallel with the LIFE project, the "Update of the Vásárhelyi Plan (VTT)" national investment was in progress, in which the embankment section at Bivalytó was relocated, and the development of the drainage zone at Bivalytó was also completed. The main objectives of the LIFE Environment project "Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (SUMAR)" fitted the aims of the relocation of embankment at Bivalytó realized within VTT, because vegetation has a major influence on the roughness of the floodbed.

The afforestation and the development of the drainage zone carried out in the frame of the LIFE project had a significant impact on the flood propagation already in 2006.

The Kvassay Jenő Plan (2015) and the River Basin Management Plans (VGT1 2010) did not exist at the time of the project implementation, yet it is consistent with their goals. Water management also plays a major role in the UN Sustainable Development Goals (SDGs) adopted in 2015.

Kvassay Jenő Plan, River Basin Management Plan, Sustainable Development Goals	Consistent with the goals of the project <b>Floodbed management of the Tisza</b>	
	YES	NO
Improving water quality	√	
Improving water use efficiency	√	

Implementation of integrated water management	√	
Protection of aquatic ecosystems	√	
Extending international cooperation		√
Involving local communities in water management	√	

### Legal framework

The construction of hydraulic structures requires a water permit, which should be obtained according to Act LVII of 1995 on water management. Additional legislation:

Act XCIII of 1995 on restoring the protection level of protected areas

Act LXXXI of 1995 on the Convention on Biological Diversity

Act XXVIII of 1998 on the protection and welfare of animals

### Geographical description

The project area is located on the Great Plain, Middle-Tisza region, Szolnok-Túri-plain micro region. The micro region is located in the territory of Jász-Nagykun-Szolnok county. It is an alluvial plain covered by loess sediments, 80-105 metres above sea level, with an area of 1,700 km<sup>2</sup>. The relative relief value is small (2 m/km<sup>2</sup>), higher on the western parts, and in the areas of sand-hills. More than 80% of the area can be classified into the orographic relief types of low flood-free plains, gently undulating plains (on the western part), and floodplains. Some variation is only provided by the scattered sand-hills of 1 to 5 m height, built of the sediment of Zagyva and Tarna, covered by loess sand; the oxbows forming a tangled network on the southern side of the micro region; and the kurgans.

Only a few watercourses run to the Tisza. Such are the Kengyeli main channel (18 km, 131 km<sup>2</sup>) running to the Alcsi-Holt Tisza, North from the project area, and the Cibakháza-Martfű main channel (12 km, 38 km<sup>2</sup>) South from the project area. The micro region is dry, scarce of water, and despite the fact that large floods are frequent, irrigation of the agricultural land is a must.

In the table below, River Basin Management Plan (RBMP) territorial delimitations are identified, supplemented by the Flood Risk Management (FRM) delimitations.

RBMP sub-basin	RBMP sub-unit	Related watercourse(s)	Geographical location
Tisza	2-18 Nagyunság	Bivaly-tói channel	The project area is located in the valley of Middle-Tisza. Most of the surface is plain, formed by rivers.

FRM planning unit	Flood basin
Middle-Tisza	2.84 Flood basin of Bivalytó

The table below shows the area affected by the intervention.

	0-0.1 km <sup>2</sup> / km	0.1-1.0 km <sup>2</sup>	1-10 km <sup>2</sup>	10-100 km <sup>2</sup>	100-1000 km <sup>2</sup>	>1000 km <sup>2</sup>
Scale of the measure		√				
Description	54 hectares of floodbed landscape rehabilitation divided amongst the measures as follows:					
	<b>Opening of scour channels, solving floodbed water management tasks</b>					7 ha
	<b>Rehabilitation of barrow pits</b>					8 ha
	<b>Habitat rehabilitation on the floodbed</b>					5 ha
	<b>Rehabilitation of grasslands, control of invasive species</b>					24 ha
	<b>Land use changes</b>					10 ha

Due to the nature of the measures they have an impact on the flood water level of the Tisza even in the distance of dozens of kilometres, which could be specifically demonstrated during the floods in 2006.

	0-0.1 km <sup>2</sup> / km	0.1-1.0 km <sup>2</sup>	1-10 km <sup>2</sup>	10-100 km <sup>2</sup>	100-1000 km <sup>2</sup>	>1000 km <sup>2</sup>
Impact area of the measure				√		
Description	It has an impact on the flood water level even at Szolnok					

## 1.1 Floodplain management at River Tisza – based on LIFE00NAT/A/7051 project

### 1.1.1 Summary

Before the LIFE project the Nagykörű Landscape Management Program was established in 2000 by the leadership of the local mayor and farmers, in order to revive traditional floodplain management along River Tisza. In addition to local NGOs, the Hortobágy National Park, the Water Directorate and other experts and local governments were involved in the development and implementation of the project. The project proposal was developed in a very short time, but in 2001 there was no Environmental Impact Study and Implementation Plans and permits were not necessary for the submission. The expected economic, social and environmental impacts were based on uncertainties. The planning and construction of the structures were done by specialists with little routine, and its risks were not taken into account. The legal, professional and financial conditions of maintaining the measures were fundamentally based on the significant change of view of the stakeholders.

During the floodbed management project of River Tisza, measures were carried out at 4 sample sites at the Middle Tisza region with the aim of demonstrating that landscape use with nature conservation can be implemented by habitat rehabilitation at the floodbed. Traditional arable farming at the floodbeds is not feasible due to unpredictable crop yields. Moreover, the chemicals used directly pollute the river water. Summer dikes and inland excess water drainage channels have fundamentally altered the water balance of the soil. Tree plantations of frequent non-native species in the floodbed and the aggressively spreading *Amorpha fruticosa* increase flood risk and reduce biodiversity. The proposed solutions are not only for nature conservation, but also help people living in the landscape. When selecting the sample areas, it was important that the program address specific issues in areas with different characteristics. They strived to rely on existing local initiatives and ideas, as this is the key for the long-term success of the programme.

Implemented by: WWF Hungary

Duration of the project: January 2001-December 2005

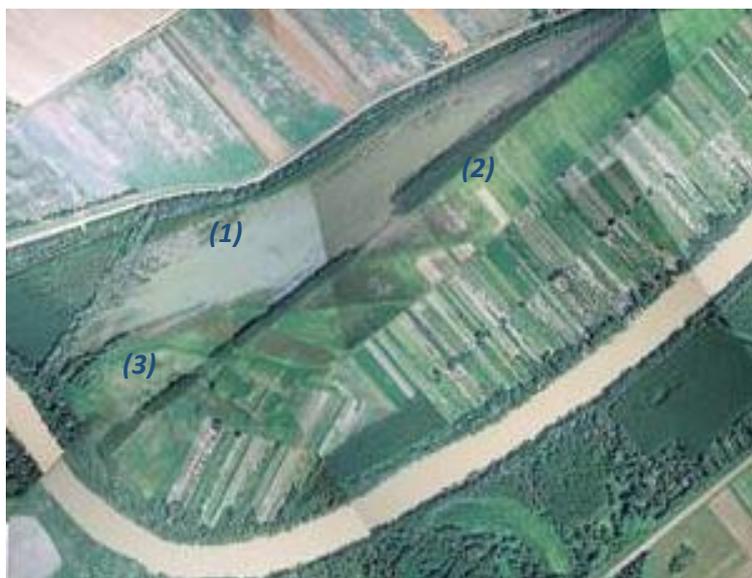
Total budget of the project: 435 326 Euro

### 1.1.2 Primary and other objectives of the project

Different measures have been implemented at the following 4 sample areas. Each measure has been implemented in order to meet a broader overall objective, which is to radically change the way in which the floodbed has been utilized until now and to show as a good example that more balanced

relationship may exist between man and nature, which can be economically and also socially successful.

There have been several significant measures in the territory of **Nagykörű**.



*Figure 1. Landscape use types at the Nagykörű floodbed*

Figure 1 shows the 3 types of landscape use at the Nagykörű area, which have been formed according to the altitude. The floodbed basin covers 300 hectares.

- (1) Tóalja is the deepest area with regular water cover, Lake Anyita is situated here.
- (2) Legelő (pasture) is a weedy arable land at the higher parts of Tóalja.
- (3) A 6-hectare floodplain orchard has been established on a ridge, which is 3 metres higher than the surrounding area.

**At the Nagykörű floodbed basin the following objectives have been set:**

Utilization of barrow pits

The barrow pits were established 150 years ago at the same time as the river control was carried out. Basically these were the clay pits from where the materials were used for dam construction, so they are situated along the dam. During floods these pits fill with water and the shallow warm water is an ideal spawning ground for fish. However, during flood propagation the juveniles are trapped in the pits and by the end of the summer the water evaporates and the fish will die, giving plenty of food for herons, storks and other large waterbirds. The aim of the project is to retain enough water during the spring floods so that the juveniles can develop and return to River Tisza in autumn. Other aims: local

people use scour channel management as an additional activity for gaining income, non-indigenous species (e.g. *Ameiurus nebulosus*) are not let to return to River Tisza.

### Revitalizing Lake Anyita

At Lake Anyita, ensuring constant water cover with water retention, water replenishment by summer dike cutting, controlling *Amorpha fruticosa* by grazing, maintaining grasslands. Its total area is 2,000x400 m, which is reduced to 30 ha water cover during the floods and 10 ha in other periods, while the rest is meadow and pasture. It functions as a real cradle for juvenile fish and a diverse wildlife can develop. By revitalizing the Anyita Scour Channel, the water level can be controlled.



*Figure 2. Lake Anyita*

### Planting native fruit trees

At areas situated on a relatively high altitude, floodplain orchards can be found at the floodbed of River Tisza. Apple, pear, plum and walnut varieties can tolerate a two-month flood, even if the bottom of the crowns is under the water. They are less sensitive to infections and pests, therefore their chemical need is much lower, and their fruits can be considered almost organic. From their fruits high quality *pálinka*, dried fruits, preserved fruits and jams can be made. The floodplain orchards provide an excellent habitat for many insect species as well as passerines feeding on them, hoopoe, European green woodpecker or bats. Within the framework of the project, orchards have been established on 6 hectares, with the aim of supplying healthy fruit to the local population and selling it in fairs and markets after processing, thereby increasing the population retention capacity of the region.

## Tiszajenő

### Improving the water management of the Great Meadow

At the 200-hectare area, the *Amorpha fruticosa* is controlled with grazing. With the water retention of the Kőrös-ér, the pasture could be flooded in summer.



*Figure 3. Great Meadow*

## Tizsakürt

### Maintaining the Grassland at Szigetmajor

At this area, eradication of Hybrid Poplar on 12 hectares and the grassland maintenance by grazing of gray cattle and buffalo. As grazing decreases, hybrid poplar around the grassland is gradually spreading at the expense of the grassland. The livestock population of local farmers has increased, but it is a burden for them to graze on the floodbed, so maintenance of grassland in good condition and the reduction of *Amorpha fruticosa* are limited.

## Kőtelek

### Holt-Tisza at Lake Göl

The expansion of the Middle Tisza Landscape Protection Area has targeted several areas. At Kőtelek there is a coherent area of 500 hectares, which is transformed gradually in the long term into a grove forest of indigenous species due to natural succession. It is the habitat of several rare bird species, including the highly protected white-tailed eagle and the black stork.

### 1.1.3 Measures applied

#### Utilization of barrow pits

Within the project connecting channels among the more than 100 pits were established with a channel system downhill to River Tisza. A sluice is built in the main channel, so during spring floods so much water can be retained in the pits, which is enough to keep the fish alive even after summer evaporation. Creating a controlled relationship with River Tisza and ensuring access of juvenile fish to River Tisza are basically based on the principles of the so-called scour channel management. In Autumn 2001 the sluice was already working and indigenous carps, northern pikes and breams could swim back to the Tisza, while the non-native brown bullhead was retained to feed the birds.

According to the original idea, local residents would have been carrying out scour channel management as a complementary activity for earning money, but the hard physical work invested results in only little benefit, so today the system is more or less operating only because of nature conservation aspects. There is no designated user and arable crop farming continuously carried out on the floodbed, so the farmers open the sluice. The real spawning ground for fish is not the shady pits surrounded by trees, but the well-lit meadow covered with shallow water, where they can get enough food. Only a small amount of the fish is trapped in the pits, and there is considerably less food for juveniles.

#### Development of Lake Anyita

Water retention was achieved by renovation of the Anyita Scour Channel (“Anyita-fok”) in 2004. However, the permeability of the sluice is not enough to follow the fast changes of the water level. Grassland maintenance and the reduction of *Amorpha fruticosa* are successful by the grazing of the gray cattle. Wildlife is progressively getting more diverse and the fish cradle function also works. Due to the flooding, non-native species are superseded and replaced by willow-poplar grove forest.

#### Planting native fruit trees

The plantation was destroyed during the flood of 2006 not even its traces can be discovered. The farmers were busy with livestock farming, so the orchard did not receive enough attention.

#### Improving the water management of the Great Meadow

The water quality of the Körös-ér was still very bad during the project implementation, so flooding of the pasture could not take place. Today the water of Körös-ér would be appropriate for flooding, but its realization would not be in the interest of anybody.

### Maintaining the Szigetmajor Grassland

By increasing the livestock population of local farmers, it has been possible to a limited extent to maintain the grasslands in good condition and control the spread of shrubs and *Amorpha fruticosa* until today.

### Holt-Tisza at Lake Goi

Based on the initiative presented during the project, the Middle Tisza Landscape Protection Area, which belongs to the Hortobágy National Park, was extended.

## 1.1.4 Beneficiaries and stakeholders of the intervention

The project participants are the following:

The beneficiary was WWF Austria but the project location was in Hungary, therefore it was in fact implemented by WWF Hungary. The major part of the ideas was based on the Nagykörű Landscape Management Program, established by the Local Government of Nagykörű and local farmers in a cooperative form. The Hortobágy National Park has provided professional assistance in the wildlife survey. The Middle Tisza Regional Water Directorate has been responsible for meeting the flood control criteria.

## 1.1.5 Maintenance tasks

Among the maintenance tasks, the maintenance and proper operation of sluices is a serious challenge at the area.

Our experience is that those measures will continue to subsist in the long term, which belong to the common interest of several stakeholders and/or the activity has economic benefits or support flood protection goals.

## 1.1.6 Strategic connection with strategies and directives

The Kvassay Jenő Plan (2015) and the River Basin Management Plans (VGT1 2010) did not exist at the time of the project implementation, yet it is consistent with their goals. Water management also plays a major role in the UN Sustainable Development Goals (SDGs) adopted in 2015.

Kvassay Jenő Plan, River Basin Management Plan, Sustainable Development Goals	Consistent with the objectives of the <b>Tisza floodbed management project</b>	
	YES	NO

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	√	

### 1.1.7 Legal framework

For the construction of aquatic structures, a water permit is required, which should be obtained in compliance with *Act LVII of 1995 on water management*. *Other legislation:*

Act XCIII of 1995 on the restoration of the level of protection of protected natural areas

Act LXXXI of 1995 on the promulgation of the convention on biological diversity

Act XXVIII of 1998 on the protection and sparing of animals

### 1.1.8 Geographical description

In the table below, the VGT territorial delimitations are identified and supplemented by the ÁKK delimitations.

VGT sub-basin	VGT-sub unit	Connecting water flow(s)	Geographical description
River Tisza	2-9 Hevesi sík		In the valley of Middle Tisza, the areas affected by the project are located between Szolnok and Kisköre. Most of the surface is filled plains, formed by rivers.
River Tisza	2-12 Nagykőrösi-homokhát	Kőrös-ér	
River Tisza	2-18 Nagyunság		

Flood risk management planning unit	Floodplain basin
Middle Tisza	Laskó-Tisza-Zagyva-Tarna Floodplain basin

The tables below indicate the size of the intervention (e.g. the size of the reservoir area) and the size of the action area of the measure.

	0-0.1 km <sup>2</sup>	0.1-1.0 km <sup>2</sup>	1-10 km <sup>2</sup>	10-100 km <sup>2</sup>	100-1000 km <sup>2</sup>	>1000 km <sup>2</sup>
Scale of measure			√			
Description	100 ha Lake Anyita, 500 ha Holt-Tisza of Lake Goi, Grazing 12 ha					

What size of area is affected by the measure?! Only that area is affected where the intervention takes place or it extends over elsewhere (e.g. reservoir effect). This may be given in km or km<sup>2</sup>, depending on the circumstances.

	0-0.1 km <sup>2</sup>	0.1-1.0 km <sup>2</sup>	1-10 km <sup>2</sup>	10-100 km <sup>2</sup>	100-1000 km <sup>2</sup>	>1000 km <sup>2</sup>
Scale of measure			√			
Description	The effect can only be felt at the floodbed.					

## Measures proposed in Phase 2 of River Basin Management Planning

### List of measures

#### Hydromorphological measures

- 2.4 Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion)
- 6.1 Establishment of open floodplain, expansion of the floodbed with the necessary land use change
- 6.2 Establishment of appropriate vegetation of the floodbed
- 6.3. River bed rehabilitation using methods depending on category and type (large river, small and medium watercourses, still waters, artificial water bodies)
  - 6.3.b Modification of the shape and alignment of the river bed approximating the natural state, with the simultaneous satisfaction of recognized human needs
- 6.5. Progressive achievement and sustenance of good ecological status / potential of watercourses and still waters through maintenance works
  - 6.5.2 Maintenance of riparian vegetation
- 6.6. Demolition of facilities within the river bed that have lost their function - progressive achievement of good ecological status / potential of the environment
- 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
- 6.8 Improving the water supply of large rivers' floodbeds

- 6.11** Creating artificial channels that indirectly help to achieve RBMP goals - e.g. flood control channel or water replenishment channel
- 6.12** Mitigation measures to reduce hydromorphological regulation
  - 6.12.1** Water replenishment on the protected side: for oxbows, branches, floodplain wetlands
  - 6.12.2** Compensatory floodbed afforestation in the dead space of river flow
  - 6.12.3** Adaptation of inland navigation to the capabilities of the river or still water
- 7.3** Mitigation measures to reduce problems related to the flow regime
  - 7.3.1** Control of water drainage from reservoirs
  - 7.3.3** Reducing the degree and impact of peak loads
- 23.2** Rainwater management, water retention within crop fields to increase infiltration and reduce drainage

### Nature conservation measures

- 6.1** Establishment of open floodplain, expansion of the floodbed with the necessary land use change
- 6.2** Establishment of appropriate vegetation of the floodbed
- 6.8.a** Restoration of the connection between the main river and cut off meanders, oxbows and side branches filled with sediment, ensuring regular flooding of the floodbed or open floodplain
- 7.1** Modification of the inland inundation drainage system
- 14.** RESEARCH AND DEVELOPMENT OF KNOWLEDGE BASE TO REDUCE UNCERTAINTY
- 17.8** Establishment of buffer zones near watercourses and lakes by creating grasslands or using agroforestry methods (coordination with the rehabilitation of riparian vegetation zones, considering flood prevention and maintenance aspects)
- 23.2** Rainwater management, water retention within crop fields to increase infiltration and reduce drainage
- 32.** REGULATION OF GROUNDWATER ABSTRACTIONS NOT AIMING AT SATISFYING WATER DEMANDS, MITIGATION OF IMPACTS

### Measures to improve the physico-chemical status of surface waters

- 1.1** Implementation of the Wastewater Program. Establishment of a new wastewater treatment plant, modernization of existing wastewater treatment plants (capacity increase, technology development, reconstruction), in compliance with the limits for surface recipients.
- 2.1** The general set of rules for the reduction of nutrient pollution in agricultural production, the actual restriction of nutrient application in croplands and plantations
- 2.4** Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion)
- 17.1** Reduction of contamination and sediment leaching by creating grasslands, forests, terraces in case of sloping areas, infiltrating surfaces, isolation of crop production in built-up areas
- 17.5** Reduction of contaminant leaching in lowland areas in the framework of the agro-environmental management program (e.g. border zones of crop fields, deep ploughing)
- 27.1** Improving the treatment of thermal waters used for energy production, which do not contain priority substances
- 27.2** Treatment of thermal waters used for bathing and healing
- 29.2** Modernization of livestock farms according to the EU Nitrate Directive
- 31.2** Regulation of the reinjection of liquid extracted from wells used for hydrocarbon production and exploration

## Use of river basin management planning measures

Below we list the measures that are related to the proposed measures of the river basin management planning and implemented by the projects.

### Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (LIFE03 ENV/H/000280)

#### List of applied types of measures

- 6.1 Establishment of open floodplain, expansion of the floodbed with the necessary land use change
- 6.2 Establishment of appropriate vegetation of the floodbed. The elements of the measure are cropland – grassland and cropland – forest conversions, which can be combined with the destruction of invasive species.
- 6.12 Mitigation measures to reduce hydromorphological regulation
  - 6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands

### Management of floodplains on the Middle Tisza (LIFE00NAT/A/7051)

- 6.1 Establishment of open floodplain, expansion of the floodbed with the necessary land use change
- 6.2 Establishment of appropriate vegetation of the floodbed. The elements of the measure are cropland – grassland and cropland – forest conversions, which can be combined with the destruction of invasive species.
- 6.8 Improving the water supply of large rivers' floodbeds
- 6.12 Mitigation measures to reduce hydromorphological regulation
  - 6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands
- 17.6 Good grazing and feed management practices for pastures

### Complex flood control and revitalization development of flood basin in the Bereg area

- 2.4 Land use change (cropland – grassland, cropland – forest, cropland – wetland conversion)
- 6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands
- 7.1 Modification of the inland inundation drainage system
- 23.4 Inland water retention in reservoirs and in wide spreading riverbed
- 32.2 Compensation of low river water and sinking ground water level level due to river deflection with river bed dams.

### Rehabilitation of Öreg-Túr

- 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 protected side: oxbows, branches, floodplain wetlands
- 7.1 Modification of the inland inundation drainage system

## Evaluation of measures

For the evaluation of measure we applied the methodology 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 2<sup>nd</sup> 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 aspects are nature protection, water management, social and financial aspects. The evaluation doesn't consist a flood risks management evaluation. The nature protection aspects are biophysical impacts and ecosystem services benefits. For the assessment of Water Framework Directive perspectives we have applied the elaboration of water management measures prepared at the 2<sup>nd</sup> phase of water management planning, which consists a thoroughly 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-analyses. 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 columns are the evaluation criteria. Third column is the scale of the impact of the measure, the fourth embraces the justification.

### MEASURE 1: Controlling the water replenishment of barrow pits

#### Biophysical impacts

Sustainable landscape rehabilitation of the flood plain in the Middle Tisza District (based on the LIFE03 ENV/H/000280 project)

Biophysical impacts scour channel opening, barrow pits		Rating	Evidence
Slowing and Storing Runoff	Store Runoff	<b>Low</b>	The water introduced into the barrow pits reduces runoff and it directs the water to the floodplain through the scour channels („fokok”). Due to its small spatial extent, its effect is low. Apart from quantitative terms, the effect of the measure is moderate.
	Slow and store runoff	<b>Low</b>	The runoff from the barrow pits to River Tisza is delayed and the water is kept in the area. Due to the relatively small amount of water it is of little importance. Apart from quantitative terms, the effect of the measure is moderate.
	Store river water	<b>Low</b>	Within the project, water retention in the floodplain has been carried out in the barrow pits. The storage time has increased with the establishment of controlled retraction. In the present case the effect is low due to the small territorial extent. Apart from quantitative terms, the effect of the measure is moderate. The effect of dike relocation within the Improvement of the Vásárhelyi Plan (VTT) is high.
	Slow river water	<b>Low</b>	By flooding the barrow pits, the runoff slows down.
Reducing Runoff	Increase evapotranspiration	<b>Low</b>	Evaporation is significantly increased by securing the water supply of barrow pits longer than before. In the present case the effect is low due to the small territorial extent. Apart from quantitative terms, the effect of the measure is moderate. Taking into account the effect of VTT, it has high effect.
	Increase infiltration and/or groundwater recharge	<b>Low</b>	Water input to the floodplain at lower water levels and thus increasing the area and time of waters leads to the recharge of groundwater. In the present case the effect is low due to the small territorial extent.
	Increase soil water retention	<b>Low</b>	Depositing sludge and high organic matter content increases the water holding capacity of the soil.
Reducing Pollution	Reduce pollutant sources	No effect	The measure does not affect this condition.
	Intercept pollution pathways	No effect	The measure does not affect this condition.
Soil conservation	Reduce erosion and/or sediment delivery	<b>Low</b>	The incoming water deposits its transported sediment.
	Improve soils	No effect	The measure does not affect this condition. This is not applicable in case of pits.

Biophysical impacts scour channel opening, barrow pits		Rating	Evidence
Creating habitat	Create aquatic habitat	<b>Medium</b>	This intervention involves the rehabilitation of aquatic habitats and the extension of water cover. Barrow pits represent a better habitat than the original, even though it has not reached the level of expectation.
	Create riparian habitat	<b>Low</b>	The banks of channels become riparian habitats.
	Create terrestrial habitat	No effect	The measure does not affect this condition.
Climate change	Enhance precipitation	<b>Low</b>	Through the evapotranspiration, it theoretically affects the enhancement of precipitation, but this is minimal in the present case due to the small territorial extent. Apart from the extension of the affected area, considering the whole flood plain, the impact of the measure is low.
	Reduce peak temperature	<b>Low</b>	The spatial and temporal increase of water cover and the increase in evapotranspiration result in temperature decrease. In the present case the impact is low due to the small territorial extent.
	Absorb and/or retain CO <sub>2</sub>	<b>Low</b>	The aquatic habitat produces larger amount of plant biomass, which increases CO <sub>2</sub> capture.

Floodplain management at River Tisza – based on LIFE00NAT/A/7051 project

Biophysical impacts water replenishment of barrow pits		Rating	Evidence
Storing and Slowing Runoff	Store runoff	<b>Low</b>	In the present situation – i.e. in the absence of an incoming and connecting channel system – barrow pits are suitable for storing runoff only at a low level. The incoming and connecting channels have broken down, thus they receive water only at higher water levels, which remained in the pits after flood propagation.
	Slow runoff	<b>Low</b>	For the above reasons, slowing runoff is only at a low level.
	Store river water	<b>Low</b>	After flooding, the pits store water for a shorter or longer period.
	Slow river water	<b>Low</b>	Flooding the barrow pits slows down the runoff. The barrow pits are situated at forest areas.
Reducing Runoff	Increase evapotranspiration	<b>Low</b>	After flooding, barrow pits store water for a shorter or longer period, which improves the water supply of their environment. This in principle leads to increased evapotranspiration. The effect is low.
	Increase infiltration and/or groundwater recharge	<b>Low</b>	After flooding, barrow pits store water for a shorter or longer period, which facilitates the recharge of groundwater.
	Increase soil water retention	<b>Low</b>	Depositing sludge and high organic matter content increases the water holding capacity of the soil.
Reducing Pollution	Reduce pollutant sources	No effect	The measure does not affect this condition.
	Intercept pollution pathways	No effect	The measure does not affect this condition.
Soil conservation	Reduce erosion and/or sediment delivery	Low	The incoming water deposits its transported sediment.

Biophysical impacts water replenishment of barrow pits		Rating	Evidence
	Improve soils	No effect	This is not applicable in case of pits.
Creating habitat	Create aquatic habitat	<b>Low</b>	Depending on the water level of River Tisza, the barrow pits are flooded, and depending on the degree of evapotranspiration the pits retain their water for a shorter or longer period of time. They are created only at high water levels of River Tisza, and become dry in a relatively short time depending on the meteorological conditions. The established aquatic habitats therefore remain for a limited period of time, and their effect is also low.
	Create riparian habitat	No effect	The measure does not affect this condition.
	Create terrestrial habitat	No effect	The measure does not affect this condition.
Climate change	Enhance precipitation	No effect	Water stored in the barrow pits increases the evapotranspiration, however due to its time and magnitude the enhanced rainfall is only theoretical.
	Reduce peak temperature	<b>Low</b>	Water stored in the barrow pits increases the evapotranspiration and thus influences local climatic conditions. Due to its relatively short duration, its effect is low.
	Absorb and/or retain CO <sub>2</sub>	<b>Low</b>	As biomass increases due to improved water supply and infiltration, the CO <sub>2</sub> binding also increases. However, its effect is low due to the frequency of floods and the short water retention time.

### Ecosystem Services Benefits

Sustainable landscape rehabilitation of the flood plain in the Middle Tisza District (based on the LIFE03 ENV/H/000280 project)

Ecosystem services scour channel opening, barrow pits		Rating	Evidence
Provisioning	Water storage	<b>Medium</b>	Surface water cover and enhanced groundwater increase the water storage of the area.
	Fish stocks and recruiting	<b>Low</b>	Barrow pits can serve as spawning grounds, the established water retention and the controlled water retraction system make it suitable for transporting fish guts to the river. The certain barrow pits are not really suitable to be spawning grounds, but there suitable clay pits for this purpose. The conditions must be carefully assessed and decisions should be made accordingly about the establishment and its expected effects. The clay pit created during the VTT interventions in the area is suitable as spawning ground, it has large effect on fish stocks and recruiting.
	Natural biomass production	<b>Low</b>	The biomass production of the given aquatic habitat has increased due to the rate and duration of water supply.
Regulatory and maintenance	Biodiversity preservation	<b>Medium</b>	As a result of the extended rate and duration of water supply of the given aquatic habitat, it could support the reproduction of amphibians the growth of juvenile fish, but forest vegetation and the relatively steep banks are inadequate in this respect. Apart from this, they are valuable aquatic habitats.
	Climate change adaptation and mitigation	<b>Low</b>	The effects of climate change are also compensated to some extent by scour channel opening („foknyitás”) and by water input.
	Groundwater/aquifer recharge	<b>Low</b>	Increased. The magnitude of the effect is directly proportional to the spatial extent and the increase of the water cover. In the present case the effect is low due to the small territorial extent.
	Flood risk reduction	No effect	

Ecosystem services scour channel opening, barrow pits		Rating	Evidence
	Erosion/sediment control	No effect	The sediment is deposited from the incoming water. The effect depends on the amount of incoming water and on the size of the area. However, this does not cover the erosion and sediment control. The measure does not affect this condition.
	Filtration of pollutants	<b>Low</b>	The effect of barrow pits and clay pits depends on the amount of water entering the site as well as the size of the site. The macro- and microvegetation of aquatic habitats reduces the nutrient content of the water. In the present case the effect is low because of the small territorial extent.
Cultural	Recreational opportunities	<b>Low</b>	Barrow pits as aquatic habitats are feeding sites for birds and ecotourism-promoting elements.
	Aesthetic/cultural values	<b>Medium</b>	Aquatic habitats are enjoyable places of the landscape.
Abiotic	Navigation	No effect	
	Geological resources	No effect	
	Energy production	No effect	

Floodplain management at River Tisza – based on LIFE00NAT/A/7051 project

Ecosystem services water replenishment of barrow pits		Rating	Evidence
Provisioning	Water storage	<b>Low</b>	Their water storage capacity is low due to frequency of floods and the short water retention time. In built-in condition, its effect was more significant, since water replacement could happen even at lower water levels and water could also be stored.
	Fish stocks and recruiting	Low/ Medium/ High	Due to the forest environment it is not an appropriate spawning ground for many fish species. The return of juvenile fish to the river is possible only under certain flooding conditions, otherwise in the drying pits both fish stuck there and juvenile fish die. In its current state, it contributes to fish stock retention only to a small extent.
	Natural biomass production	<b>Low</b>	Regarding the forest environment, biomass production is relatively small in the water body, and it rather increases biomass production by improving the water supply of the surrounding terrestrial habitat.
Regulatory and maintenance	Biodiversity preservation	<b>Low</b>	It is also valuable as temporary aquatic habitat, although in many cases its early drying causes the decay of water dependent development forms.
	Climate change adaptation and mitigation	<b>Low</b>	Their water storage effect is low, therefore its effect on climate change mitigation is also low.
	Groundwater/aquifer recharge	<b>Low</b>	The water remained in the pits nourishes the groundwater supply, but its effect is low due to its temporary nature.
	Flood risk reduction	No effect	The measure does not affect this condition.
	Erosion/sediment control	No effect	The measure does not affect this condition.

Ecosystem services water replenishment of barrow pits		Rating	Evidence
	Filtration of pollutants	Low/ Medium/ High	The flora utilizes significant part of the nutrients of the incoming water, it is also deposited in the sludge and the pollutant content of the water decreases with the deposition of the suspended matters. At the same time, water does not return to River Tisza in most cases.
Cultural	Recreational opportunities	No effect	Under the current conditions, the barrow pits are not suitable for recreational activities.
	Aesthetic/cultural values	<b>Low</b>	The aesthetic values of its environment are enhanced by extending the water supply and enriching the vegetation.
Abiotic	Navigation	No effect	The measure does not affect this condition.
	Geological resources	No effect	The measure does not affect this condition.
	Energy production	No effect	The measure does not affect this condition.

### Analysis according to the Water Framework Directive

The analysis of the barrow pits according to the Water Framework Directive was carried out based on two projects. Although it may seem pointless to evaluate the same measure twice, the assessment of the two projects led to completely different results in some respects. Local circumstances and interest relationships, whether the intervention is carried out independently or as part of a complex development, are all influencing factors that fundamentally determine the performance, efficiency and sustainability of the measure.

Below we present the analysis of the measure “Regulating the water replenishment of barrow pits” based on the projects “Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (LIFE03 ENV/H/000280)” and “Management of floodplains on the Middle Tisza (LIFE00NAT/A/7051)” respectively. The analyses of the two projects are then summarized and the SWOT analysis for the measure is prepared on the basis of the experience gained in these two projects.

#### Sustainable use and management rehabilitation of flood plain in the Middle Tisza District (LIFE03 ENV/H/000280) project

MEASURE Nr. 1: Regulating the water replenishment of barrow pits (analysis according to the RBMP)			
Policy objectives		Evaluation	Description
Achieve Good Surface Water Status	Identification of river basin management measures	<p>6.12 Mitigation measures to reduce hydromorphological regulation</p> <p>6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands</p>	<p>Mitigation measures of the river basin management plan include water replenishment on the protected side.</p> <p>The barrow pits were connected with the Tisza and with each other via channels in the floodbed. The measure thus did not result in water replenishment providing transversal continuity.</p>
	Improving status of biological quality elements	Low	<p>In terms of effectiveness, floodplain habitats will improve as a result of water replenishment. During the nature conservation study carried out in 2004, 1351 specimens of 18 species were sampled from 5 sampling points of 4 locations of the examined barrow pits. Of the 9 species, 3 are adventive (<i>Pseudorasbora parva</i>, <i>Carassius auratus</i>, <i>Ictalurus melas</i>) and two are protected (<i>Rhodeus sericeus amarus</i>, <i>Proterorhinus marmoratus</i>). The nature conservation studies did not cover the examination of post-interventional conditions, thus the changes and processes cannot be identified. During the inspection of the site, the structures and channels used for water replenishment were found in a properly maintained condition. The detention of the flood water of Tisza improved the conditions of wetland habitats. Fish show little improvement, as fish, especially native species, dislike waters shaded by dense forests, they only use them to return to the river at recession.</p>

	Improving status of physico-chemical quality elements	Low	According to the river basin management assessment, the water body is in good condition, therefore no action has been proposed in this regard. The measure has no or only low impact on physico-chemical conditions.
	Improving quality status of specific pollutants	None	The impact of the measure on the reduction of specific pollutants is negligible due to the disproportionately small water mass dispersed from the barrow pits compared to the water mass of the Tisza. During the monitoring, testing the sediment in the barrow pits is recommended in the interest of habitats.
	Improving status of hydromorphological quality elements	Low	In respect of improving the river's connection with the floodplain it is a positive measure; however it does not improve transversal continuity on the protected side.  Hydromorphological loads are not reduced by the measure.
	Improving chemical status and priority substances	None	Depletion of the sediment may also cause the toxic elements to settle. There is no available information on whether this takes place and to what extent; its magnitude is presumably negligible for the reasons mentioned above. During the monitoring, testing the sediment in the barrow pits is recommended.
Achieve Good Groundwater Status	Improved quantitative status	None	The measure has no impact on groundwater status.
	Improved chemical status	None	The measure has no impact on groundwater status.

Prevent Deterioration	Prevent surface water status deterioration	None	Unless there is any special contamination coming from the floodbed, water replenishment of the barrow pits and recirculation of the water into the Tisza has no significant effects on the water quality of the Tisza.
	Prevent groundwater status deterioration	None	The measure has no impact on groundwater status.
<b>Additional impacts expected by river basin management planning</b>		Natural resources and natural environment	<ul style="list-style-type: none"> <li>(+) growth of natural habitats and biodiversity, increasing ecosystem services and their quality (e.g. ecological corridor function) – <b>GROWTH OF BIODIVERSITY IS NOT EXAMINED, THUS NOT CONFIRMED.</b></li> <li>(+) restoring the conditions necessary for environmentally friendly floodplain ecosystem and farming – <b>NO IMPACT ON FLOODPLAIN FARMING.</b></li> <li>(+) controlled outlet reduces drought sensitivity – <b>WATER RETENTION IN BARROW PITS WILL MITIGATE DROUGHT DAMAGES.</b></li> <li>(+) creating near-natural habitats, restoring previously existing wetlands, increasing landscape ecological values – <b>LANDSCAPE ECOLOGICAL VALUES AND WATER SUPPLY OF THE HABITATS HAVE BEEN INCREASED BY THE MEASURE, CHANGE OF HABITAT QUALITY IS NOT EXAMINED.</b></li> </ul>

	Economic	<p>(+) expansion of utilization opportunities (recreation, tourism, etc.) – <b>THE RELATED NATURE TRAILS PRESENT THE WORLD OF FLOODPLAIN FORESTS, GRASSLANDS AND BARROW PITS TO THE VISITORS. AT THE IMPLEMENTATION OF THE PROJECT, THE STUDY TRAILS WERE MANAGED BY THE MUNICIPALITY, BUT WERE HANDED OVER TO THE WATER DIRECTORATE IN RECENT YEARS. THE DIRECTORATE HAS NO SEPARATE BUDGETARY RESOURCE FOR MAINTENANCE, THUS THEIR SUSTENANCE DEPENDS ON THE ACTUAL BUDGETARY DECISIONS OF THE WATER DIRECTORATE. FROM THE PLANNED MEASURES TOWARDS INCREASING TOURISM, ONLY THE NATURE TRAILS REMAINED.</b></p> <p>(-) the operating cost of the solution – <b>STATE RESOURCES ARE PROVIDED FOR THE OPERATION AND MAINTENANCE OF SLUICES. WITH THE HELP OF AREA AIDS, MANAGEMENT OF FLOODPLAIN GRASSLANDS NEAR THE BARROW PITS PROVIDES INCOME. THE SELLING OF HAY LESSENS AS DEMAND DECREASES. THE CONTROL, SHREDDING AND SELLING OF INVASIVE SPECIES THAT OCCASIONALLY APPEAR ON THE FLOODPLAIN IS NOT PROFITABLE, PROBABLY DUE TO THE STRICT PURCHASE CRITERIA. THERE IS NO DEMAND FOR GRAZING THE FLOODPLAIN GRASSLANDS. THE UTILIZATION OF DESERT FALSE INDIGO (<i>Amorpha fruticosa</i>) MAY IN PRINCIPLE BE FAVOURABLE DUE TO ITS HIGH HEATING VALUE AND ITS POTENTIAL FOR HONEY PRODUCTION.</b></p>
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	Social	<p>(+) better opportunities for land use: recreation, tourism development, (+) quality of life improvement, better microclimate - <b>THE MEASURE CONTRIBUTES TO THE IMPROVEMENT OF THE ENVIRONMENT OF LOCAL COMMUNITIES. IT HAS A POSITIVE IMPACT ON RECREATION, IF PROPER MAINTENANCE IS PROVIDED. THE WATER REPLENISHMENT OF BARROW PITS WAS A SINGLE ELEMENT OF A COMPLEX INTERVENTION, THUS THEY HAVE A COMBINED IMPACT. THE COMPLEX DEVELOPMENT HAD A FAVOURABLE IMPACT ON THE APPEARANCE OF OTHER ORGANIZATIONS, E.G. A NATURE-FRIENDLY ALLIANCE, WHICH ESTABLISHED A TOURIST ROUTE. THE INDIRECT EFFECT OF THE PROJECT IS THE COOPERATION OF WATER AND NATURE CONSERVATION AUTHORITIES, WHICH SHOULD BE EMPHASIZED IN THE FUTURE.</b></p>
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<p>Maintaining the measure</p>	<p>To what extent have barrow pits been maintained after project closure</p>	<p>Accomplished</p>	<p>The sluices controlling water replenishment are well maintained and operated.</p> <p>Maintaining water replenishment depends on the maintenance and operation of structures and the water management planning and construction of the barrow pits. Unless this takes place, nature restores the original state and the positive effects created by the measure will not remain in the long run.</p> <p>Maintenance highly depends on the budgetary funds of the management organization, and their alterations. Operation and management requires expertise, regular attention, financial resources and the existence of interest.</p>
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<p><b>Summary of effects from the viewpoint of river basin management planning</b></p>	<p><b>Low - Medium</b></p>	<p>The operation of the barrow pits has low impact on the condition and ecological potential of the water body concerned.</p> <p>Water replenishment of the barrow pits, connecting them to the main watercourse is an element of scour channel management (“fokgazdálkodás”, traditional floodbed farming), playing a direct role in creating a connection with the river. Its significance can be reached in a complex floodbed development environment, and the Bivaly-lake rehabilitation can be seen as a first step in the development of floodbed management. By connecting the barrow pits to the river along the whole length of the Tisza, a greater positive effect can be reached on the whole river.</p> <p>In this case, maintenance and operation are of paramount importance; in their absence, the benefits of water replenishment and water retention become ineffective. Current interests and relationships have special importance in maintenance, as – according to our knowledge – the organisations in question do not receive further funding for maintenance.</p>
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Management of floodplains on the Middle Tisza (LIFE00NAT/A/7051) project

MEASURE Nr. 1: Regulating the water replenishment of barrow pits			
Policy Objectives		Evaluation	Description
Achieve Good Surface Water Status	Identification of river basin management measures	<p>6.12. Mitigation measures to reduce hydromorphological regulation</p> <p>6.12.1 Water replenishment on the protected side: oxbows, branches, floodplain wetlands</p>	<p>Mitigation measures of the river basin management plan include water replenishment on the protected side.</p> <p>The barrow pits were connected with the Tisza and with each other via channels in the floodbed. The measure thus did not result in water replenishment providing transversal continuity.</p> <p>Water replenishment has a positive effect on floodbed wetlands, but its extent is low. Experience shows that their morphological design is not particularly attractive to fauna and flora.</p> <p>Maintaining water replenishment depends on the maintenance and operation of structures and the water management planning and construction of the barrow pits. Unless this takes place, nature restores the original state and the positive effects created by the measure will not remain in the long run. In the case of the LIFE project for improving water management in the floodplain, this maintenance has not taken place.</p>

	Improving status of biological quality elements	Low	<p>In terms of effectiveness, water replenishment improves floodplain habitats, but experience shows that the barrow pits are not a desirable spawning-ground for indigenous fish species.</p> <p>The project aimed at developing the habitat of the following living organisms relevant to the biological evaluation of river basin management planning: European mudminnow (<i>Umbra krameri</i>), Bitterling (<i>Rhodeus sericeus amarus</i>), European weatherfish (<i>Misgurnus fossilis</i>).</p>
	Improving status of physico-chemical quality elements	Low	<p>According to the river basin management assessment, the water body is in good condition, therefore no action has been proposed in this regard. The measure has no or only low impact on physico-chemical conditions.</p>
	Improving quality status of specific pollutants	None	<p>The impact of the measure on the reduction of specific pollutants is negligible due to the disproportionately small water mass dispersed from the barrow pits compared to the water mass of the Tisza. During the monitoring, testing the sediment in the barrow pits is recommended in the interest of habitats.</p>
	Improving status of hydromorphological quality elements	Low	<p>In respect of improving the river's connection with the floodplain it is a positive measure; however it does not improve transversal continuity on the protected side.</p> <p>Hydromorphological loads are not reduced by the measure.</p>

	Improving chemical status and priority substances	None	Depletion of the sediment may also cause the toxic elements to settle. There is no available information on whether this takes place and to what extent; its magnitude is presumably negligible for the reasons mentioned above. During the monitoring, testing the sediment in the barrow pits is recommended.
Achieve Good Groundwater Status	Improved quantitative status	None	The measure has no impact on groundwater status.
	Improved chemical status	None	The measure has no impact on groundwater status.
Prevent Deterioration	Prevent surface water status deterioration	None	Unless there is any special contamination coming from the floodbed, water replenishment of the barrow pits and recirculation of the water into the Tisza has no significant effects on the water quality of the Tisza.
	Prevent groundwater status deterioration	None	The measure has no impact on groundwater status.

<p><b>Additional impacts expected by river basin management planning</b></p>	<p>Natural resources and natural environment</p>	<ul style="list-style-type: none"> <li>(+) growth of natural habitats and biodiversity, increasing ecosystem services and their quality (e.g. ecological corridor function) – <b>THE MEASURE SUPPORTED GROWTH OF BIODIVERSITY, HOWEVER, THE APPEARANCE OF INVASIVE FISH SPECIES BROUGHT NEGATIVE IMPACTS.</b></li> <li>(+) restoring the conditions necessary for environmentally friendly floodplain ecosystem and farming – <b>NO IMPACT ON FLOODPLAIN FARMING.</b></li> <li>(+) controlled outlet reduces drought sensitivity – <b>WATER RETENTION IN BARROW PITS WILL MITIGATE DROUGHT DAMAGES.</b></li> <li>(+) creating near-natural habitats, restoring previously existing wetlands, increasing landscape ecological values – <b>LANDSCAPE ECOLOGICAL VALUES HAVE BEEN INCREASED BY THE MEASURE, BUT DUE TO LACK OF MAINTENANCE, THE EFFECT IS TEMPORARY.</b></li> </ul>
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	Economic	<ul style="list-style-type: none"> <li>(+) creating opportunities for land management better suited to the local features – <b>LAND MANAGEMENT WAS INTENDED TO BE IMPLEMENTED WITH SUPPORT FROM THE LOCAL POPULATION, BUT THIS WAS NOT SUSTAINABLE.</b></li> <li>(+) expansion of utilization opportunities (recreation, tourism, etc.) – <b>DUE TO LACK OF MAINTENANCE AND DIFFICULTY OF ACCESS, THE MEASURE DID NOT RESULT IN TOURIST APPEAL.</b></li> <li>(-) widening the floodbed entails the depreciation of previously protected land, and limitations of use – <b>AGRICULTURAL UTILISATION HAS DECLINED. COMPENSATION FOR LAND WITHDRAWN FROM CULTIVATION HAS TAKEN PLACE ONLY PARTIALLY.</b></li> <li>(-) abandonment of agricultural land or land use change may be necessary (lost revenues, disadvantages) – <b>NO CHANGE IN LAND USE</b></li> <li>(-) the operating cost of the solution – <b>STATE RESOURCES MUST BE PROVIDED FOR THE OPERATION AND MAINTENANCE OF SLUICES.</b></li> </ul>
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		Social	<p>(+) decreasing drought sensitivity by the draining and retention of water – <b>WATER REPLENISHMENT OF BARROW PITS IMPROVES WATER MANAGEMENT CONDITIONS AND THE MICROCLIMATE, REDUCES DRAUGHT DAMAGES IN ECOLOGICAL AREAS, BUT THE SOCIAL IMPACT IS INDIRECT.</b></p> <p>(+) reducing flood risks – <b>THE MEASURE HAS NO IMPACT ON FLOOD RISKS.</b></p> <p>(+) the benefits provided by the system might mean new forms of livelihood – <b>THE MEASURE HAS NOT PROVIDED SUCH BENEFITS.</b></p> <p>(-) decrease of the feeling of public safety, deterioration of the population’s living conditions – <b>THE MEASURE HAD NO NEGATIVE IMPACT ON THE POPULATION’S LIVING CONDITIONS.</b></p>
Maintaining the measure	To what extent have barrow pits been maintained after project closure	Low	The sluices regulating water replenishment have been neglected, the channels connecting the barrow pits have broken in, and the barrow pits have not been maintained. According to the plan, maintenance should have been carried out by the local population; however, there was no serious intention on their part to do so.

<p><b>Summary of effects from the viewpoint of river basin management planning</b></p>	<p><b>Low - Medium</b></p>	<p>The operation of the barrow pits has low impact on the condition and ecological potential of the water body concerned.</p> <p>Water replenishment of the barrow pits, connecting them to the main watercourse is an element of scour channel management (“fokgazdálkodás”, traditional floodbed farming), potentially playing a direct role in creating a connection with the river. However, if water replenishment of the barrow pits does not form part of the complex development of the relevant floodbed, it does not significantly contribute to the development of floodbed management.</p> <p>By connecting the barrow pits to the river along the whole length of the Tisza, there may be a greater positive effect on the whole river.</p> <p>In this case, maintenance and operation are of paramount importance; in their absence, the benefits of water replenishment and water retention become ineffective. Current interests and relationships have special importance in maintenance, as the organisations in question do not normally receive further funding for maintenance. In this case, maintenance has been neglected over the years due to lack of demand and interests. In such cases nature restores the near original state in the long run.</p>
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## Expenditures

Sustainable landscape rehabilitation of the flood plain in the Middle Tisza District (based on the LIFE03 ENV/H/000280 project)

Cost category	Cost range (EUR)	Description
Purchase of land	-	Purchase of land was not required.
Preparation of surveys and studies	n.a.	
Investment cost	n.a.	
Maintenance costs	<p>Wage costs: approx. HUF 30 million/year</p> <p>Maintenance of educational nature trail: 1-2 million HUF/year</p> <p>Maintenance of grassland with mowing: 10-15 million HUF/year</p> <p>Total: 41-47 million HUF/year</p>	The maintenance of the area affected by barrow pits, the annual costs of mowing and the maintenance of the educational trail would provide work for 10-15 persons. The maintenance of the educational trail requires approx. 1-2 million HUF annually. The annual cost of mowing the grasslands is approx. 10-15 million HUF. The management of barrow pits does not require extra costs in addition to the wage costs.
Additional costs	n.a.	

## SWOT analysis

Regulating the water replenishment of barrow pits	
Strengths	Weaknesses
<p>Providing water replenishment to flooded wetlands even at lower water levels; extending the period of water coverage; water retention in the floodbed; slowing down of drainage. By installing backwater gates, automatic loading, but manual outlet allows the optimal opening time to be decided based on the detailed assessment of the situation.</p> <p>Locally reduces drought sensitivity.</p>	<p>By creating wetlands in different areas, ecologically different impacts can be achieved. (Barrow pits with steep banks, in a woody environment are less suitable as spawning ground for fish, and their biodiversity is much lower than that of the sunny borrow areas with slightly sloping banks and warm water.)</p> <p>The manual operation of the backwater gates, deciding the ideal opening time are problematic, require professional expertise and</p>

**Regulating the water replenishment of barrow pits**

attention. The date of opening may differ depending on different interests (release of juvenile fish, nesting period of birds). Operation can be determined by compromise of different interests.

In the absence of a governmental professional management organization, the long-term operation of the water replenishment system and water retention is not ensured.

From the point of view of the Water Framework Directive, the operation of the barrow pits has little effect on the good condition and good ecological potential of the water body concerned.

Regulating the water replenishment of barrow pits	
Opportunities	Threats
<p>Wetlands provide extra opportunity and favourable conditions in all cases. Creating spawning grounds, ensuring rearing of juveniles, providing nesting place and nutrition for birds. Water retention for a longer period in the area. Creation of stable wetland habitats.</p> <p>Its significance can be reached in a complex floodbed development environment, it may be a first step in the development of floodbed management. By connecting the barrow pits to the river along the whole length of the Tisza, a greater positive effect can be reached on the whole river.</p>	<p>Unrealistic assessment of the features of wetlands that can be created in the given area. Without proper maintenance the system will become inoperable or malfunctioning.</p> <p>Water coverage and increasing groundwater level may infringe the interest of farmers or others.</p> <p>The closing mechanism can be accessed by anyone, which may lead to its operation (opening or closing) at inappropriate times, and may even cause habitat destruction. In case of removing the backwater gate, water retention is not realized.</p> <p>Failure to open the valve will result in the juveniles to remain in the area, which may lead to their death.</p> <p>Without specific economic benefits or other professional interest, operation and maintenance is not ensured.</p> <p>In the absence of operational regulations that take into account stakeholder interests, operation is uncertain and inappropriate.</p>

## MEASURE 2: Land use change aiming at extensive farming

### Biophysical impacts

Sustainable landscape rehabilitation of the flood plain in the Middle Tisza District (based on LIFE03 ENV/H/000280 project)

Biophysical impacts floodplain habitat, <b>grassland rehabilitation, control of invasive alien species</b> , conversion of Populus sp. to grassland		Rating	Evidence
Slowing and Storing Runoff	Store Runoff	Low/ Medium/ High	These interventions accelerate runoff in the floodplain and promote flood propagation.
	Slow and store runoff	Low/ Medium/ High	These interventions accelerate runoff in the floodplain and promote flood propagation.
	Store river water	No effect	
	Slow river water	No effect	
Reducing Runoff	Increase evapotranspiration	Low/ Medium/ High	The measure does not increase evaporation.
	Increase infiltration and/or groundwater recharge	No effect	
	Increase soil water retention	No effect	
Reducing Pollution	Reduce pollutant sources	Low/ Medium/ High	In this case, not an agricultural area has been replaced by grassland, thus pollutant sources have not been reduced. However, the grassland effectively retains the pollutants.
	Intercept pollution pathways	No effect	
Soil conservation	Reduce erosion and/or sediment delivery	Low/ Medium/ High	By reducing the roughness of the floodplain, sediment delivery is less impeded.
	Improve soils	No effect	

Biophysical impacts floodplain habitat, <b>grassland rehabilitation, control of invasive alien species</b> , conversion of <i>Populus</i> sp. to grassland		Rating	Evidence
Creating habitat	Create aquatic habitat	No effect	
	Create riparian habitat	No effect	
	Create terrestrial habitat	<b>High</b>	The inadequate <i>Amorpha fruticosa</i> vegetation with low species diversity and areas covered by other invasive species have been cleaned, as well as fresh meadow habitat have been restored.
Climate change	Enhance precipitation	No effect	
	Reduce peak temperature	No effect	
	Absorb and/or retain CO <sub>2</sub>	No effect	

Floodplain management at River Tisza – based on LIFE00NAT/A/7051 project

Biophysical impacts Establishment of open floodplain, expansion of floodbed with the necessary land use change (Lake Anyita)		Rating	Evidence
Storing and Slowing Runoff	Store runoff	<b>High</b>	Runoff storage have been carried out at the floodplain by establishing the possibility of regular flooding and water retention at agricultural areas protected by summer dikes.
	Slow runoff	<b>High</b>	Runoff is slowed down by the water drained into the area, it results in controlled retraction.
	Store river water	<b>High</b>	Taking into account its conditions, the naturally deep area surrounded by summer dikes introduces water into the area at high water levels and retains it from spring until autumn. In case of spring floods with an area of 80 ha, area covered by water falls to 50 ha in autumn. Water is let out through a sluice.
	Slow river water	<b>High</b>	The runoff in this case is ensured by locking the sluice, however, the area has become forested so the vegetation has basically changed. Instead of arable farming, a growing forested area has developed. The original idea was to maintain the grassland by grazing Gray Cattle.
Reducing Runoff	Increase evapotranspiration	<b>High</b>	In the present case, the aquatic habitat has replaced agricultural utilization. From spring to autumn, the area is covered by water, but it is not completely depleted even after draining down the water due to the varied terrain and because the drainage ditch is filled. It increases local humidity.

Biophysical impacts Establishment of open floodplain, expansion of floodbed with the necessary land use change (Lake Anyita)		Rating	Evidence
	Increase infiltration and/or groundwater recharge	<b>High</b>	In practice during the whole year there is infiltration into the groundwater from the area with continuously decreasing water from spring.
	Increase soil water retention	<b>Medium</b>	The depositing sludge and the high organic matter content increase the water holding capacity of the soil.
Reducing Pollution	Reduce pollutant sources	<b>Medium</b>	With the termination of agricultural cultivation, certain contaminations such as pest control, have ceased.
	Intercept pollution pathways	No effect	Not relevant, no such effect.
Soil conservation	Reduce erosion and/or sediment delivery	<b>Low</b>	The incoming water deposits the sediment carried with it.
	Improve soils	<b>Medium</b>	The high nutrient content and composition of the deposited sediment are favorable, but the long water cover is not necessarily beneficial for soil-forming processes, thus medium effect is calculated on the whole.
Creating habitat	Create aquatic habitat	<b>High</b>	The aquatic habitat developed on 80 hectares is a good spawning ground, rich marsh community has formed. At the lake no fish survey or other ecological survey have been carried out recently. The water is let out in October, which is not certainly optimal for growing juvenile fish. At present the lake and the drainage sluice do not have a manager.
	Create riparian habitat	No effect	The measure does not affect this condition.

Biophysical impacts Establishment of open floodplain, expansion of floodbed with the necessary land use change (Lake Anyita)		Rating	Evidence
	Create terrestrial habitat	No effect	The measure does not affect this condition.
Climate change	Enhance precipitation	<b>Low</b>	Through evapotranspiration, it theoretically affects the amount of precipitation, but this is minimal in the present case because of the small territorial extent. Apart from the magnitude of the affected area, the effect of the measure is low for the whole floodbed.
	Reduce peak temperature	<b>Medium</b>	The water-covered area and the increased evapotranspiration are significant enough to affect the temperature locally.
	Absorb and/or retain CO <sub>2</sub>	<b>Medium</b>	The aquatic habitat produces larger plant biomass, which increases CO <sub>2</sub> binding. At this area due to the degree of vegetation change, the effect can be considered medium.

### Ecosystem Services Benefits

Sustainable landscape rehabilitation of the flood plain in the Middle Tisza District (based on the LIFE03 ENV/H/000280 project)

Ecosystem services floodplain habitat, <b>grassland rehabilitation, control of invasive alien species</b> , conversion of Hybrid Poplar to grassland		Rating	Evidence
Provisioning	Water storage	N/A	
	Fish stocks and recruiting	N/A	
	Natural biomass production	Low/ Medium/ High	In this case, biomass production is decreasing.
Regulatory and maintenance	Biodiversity preservation	<b>High</b>	The diverse and mosaic land use, as well as the grassland in good condition and having high species diversity are indispensable for biodiversity conservation. Reducing adverse invasive plants and replacing the prevailing Hybrid Poplar populations of poor habitats lead to the improvement of biodiversity.  Clearing the ground cover vegetation of the forest significantly reduces biodiversity.
	Climate change adaptation and mitigation	N/A	
	Groundwater/aquifer recharge	N/A	
	Flood risk reduction	<b>High</b>	In the present case, the restored grassland significantly facilitates flood runoff since it is located in the flood drainage zone. The grassland located in the zone out of water flow has no role in flood risk reduction.
	Erosion/sediment control	Low/ Medium/ High	There is no erosion on a well-closed grassland.
	Filtration of pollutants	No effect	

Ecosystem services floodplain habitat, <b>grassland rehabilitation, control of invasive alien species</b> , conversion of Hybrid Poplar to grassland		Rating	Evidence
Cultural	Recreational opportunities	<b>High</b>	Wet meadows are good places for ecotourism.
	Aesthetic/cultural values	<b>High</b>	The restored landscape and the grasslands with high species diversity are harmonic landscape features.
Abiotic	Navigation	N/A	
	Geological resources	N/A	
	Energy production	N/A	

Floodplain management at River Tisza – based on LIFE00NAT/A/7051 project

Ecosystem services		Rating	Evidence
Provisioning	Water storage	<b>High</b>	In the present case, the restoration of the reservoir role of the floodplain leads to surface water storage.
	Fish stocks and recruiting	<b>High</b>	The area is a good spawning ground and place for growing juvenile fish. The grown juvenile fish will be released into River Tisza. The release in October is probably not the perfect time in this respect due to the small water depth of the lake (40-110 cm).
	Natural biomass production	<b>High</b>	Biomass production of the aquatic habitat is high.
Regulatory and maintenance	Biodiversity preservation	<b>High</b>	The established marshland community is the habitat of many aquatic and water-dependent species, which become less abundant with the disappearance and reduction of aquatic habitats.
	Climate change adaptation and mitigation	<b>Medium</b>	The technical solution for water retention also compensates the effects of climate change.
	Groundwater/aquifer recharge	<b>High</b>	The large water cover provides for groundwater replenishment.
	Flood risk reduction	No effect	The measure does not affect this condition.
	Erosion/sediment control	No effect	The sediment is deposited from the inflowing water. The effect depends on the amount of incoming water and the size of the area. However, this does not cover the regulation of erosion and sedimentation. The measure does not affect this condition.
	Filtration of pollutants	<b>Medium</b>	The vegetation utilizes a significant part of the nutrients of the incoming water, it is also deposited in the sludge and the amount of pollutants in the water decreases with the deposition of the floating agent.
Cultural	Recreational opportunities	<b>Low</b>	In the present case it is low. This could improve and may reach a medium level.

Ecosystem services		Rating	Evidence
	Aesthetic/cultural values	<b>High</b>	The aesthetic value of a nearby landscape is high.
Abiotic	Navigation	No effect	The measure does not affect this condition.
	Geological resources	No effect	The measure does not affect this condition.
	Energy production	No effect	The measure does not affect this condition.

## Analysis according to the Water Framework Directive

Sustainable Use and Management Rehabilitation of Flood Plain in the Middle Tisza District  
(LIFE03 ENV/H/000280) project

MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)		
Legislative Objectives	Evaluation	Description
Achieve Good Surface Water Status	<p>6.1 Establishment of open floodplain, expansion of the floodbed with the necessary land use change</p> <p>6.2 Establishment of appropriate vegetation of the floodbed</p> <p>The elements of the measure are cropland – grassland and cropland – forest conversions, which can be combined with the destruction of invasive species.</p> <p>Possible voluntary changes of cultivation branch / mode (development and maintenance):</p> <ul style="list-style-type: none"> <li>• Change of cultivation branch on floodplain / floodbed croplands (cropland – forest conversion, creation of agroforestry systems, cropland-grassland, cropland – wetland conversion).</li> <li>• Change of cultivation mode: change to floodplain farming (the rules and subsidy system of floodplain farming are still to be developed, e.g. the rules of floodplain forestry, floodplain arable farming, and extensive grassland management).</li> </ul>	<p>Land use change in the case of the Bivaly Lake project meant a forest – grassland conversion. On 4.2 hectares a protective forest of hybrid black poplar was cut. It should be noted that the forest – grassland conversion measure was closely connected to a later relocation of a dike and the design of a floodwater drainage zone for the floodbed management plan. The vicinity of the relevant section of the drainage zone is characterised by grassland interspersed with groves. Relocating the dike in the direction of the protected side aids the achievement of river basin management objectives.</p> <p>6.2 In accordance with the river basin management objectives and for the purpose of creating suitable vegetation in the floodbed, the Natura 2000 regulations as well as the special floodplain/floodbed regulations include the use of indigenous species and regional fruit varieties in case of afforestation or renovation. Grassland is only recommended for conservation purposes in areas that were originally not covered by forest vegetation. Shrubs and bushes were destroyed on a 14,5-hectare floodbed area, and grassland created. Creating grassland was successful due to regular maintenance with machine mowing.</p>

<b>MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)</b>			
Legislative Objectives		Evaluation	Description
	Improving status of biological quality elements	Medium	<p>The purpose of land use change was to create flood drainage zones. The black poplars were felled in cooperation with the Hortobágy National Park Directorate. The presence of black poplars in the floodbed is currently prohibited by law. The grassland is maintained and in good condition. The condition of the biological elements has changed favourably.</p> <p>Growing black poplars on the floodplain is unfavourable from an ecological point of view, as the territory's biodiversity is low, and its ecology's development is hampered by mechanic and human disturbance effects. The grassland created is more favourable from an ecological point of view.</p> <p>It would have been worthwhile to explore the possibility of installing grove forests, as this would significantly reduce maintenance costs after canopy closure takes place. Until that time, however, it would present a difficulty in machine mowing.</p>
	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.

<b>MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)</b>			
<b>Legislative Objectives</b>		<b>Evaluation</b>	<b>Description</b>
	Improving status of hydromorphological quality elements	None	The measure does not result in the quality improvement of hydromorphological elements.
	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	The measure has no impact on the quantity status of groundwater.
	Improved chemical status	None	The measure has no impact on the chemical status of groundwater.
Prevent Deterioration	Prevent surface water status deterioration	None	The measure has no significant impact on surface water status.
	Prevent groundwater status deterioration	None	The measure does not contribute to good groundwater status.

MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)		
Legislative Objectives	Evaluation	Description
<p><b>Additional impacts expected by river basin management planning</b></p>	<p>Natural resources and natural environment</p>	<p>(+) growth of near-natural habitats, increasing ecosystem services and their quality (e.g. ecological corridor function), changing mosaic of the landscape; landscape becoming more natural, (+) creation and operation of near-natural habitats, increasing landscape ecological values, (+) improving the conditions of natural habitats – <b>REDUCING INVASIVE SPECIES IS ONLY USEFUL AND SUSTAINABLE IF THE NEW HABITAT IS MAINTAINED. PLANTING INDIGENOUS TREE SPECIES IS NECESSARY.</b></p> <p>(+) Improving water management, including improving the regulation of artificial fertilizer and pesticide use – <b>NO ARTIFICIAL FERTILIZERS OR PESTICIDES WERE USED IN THE AREA, THEREFORE THE MEASURE HAD NO POSITIVE IMPACT IN THIS RESPECT.</b></p> <p>(+) near-natural river bed design, possibly functioning as part of the ecological network – <b>THE MEASURE HAD NO IMPACT ON THE RIVER BED.</b></p>

	Economic	<p>(+) possible upswing in nature and water related tourism, (+) expansion of utilization opportunities (recreation, fishing, tourism) – <b>THE UPSWING OF TOURISM CAN ONLY BE INTERPRETED BY LOOKING AT THE WHOLE OF THE COMPLEX DEVELOPMENT. CREATING THE GRASSLAND CONTRIBUTES TO IT, BUT APPEAL WILL ONLY BE CREATED BY THE MOSAIC-LIKE STRUCTURE AND THE AREAS WITH DIFFERING “FUNCTIONS”.</b></p> <p>(+) land use is better adapted to the characteristics, which is more sustainable over the long term, both economically and environmentally – <b>THE AREA CAN BE ECONOMICALLY UTILISED BY GRAZING. IN THE ABSENCE OF THIS, NO ECONOMIC BENEFITS ARISE.</b></p> <p>(+) reduction of water purification costs – <b>THE MEASURE HAS NO SIGNIFICANT IMPACT ON WATER QUALITY.</b></p> <p>(-) possibly decreasing opportunities for use: energy production, navigability. – <b>REGULAR FELLING OF INVASIVE SPECIES AND THEIR USE IN ENERGY PRODUCTION IS A DECREASING OPPORTUNITY. INVASIVE SPECIES APPEAR REGULARLY, THEIR REAPPEARANCE IS TO BE EXPECTED, AND THEREFORE THEIR USE IN ENERGY PRODUCTION MAY PROVIDE ECONOMIC OPPORTUNITIES.</b></p> <p>(-) reduction of cropland – <b>THE MEASURE HAS NOT RESULTED IN A REDUCTION OF CROPLAND.</b></p> <p>(-, +) changing benefit opportunities – <b>THERE HAS BEEN NO RESEARCH ON THE POSSIBILITIES OF TURNING THE</b></p>
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<b>MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)</b>		
<b>Legislative Objectives</b>	<b>Evaluation</b>	<b>Description</b>
		<p><b>BLACK POPLARS TO BENEFIT. BLACK POPLARS ARE SUITABLE FOR BRIQUETTING AND PROVIDE GOOD HEATING VALUE.</b></p> <p>(-) there is a need for maintenance; failure to do so may result in weeds and endangers the function, (-) the solution has an operating cost – <b>THE MAINTENANCE OF THE GRASSLAND IS CARRIED OUT BY THE WATER DIRECTORATE. TO OUR KNOWLEDGE NO EXTRA RESOURCES ARE AVAILABLE; AREA AIDS ARE AN EXTRA RESOURCE.</b></p>

<b>MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)</b>		
<b>Legislative Objectives</b>	<b>Evaluation</b>	<b>Description</b>
	Social	<p>(+) favourable area development impact – <b>THE COMPLEX AREA DEVELOPMENT MIGHT HAVE A FAVOURABLE IMPACT ON THE LANDSCAPE VALUE.</b></p> <p>(+) maintaining flood security with proper management – <b>THE MEASURE INCREASES FLOOD WAVE DRAINAGE CAPACITY. DURING THE PROJECT, THE PLANNERS DID NOT EXAMINE THE EXTENT OF THE IMPACT ON FLOOD SAFETY.</b></p> <p>(+) production methods requiring more work and expertise, with previously used but now forgotten production methods, job opportunities – <b>AS A SUPPLEMENTARY MEASURE AND A FOLLOW-UP, THE IMPLEMENTATION OF GRAZING SHOULD BE EXAMINED.</b></p> <p>(0) maintenance is difficult to mechanize, requires great care and different, more complex expertise than traditional solutions (coordinated work by an ecologist and a water engineer) but after a while the system sets, and the maintenance requirement becomes lower than currently. – <b>IN THIS CASE, MAINTENANCE CAN BE MECHANISED. MAINTENANCE COSTS COULD BE REDUCED BY UTILISATION AND THE CREATION OF A GROVE FOREST.</b></p>

<b>MEASURE Nr. 2: Land use change aiming at extensive land management (RBMP-based evaluation)</b>			
<b>Legislative Objectives</b>		<b>Evaluation</b>	<b>Description</b>
Maintaining the measure	To what extent has land use change and extensive land management been maintained after project closure	Maintained	Maintenance (machine mowing of the area one or two times a year) is carried out by the Water Directorate.
<b>Summary of effects from the viewpoint of river basin management planning</b>		<b>Low</b>	<p>The favourable impact of forest – grassland conversion was the destruction of invasive species, contributing to the maintenance of the floodbed and the improvement of ecological living space. The measure did not result in extensive land management. The reason for this is low social demand.</p> <p>The measure has been implemented as part of a complex floodbed development; therefore it is difficult to interpret only the measure itself. As part of the complex development, ca. 6 km of the dike was relocated, as a result of which the floodbed was increased by 400-450 hectares. This has a favourable effect both on flood wave peaks and on their drainage, and additionally enlarges the territory available to the river's wildlife. To our knowledge, the area will not automatically receive nature conservation status; this should be examined in the interests of achieving RBMP objectives.</p>

Management of Floodplains on the Middle Tisza (LIFE00NAT/A/7051) project

MEASURE Nr. 2: Land use change aiming at extensive land management			
Legislative Objectives		Evaluation	Description
Achieve Good Surface Water Status	Identification of river basin management measures	6.1 Establishment of open floodplain, expansion of the floodbed with the necessary land use change	<p>The measure can be divided into two groups:</p> <ul style="list-style-type: none"> <li>a. Disassembly and relocation of dikes, construction of ring levees on big rivers</li> <li>b. Disassembly and relocation of dikes/spoil banks on small and medium watercourses (taking into consideration the maintenance demand of the vegetation zones acting as buffer zones)</li> </ul> <p>The implemented measure improves the water supply of the former floodplains which have been blocked from the river by summer dikes, thus reducing the degradation of water-dependent floodplain associations. In the long run, the measure contributes to the increase of water resources in the floodbed and promotes the expansion of ecosystem services and the improvement of their quality. It does not support the lateral movement of the Tisza and the natural river bed development processes. The expansion of the floodbed has not taken place.</p> <p>By the partial dismantling of the summer dikes and the operation of sluice valves, the floodbed has been reconnected to the river under controlled conditions. The measure provides for more frequent flooding of the floodbed and local water retention.</p> <p>No primary protection line has been opened or relocated.</p>

MEASURE Nr. 2: Land use change aiming at extensive land management			
Legislative Objectives		Evaluation	Description
		6.2 Establishment of appropriate vegetation of the floodbed	<p>The measure implements the appropriate proportions and a mosaic-like structure of forest / grassland / cropland of floodplain vegetation in the target area.</p> <p>-</p> <p>The project implemented regular water replenishment of the Lake Anyita and facilitated water retention in the lake.</p> <p>A further goal was floodplain grazing and the establishment of floodplain orchards. Floodplain grazing was maintained until 2017; after 2017 the livestock of grey cattle was replaced by red angus cattle, and the latter does not thrive on floodplain grazing.</p> <p>Filling up the lake has reduced agricultural activity, in that the land was purchased from most of the owners. Two of the owners have still not been willing to part with their lands and claim compensation for their inundated land. This unsettled relationship with the landowners is a major conflict that has not been addressed so far.</p> <p>The operating permit for the inlet and outlet structure was issued to the municipality. Since its expiration the structure has not been operated by anyone. Operating the sluice valve would be advisable, especially because opening it up before time causes serious ecological damage to the fish that spawned and grew in the lake.</p> <p>A floodplain orchard was planted on the floodbed that wasn't maintained.</p>

<b>MEASURE Nr. 2: Land use change aiming at extensive land management</b>		
<b>Legislative Objectives</b>	<b>Evaluation</b>	<b>Description</b>
	6.8 Improving the water supply of large rivers' floodbeds	The floodbed's water supply has improved significantly.
	17.6 Good grazing and feed management practices for grasslands	<p>The purpose of the measure is to preserve and maintain the living conditions of the plant species, communities and animal species associated with the grasslands, to maintain the favourable environmental impacts provided by extensive grassland management and to contribute to the maintenance and increase of biodiversity.</p> <p>A further goal of the project was floodplain grazing and the establishment of floodplain orchards. Floodplain grazing was maintained until 2017; after 2017 the livestock of grey cattle was replaced by red angus cattle, and the latter does not thrive on floodplain grazing.</p>
Improving status of biological quality elements	Low	<p>Ecologic living space has improved through regular water supply, primarily for the fish stock.</p> <p>The fish stock of the Tisza will only improve if the fish proliferating and living in the lake can return to the Tisza.</p>
Improving status of physico-chemical quality elements	None	Water retention has no significant impact on physico-chemical elements.
Improving quality status of specific pollutants	None	Water retention has no significant impact on specific pollutants.

<b>MEASURE Nr. 2: Land use change aiming at extensive land management</b>			
<b>Legislative Objectives</b>		<b>Evaluation</b>	<b>Description</b>
	Improving status of hydromorphological quality elements	Low	<p>The measure improves the water management of the floodbed, but no measures have been taken on the protected side that would have increased the drainage and storage of flood waves from the Tisza and the extent of wetland habitats on the protected site.</p> <p>It would have been possible to do so on the large and shallow borrow areas on the protected side, but this has not happened. This is probably due to the lack of water management interests and the dominance of agricultural land.</p>
	Improving chemical status and priority substances	None	Water retention has no significant impact on chemical elements.
Achieve Good Groundwater Status	Improved quantitative status	Low	The measure had a favourable impact on the amount of groundwater, but its dimension and extent are unknown, presumably local.
	Improved chemical status	None	Water retention has no significant impact on chemical elements.
Prevent Deterioration	Prevent surface water status deterioration	None	The measure has no significant impact on surface water status.
	Prevent groundwater status deterioration	None	The measure has no significant impact on groundwater status.

<b>MEASURE Nr. 2: Land use change aiming at extensive land management</b>		
<b>Legislative Objectives</b>	<b>Evaluation</b>	<b>Description</b>
<p><b>Additional impacts expected by river basin management planning</b></p>	<p>Natural resources and natural environment</p>	<ul style="list-style-type: none"> <li>(+) growth of near-natural habitats, increasing ecosystem services and their quality (e.g. ecological corridor function), changing mosaic of the landscape; landscape becoming more natural – <b>ACCOMPLISHED; WITH PROPER MAINTENANCE, THERE IS DEFINITE IMPROVEMENT</b></li> <li>(+) creation and operation of near-natural habitats, increasing landscape ecological values – <b>PARTIALLY ACCOMPLISHED. THE ORCHARD DID NOT SURVIVE AFTER PROJECT CLOSURE, AND THE SLUICE VALVE OF THE ANYITA LAKE BECAME UNATTENDED AFTER THE OPERATING PERMIT EXPIRED. THE LIVESTOCK OF GREY CATTLE WAS REPLACED BY RED ANGUS CATTLE IN 2017.</b></li> <li>(+) Improving water management, including improving the regulation of artificial fertilizer and pesticide use – <b>THE CROPLAND – WETLAND CONVERSION REDUCES ARTIFICIAL FERTILIZER AND PESTICIDE USE. DUE TO THE AREA'S SIZE, THE EXTENT OF THE REDUCTION IS NOT CONSIDERABLE.</b></li> <li>(+) near-natural river bed design, possibly functioning as part of the ecological network – <b>THE MEASURE HAD NO SIGNIFICANT IMPACT ON THE RIVER BED, BUT THE SLUICE VALVE AND THE DIKE OF THE ANYITA LAKE PROBABLY INHIBIT THE TISZA'S LATERAL MOVEMENT.</b></li> <li>(+) improving the conditions of natural habitats – <b>CONDITIONS OF NATURAL HABITATS HAVE IMPROVED, MAINTENANCE IS ENSURED.</b></li> </ul>

	Economic	<p>(+) possible upswing in nature and water related tourism, (+) expansion of utilization opportunities: recreation, fishing, tourism – <b>THE LAKE HAS LANDSCAPE VALUE. ONE CAN SKATE ON THE LAKE IN WINTER. ONE CANNOT ROW OR FISH ON THE LAKE.</b></p> <p>(+) land use is better adapted to the characteristics, which is more sustainable over the long term, both economically and environmentally – <b>THE LAND THAT USED TO BE UNDER AGRICULTURAL CUTIVATION WAS NOT GOOD QUALITY CROPLAND.</b></p> <p>(-) possibly decreasing opportunities for use: energy production, navigability. – <b>THE MEASURE HAD NO SUCH IMPACT</b></p> <p>(-) reduction of cropland – <b>CROPLAND HAS DECREASED; COMPENSATION HAS NOT FULLY TAKEN PLACE</b></p> <p>(-, +) changing benefit opportunities – <b>INSTEAD OF CROPLAND, THE MEASURE CREATED PASTURE-LAND AND A FLOODPLAIN ORCHARD. UNLESS THEIR MARKET PROFITABILITY IS GUARANTEED, MAINTENANCE IS NOT ENSURED.</b></p> <p>(-) there is a need for maintenance; failure to do so may result in weeds and endangers the function – <b>NEED FOR MAINTENANCE: WATER REPLENISHMENT HAS TO BE CONTROLLED, EXTENSIVE ANIMAL HUSBANDRY AND THE ORCHARD HAS TO BE MAINTAINED. OUT OF THESE, THE ORCHARD WAS NOT MAINTAINED IN THE LONG RUN.</b></p> <p>(-) the solution has a high operating cost – <b>IT TYPICALLY DOES NOT.</b></p>
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	Social	<p>(+) favourable area development impact – <b>LANDSCAPE VALUE HAS GROWN.</b></p> <p>(+) maintaining flood security with proper management – <b>THE MEASURE HAD NO SIGNIFICANT NEGATIVE IMPACT ON FLOOD SAFETY. HARMONISATION WITH THE FLOOBD BED MANAGEMENT PLAN IS NECESSARY.</b></p> <p>(+) improved public access to the watercourse, growth of green areas, improved quality of life – <b>WATER REPLENISHMENT IMPROVES THE QUALITY OF FLOOBD BED HABITATS AND THE CONDITIONS OF NATURAL HABITATS.</b></p> <p>(+) production methods requiring more work and expertise, with previously used but now forgotten production methods, job opportunities – <b>INSTEAD OF SMALL PARCEL FARMING, GRAZING HUSBANDRY WAS IMPLEMENTED AND A FLOODPLAIN ORCHARD ESTABLISHED.</b></p> <p>(1) maintenance is difficult to mechanize, requires great care and different, more complex expertise than traditional solutions (coordinated work by an ecologist and a water engineer) but after a while the system sets, and the maintenance requirement becomes lower than currently. – <b>THE COORDINATED WORK OF THE WATER DIRECTORATE, THE NATIONAL PARK AND THE LOCAL POPULATION IS NECESSARY, BUT MARKET PROFITABILITY HAS TO BE STRESSED AS WELL.</b></p> <p>(-) public resistance due to land use changes and expropriations– <b>WHEN THE ANYITA LAKE WAS FILLED WITH WATER, LAND THAT WAS PREVIOUSLY PRIVATE PROPERTY AND</b></p>
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MEASURE Nr. 2: Land use change aiming at extensive land management			
Legislative Objectives		Evaluation	Description
			<b>TYPICALLY USED AS CROPLAND WAS INUNDATED. EXPROPRIATION AND ACQUISITION WAS TYPICALLY SUCCESSFUL, HOWEVER, TWO OWNERS REFUSED TO SELL THEIR LAND. THIS LEADS TO BASIC SOCIAL CONFLICT THAT MAKES MAINTENANCE OF THE MEASURE IMPOSSIBLE.</b>
Maintaining the measure	To what extent has land use change and extensive land management been maintained after project closure	High	When examining maintenance, it is necessary to consider the decrease of water level due to the Tisza's bed becoming deeper, which might have a negative impact on regular water replenishment. The maintenance of the lake whose water surface is 30 hectares when filled with water and 10 hectares when the water is let out was ensured until the operating permit expired. Since then it has become uncertain. Based on what was said during the on-site visit, animal husbandry depends greatly on the subsidy system. It is not attractive enough economically, and the local livestock is small. Intensive animal husbandry is more typical.
<b>Summary of effects from the viewpoint of river basin management planning</b>		<b>Low/ Medium/ High</b>	Cropland – wetland and cropland – grassland conversion was implemented in the floodbed. With proper maintenance, it provides a very favourable ecological habitat.  Maintenance has to be ensured after the expiration of the operating permit.  Subsidies play a significant role in animal husbandry. Without it, farmers are not interested in floodplain animal husbandry. Livestock is small, and intensive animal husbandry is dominant.

## Expenditures

Cost category	Cost range (EUR)	Description
Purchase of land	n.a.	
Preparation of surveys and studies	n.a.	
Investment cost	One-off yield: $1 \times 55 \text{ m}^3/\text{ha} \times 14.000 \text{ HUF}/\text{m}^3$ (average price in 2009) = 770.000 HUF/ha One-off cost, harvesting cost: $55 \text{ m}^3/\text{ha} \times 2.900 \text{ HUF}/\text{m}^3 = 159.500 \text{ HUF}/\text{ha}^1$	
Maintenance costs	Maintenance of grassland with mowing: with 4 HUF/m <sup>2</sup> average price it is 748.000 HUF/year on 18,7 ha	
Additional costs	n.a.	

## SWOT analysis

Land use change aiming at extensive land management	
Strengths	Weaknesses
<p>Grassland rehabilitation: Creation of good quality pasture, increase of animal carrying ability, reduction of weeds, increase of diversity, creation of favourable habitat. Favourable for flood management.</p> <p>Reducing adventive, invasive species: Promoting native species, increasing biodiversity, creating a more favourable situation for flood management.</p> <p>Black poplar – grassland conversion: Replacement of a planted forest of invasive tree species and low quality habitat. Favourable for flood management.</p> <p>Establishment of a nature trail: Attraction of visitors, tourist destination, knowledge transfer.</p>	<p>Grassland rehabilitation: Regular care, mowing or grazing is required.</p> <p>Reducing adventive, invasive species: Continuous maintenance work is required, at least one treatment yearly, except for well-closed forests.</p> <p>Black poplar – grassland conversion: Replacement of high profitability black poplar plantation to grassland, which cannot be utilised as feed due to low livestock numbers and oversupply.</p> <p>Establishment of a nature trail: Requires maintenance work and expenditures. A dedicated operator with adequate financial resources and workforce is necessary.</p> <p>There was no significant demand for floodbed grazing and hay, and in the absence of this, no economic benefits arise.</p>

<sup>1</sup> Source: [www.kerekerdo.org](http://www.kerekerdo.org)

<b>Land use change aiming at extensive land management</b>	
Animal husbandry, grazing on floodbed pastures: Economical utilization of good quality grazing areas, breeding of high quality livestock.	Animal husbandry, grazing on floodbed pastures: Remote pasture, remote drinking water, installation of temporary pens, resting places and electric fencing. Overall profitability of livestock farming.
<b>Opportunities</b>	<b>Threats</b>
<p>Grassland rehabilitation: Good quality grassland provides farmers access to high quality feed. Suitable to produce high-value meat; provides an opportunity for organic farmers.</p> <p>Reducing adventive, invasive species: Promoting native species, increasing biodiversity, creating a more favourable situation for flood management.</p> <p>Black poplar – grassland conversion: Release of an area of intensive tree plantation to be taken over by native species.</p> <p>Establishment of a nature trail: Incorporation into education, usage for other means of knowledge dissemination, extension, connection to related facilities.</p> <p>The possibility of planting groves is worth examining, which, after canopy closure takes place, reduces maintenance costs.</p> <p>The economic utilization of invasive species is theoretically possible, but the conditions are not met.</p> <p>In case of cropland – wetland conversion: The establishment or rehabilitation of wetlands are favourable. Appearance of valuable, protected species, enhancement of fitness as feeding or breeding area.</p> <p>Animal husbandry, grazing on floodbed pastures: Livelihood and job opportunities.</p>	<p>Grassland rehabilitation: Due to the low number of livestock, there is no demand for pasture utilization and hay. The maintenance costs do not show a return, the feed is not utilized. In the absence of any interest, maintenance may be omitted. Apart from farming, flood protection may gather interest.</p> <p>Reducing adventive, invasive species: Continuous maintenance work is required, at least one treatment yearly, except for well-closed forests.</p> <p>Black poplar – grassland conversion: No financial coverage for maintenance.</p> <p>Establishment of a nature trail: Deterioration, disappearance, risk of accidents.</p> <p>It may harm neighbouring business or residential interests.</p> <p>Operation can be determined by compromise of different interests, where the lack of compromises endangers the achievement and sustenance of the set goals. Without specific economic benefits or other professional interest, operation and maintenance is not ensured.</p> <p>In case of cropland – wetland conversion: In the absence of operational regulations that take into account stakeholder interests, operation is uncertain and inappropriate.</p> <p>Animal husbandry, grazing on floodbed pastures: Profitability of animal husbandry is low, lack of workforce.</p>



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