PROLINE-CE

WORKPACKAGE T1, ACTIVITY T1.2

REVIEW OF BEST MANAGEMENT PRACTICES FOR DRINKING WATER SUPPLY ISSUES

D.T1.2.1 Country-specific best management practice reports

HUNGARY

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Lead Institution	**General Directorate of Water Management**
Contributor/s	**Herman Otto Institute Non-profit Ltd.**
Lead Author/s	**Agnes Tahy**
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Contributors, name and surname	Institution
Robert Hegyi	General Directorate of Water Management
Magdolna Ambrus	General Directorate of Water Management
Peter Molnar	General Directorate of Water Management
Tamas Belovai	General Directorate of Water Management
Barbara Bezegh	Herman Otto Institute Non-profit Ltd.
Matyas Prommer	Herman Otto Institute Non-profit Ltd.
Mihaly Vegh	Herman Otto Institute Non-profit Ltd.

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1. Introduction

The aim of this report is to provide a review of best practices which have already implemented or the application is in progress in Hungary regarding different types of land use (agriculture, grassland, forestry) to protect water and mitigate floods or drought, resulting from several studies lined out in former projects (please refer to CC WARE project).

These best management practices are implemented more or less countrywide in Hungary. The selected measures are included in several strategic programs or plans like the National Rural Development Programme, the National Water Strategy, as well as in the Program of Measures of the 2nd River Basin Management Plan 2015 or the 1st Flood Risk Management Plan of Hungary.

Best management practices are divided into the three clusters according to WP T2 (Pilots) and contain a general description, advantages and challenges of the respective measure. Each measure is evaluated due to its respective water protection functionality, costs, duration of implementation and time interval of sustainability.

The name of best practice measure is created by the first letters of the respective cluster and its subcategories (for example BP MF1 – Best practice for mountain region, subcategory forest). If the relevant measure also fits to another cluster the respective additional valid cluster is added with brackets.

2. Mountain sites

2.1 Forest

BP MF1 Continuous forests cover (CFC)

Continuous forests cover (CFC) is not a new idea in forest management but there has been renewed interest in it for the potential it has to meet the sustainability requirements which are part of the Rio/Helsinki process and certification. The historical roots of CFC can be found in Vend country along the Slovenian border of Hungary.

Broadly speaking CFC includes those silvicultural systems which involve continuous and uninterrupted maintenance of forest cover and which avoid clearcutting.

CFC systems are being introduced throughout Hungary, where there is emphasis on the direct transformation of existing even-aged plantations to some form of mixed, uneven-aged woodland. There is also the opportunity to establish such woodlands either at re-stocking or when afforesting former agricultural land. One approach would be to use nurse crops to aid establishment of desired species, especially where there are difficult site conditions or the trees naturally require cover for optimal growth.

The regulation of sustained yield of a natural living community was not only the desirable aim of management but became increasingly important because of the multiple requirements of the forest stands and the demanded and expected benefits, changing more from wood and timber production to conservation. In Hungary, there are some forest areas in the mountains (hills) that are specifically managed for protecting the soil or drinking water.

Measure advantages

CFC is a true alternative to simple timber production and provides the basis for a economical strategy in forestry with the overall purpose of drinking water protection and/or flood prevention. It ensures the soil and water protection functionality of forest ecosystems over space and time.

Challenges

In Hungary only a few forestry has started establishing CFC systems yet. The application of CFC requires specific knowledge and understanding of long term benefits.

BP MF2 Pro-Silva movement

The Pro-Silva movement initiated in Central Europe (in Slovenia). This movement promotes the expansion of the goals within silviculture. Pro Silva Hungaria was established in 1999 as a non-governmental organization.

Pro Silva membership is made up of forest owners, foresters, forestry students and others who wish to practice and learn more about Pro Silva forestry practice.

Pro Silva promotes forest management strategies which optimize the maintenance, conservation and utilization of forest ecosystems in such a way that the ecological and socio-economic functions are sustainable and profitable. As a result of the discussions silviculture includes not only wood production but an emphasis on maintaining forest biodiversity, recreational, landscape, soil, air and water protective functionalities as well as socio-economic and cultural functions.

Measure advantages

Pro Silva advocates and promotes Close to Nature Forest Management Principles as an alternative to clear felling, short-term tree plantations. These principles ensure the soil and water protection functionality of forest ecosystems over space and time as well. Ensure up-to-date knowledge transfer across 25 countries on integrated forest management for resilience and sustainability.

Challenges

In Hungary the thinking on Pro Silva principles has started only a few years ago. The NGOs have minor impact on daily practice of forestry.

BP MF3 Protective forest management

According to the Hungarian National Forest Database 20.5% or about 2,029,000 ha of Hungary is forested, according to FAO. Hungary had 1,612,000 ha of planted forest. Change in Forest Cover: Between 1990 and 2010, Hungary lost an average of 11,400 ha or 0.63% per year. In total, between 1990 and 2010, Hungary gained 12.7% of its forest cover, or around 228,000 ha. Thus forest growth (artificial and natural) surpasses cutting activities, resulting in steady increase of forest area.

There are only a few old-growth forests left on mountainsides and in ravines that are difficult to access. Although the economic importance of still existing old-growth forests is often minimal, they are great tourist attractions and their conservation value is huge.

Trends in Natural and Planted Forest Cover (OECD), 1990-2010

1000 ha	1990	2000	2005	2010
natural forest cover	348	398	417	417
planted forest cover	1453	1509	1566	1612

Protective forests cover around 11% of total forest area (KSH, 2013) and 22% of forest are nature protected. Protective forests are forests that mitigate or prevent the impact of a natural hazard, including soil erosion, landslide or flooding. One of the most effective protective functions of forests is reducing soil erosion by water or wind. Where forests were the original land cover, the protective effect consists in maintaining as far as possible the 'natural' flow regime, which inevitably consisted of both flooding and low flows to which stream channels and associated biota were adjusted. With regard to floods forests reduce stormflow peaks and delay them better than other land cover. Protecting stream and river banks from undue horizontal erosion is function of a buffer zone of trees along both sides of a watercourse. The buffer area also acts as a filter and depository for sediment, pesticides and fertilizers from upslope land use (FAO, 2005).

Measure advantages

Protective forests have established in Hungary for protection of land from landslides and rock crumbling. These are forests on steep slopes or banks of waters, forests, exposed to strong winds, forests in torrential areas withhold excessive discharge of water and thus protect the land from erosion. Protective forests also form forest belts, which protect forests and land from wind, water, snowfall and avalanches.

Challenges

In Hungary the management of forests depend on the owners. The good practices in forests management ensured if waterworks company can treat the protective area.

BP MF4 Prohibition or restriction of grazing in forests

According to the Hungarian Forest Law grazing in the forests has been prohibited for the last decades. The farming and land use have significantly been changed during the last 200 years. A lot of one-time management and land use types have disappeared for today as the effects of changing, like pannage, grazing in forests,

grazed forests and wood pastures. The grazing in forests was maintained until the middle of the 20th Century, but it had been regulated by laws since the early times. This fact shows the importance of forests in livestock keeping. Since the first law on forestry in 1791 the changing rules of grazing in forests and the connected land uses could be followed well from the moderated regulation to the total prohibition (Saláta Dénes, Horváth Soma, Varga Anna, 2009).

The reasons of prohibition were to protect soil from degradation, increase game production and biodiversity as well. The impact of livestock grazing on soil compaction is well known. Compaction of soil can reduce plant growth, inhibit root penetration, restrict water and air movement in the soil and, ultimately, reduce yields.

Overgrazing can occur when undergrowth is exposed to intensive grazing for extended periods of time, or without sufficient recovery periods. It can be caused by either livestock in poorly managed agricultural applications, game reserves, or nature reserves. It can also be caused by immobile, travel restricted populations of native or non-native wild animals. The only thing to stop overgrazing is to limit the animals space to roam around. Overgrazing reduces the usefulness, productivity, and biodiversity of the land and is one cause of desertification and erosion. Overgrazing is also seen as a cause of the spread of invasive species of non-native plants and of weeds.

Measure advantages

Negative impacts of overgrazing can be prevented and/or reversed by proper forest management.

Challenges

Undergrowth management have to solve by forestry. The quality of forest management depends on the owners of the forest.

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP MF1	High	Medium	Long Term	Long Term

BP MF2	High	Low	Long Term	Long Term
BP MF3	High	Medium	Long Term	Long Term
BP MF4	High	Low	Long Term	Long Term

2.2 Grassland

BP MG1 Protective grassland management

In karstic areas mountain grasslands are managed in Hungary for protecting grassland ecosystem and drinking water resources.

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
Protective grassland management	High	Low	Long Term	Long Term

2.3 Agriculture

There is no significant agriculture in the mountains in Hungary except vineyards but without remarkable water protection functionality.

3. Plain sites

3.1 Agriculture

BP PA1 "Good Agricultural Practice" guidelines

On Szentendrei or Csepel Island water protection areas managed by Budapest Waterworks (BW) by establishment of a farm advisory system.

There are more than 150 wells on Csepel Island and several hundred on Szentendrei Island producing potable water for Budapest and its agglomeration. The long-term sustainability of the excellent quality of that water depends on a number of impacts:

the local waste and sewage management, the local industry, its locations and environmental status, mining, presence of open and/or stagnant water and the agricultural activities.
Inappropriate agricultural use of land and use of fertilizers and pesticides can cause significant pollution endangering the quality of potable water. Thus Budapest Waterworks Company created a good practice guideline for farmers to support the protection of drinking water in an agricultural area and at the same time to help farmers making their livelihood in the water protection zones. In the guidelines clear explanation is given on the connection between land use and the drinking water base and there are suggestions for appropriate and "water-friendly" soil preparation, use of fertilizers and pesticides, sowing and planting, irrigation, husbandry and livestock breeding, as well as adminsitrative obligations. The guideline was especially designed for farmers working in water protection zones and considers all aspects of water protection needs, as well as the need of the farmers.

In Hungary there are four protection zone types:
In the immediate environment of wells (inner protection zone) where any type of land use is prohibited. Those areas are mostly owned and managed by waterworks.
In the areas relatively close to wells, but outside of the inner zones (outer protection zone) agricultural use is allowed, but under strict conditions, because pollution may reach the drinking water resource very quickly.
Further away from wells, in the "A" protection zone, rules are less strict.
In the other parts of the protected area far away from wells, in the "B" protection zone, general rules on agriculture should apply, settlements and industrial activities can be allowed.

The maps of areas with various levels of restrictions and the detailed description of regulations are also available at the local governments.

The appropriate agricultural use considers also soil and water protection, as well nature conservation and do not expose the environment to unnecessary load from irrigation, use of fertilizers and pesticides. Substances not absorbed by plants will be washed out and sink to the ground water, thus they are not only pollute the drinking water, but also they are wasted from the farmers' point of view.

Advantages

- Farmers are considered as partners and they are positively motivated for water-friendly farming, which is much more positive than only the use of rules

- If well-targeted, the information can reach many farmers and may cause significant improvement in water-base management on long term complementing the regulations
- "Good Agricultural Practice" can be applied also in other areas
- Water-friendly land use favours also nature conservation and human health, thus it is a multi-aspect approach

Challenges

- The number of farmers reached
- The willingness of farmers to follow the guideline
- It is difficult to measure its effectiveness

BP PA2 Prohibition or restriction of application of manure in high-risk areas

The "Government Regulation 123/1997. (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply" define the rules of the application of manure, of dissolved fertiliser and liquid manure and the release of liquid manure on the DPWZs. On the inner zone of the surface and groundwater recources it is strictly prohibited, on the outher and on the hydrogeological "A" protective zones it is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The dissolved fertiliser and liquid manure land application to agricultural land within the inner, outher and hydrogeological "A" protective zones is prohibited, inside the hydrogeological "B" protective zone is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. Release of liquid manure on the DPWZs is strictly prohibited.

Advantages:

- NO3 (plus ammonium and nitrite) leaching losses and indirect and direct N2O emissions would be reduced by a small amount.
- Soluble and particulate P losses would be reduced by a small amount.
- Organic load losses would be reduced by a small amount.
- It should be used in other sensitive areas

Challenges

- It is difficult to verify

BP PA3 Controlling storage of manure

The impermeable base and leachate collection prevents the direct loss of pollutants in surface runoff and drainflow.

There are a number of tender opportunities for farmers to construct storage infrastructure for solid manures with an impermeable base. Those who engaged in organic farming, or manage on nitrate vulnerabil zones, get extra points in the tender evaluation.

This method is applicable to all livestock farms that produce or import solid manure.

Advantages:

- continuous tender opportunities

Challenges

- Relatively high investment cost
- Need of high own contribution

BP PA4 Controlled application of manufactured fertilizer in high-risk areas

According to the Government Regulation 123/1997 inside the inner protective zone is prohibited the fertiliser application, within the outer, hydrogeological "A" and hydrogeological "B" zones it is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation.

All drinking water protected areas are designated as nitrate sensitive areas as well. To protect the nitrate sensitive areas, and to protect waters, the use of artificial fertilizers and plant protection chemicals shall be reduced. In order to protect waters and to diminish the existing nitrate pollution, the rules of Good Farming Practice have to be observed in the affected agricultural areas. The sound use of soil, which takes into consideration the perspectives of the nutrients and the soil management, has to be fostered.

Rural Development Program supports conversion arable land farming practices into less intensive land use near vulnerable water resources. This measures has provided for areas in the protection zone of vulnerable drinking water resources, or on land with a slope steeper than 12%, or in areas affected by floods to preserve and improve the condition of the environment.

The specifications referring to the sustainability of "good agricultural and environmental condition" are display in the national legislation. The minimum requirements referring to nutrient management and application are imposed in the pieces of national legislation below. These minimum requirements must be met by the beneficiaries of RDP in the complete areas of their agricultural lands.

- The amount of nitrogen from organic manure disposed in an agricultural area on an annual basis cannot exceed 170 kg/ha.
- Manure cannot be applied on frozen ground, land filled with water or covered completely with snow.
- Manure shall not be spread in prohibited period
- Manure cannot be applied in a radius within the protection zone of surface water, source, and wells whose water is used for human consumption or watering animals.
- Improvement of acidic, saline and sand grounds can be undertaken in line with ground protection authority permit and complying with regulations of relevant legislation.
- Treated wastewater, sewage sludge and slurry application shall be done in accordance with the permit issued by soil protection authority and meeting specifications of relevant legislation.

Advantages

- Clear legislative background system
- Controlled nutrient use by authorities
- The measure prevents the pollution of water resources, so reduces quality vulnerability of drinking water supply.

Challenges

- Need of professional knowledge, permanent education of farmers/users of fertilizers

BP PA5 Controlling the use of pesticides

Due to the predominant role of agriculture in Hungary's economy, national plant protection policy and institutions have been developed gradually since 1760. The establishment of the regional plant protection services in 1954 – the original structure of today's Directorate – was another important milestone and the special higher education program for plant protection experts started in 1960. In 2007 by merging the background institutes of the Ministry of Agriculture and Rural Development into one single institution, the Government Decree 274/2006 establishing the Agricultural Office (hereinafter: AO) designated the AO, among others, as the plant protection and soil conservation competent authority.

In accordance to the relevant European legislation, the primary objective of the Directorate of Plant Protection and Soil Conservation (hereinafter: Directorate) is to increase the efficiency of production and market control, using the most appropriate controlling priorities and methods. The Directorate is also responsible for the nation-wide co-ordination of plant protection and plant health control and the continuous

further education of its experts. Other fields of the Directorate's activities are: adequate information of producers and sellers, related publications and articles and the management of an updated database system.

According to the Government Regulation 123/1997 within the inner protective zone of the drinking water resources is prohibited the use of pesticides. Inside the outer, hydrogeological "A" and hydrogeological "B" zones it is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The pesticide application from aircraft is prohibited within the inner, outer and hydrogeological "A" protective zone, within the hydrogeological "B" zone it is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The pesticide storage and residues disposal and washing pesticide equipment, effluent disposal within the inner, outer and hydrogeological "A" zones is allowed. The washing pesticide equipment, effluent disposal within the hydrogeological "B" zone is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation.

Advantages

- Clear legislative background system
- Strictly controlled pesticide use by authorities
- The measure prevents the pollution of water resources, so reduces quality vulnerability of drinking water supply.

Challenges

- Uses of not registered pesticides (illegal activities)
- Need of professional knowledge, permanent education of farmers/users of pesticides

BP PA6 No-chemicals and organic farming

Recent years in Hungary have seen the rapid rise of organic farming, although domestic demand for fresh and processed organic produce has increased at a slower pace. One reason is the higher consumer price of organic products; another is the lack of organization in the internal markets. Most of the country's organic farms continue to focus on exports, with 95-97% of their certified and branded organic products landing in markets in Western Europe In addition to their core production business, a minority of organic farms also pursue certain supplementary activities, first and foremost in other food industry areas, primarily food processing. Most of them deal with wine production, processing of fruits, vegetables; milk and meat, but trade activities are also strong in this farming sector.

This allows the producers to process an increasing portion of their organic products in their own facilities, under strictly supervised conditions. Some organic farms also offer visitor facilities and accommodation under the "rural tourism" scheme, naturally exploiting the gastronomic attraction of their organic products. The support of processing of organic products – establishing the product line "from farm to fork" also has a peculiar significance for us, as most of the products grown in Hungary, still in a ratio above 70 %, are sold as unprocessed products in foreign markets.

Advantages:

- strictly supervised productions

Challenges

- Relatively high cost
- Need of professional knowledge

BP PA7 Agri-environmental payments under Rural Development Programme of Hungary

Agri-environmental payments contribute to the development of rural areas and provide environmental services for the whole of society. These payments encourage producers of agricultural lands to adopt farming and production methods which are compatible with the sustainable use of environment, landscape, and natural resources and with the preservation of genetic resources.
This action contributes to the fulfilment of the commitment taken on in Gothenburg aiming at the reversal of the decline of biodiversity along with the accomplishment of the objectives set in the so-called Water Framework Directive.
At the establishment of agri-environmental actions close attention is devoted to the alleviation and reduction of agri-environmental problems typical in Hungary, and to the promotion of such environmentally friendly farming practices which prevent certain environmental problems to occur. In line with the above, the following specifications have been laid down in accordance with agri-environmental priorities and have been integrated into various schemes:

- Soil protection: the amelioration of effects of various soil degradation procedures (land erosion, acidification, soil compaction) by the adoption of a variety of agrotechnical methods. As environmentally friendly nutrient management practices are promoted, the negative balance of land nutrients is restored, and this is one of the key objectives.
- Protection of surface- and ground waters: with the help of the promotion of restructuring land use and the practices of environmentally friendly nutrient management and plant protection, the quality of water resources shall be protected and possible contaminations shall be reduced.

- Nature conservation: in all areas of agricultural land use (arable farming, grassland management, plantations) the target is the development of an active nature conservation system by the establishment and preservation of diverse, semi-natural habitats, by the provision of adequate feeding, reproduction and resting places for animal and plant species which are valuable from a nature conservation aspect. The above-mentioned instruments for the preservation and enhancement of biodiversity primarily serve the protection and development of Natura 2000 areas.
- Genetic conservation: in various management systems plant species of high genetic and agricultural value, often endangered by extinction/genetic erosion enjoy overwhelming support.
- Reducing air pollution: via extensive farming along with management methods and plant groups requiring low external input schemes contribute to the reduction of contamination produced by agriculture.

Advantages:

- Support the sustainable development of rural areas, to preserve and improve environmental conditions, to reduce load on environment from agricultural sources, to offer environmental protection services, and to promote agricultural practice based upon the sustainable use of natural resources.
- Support the preservation of biodiversity on farm,
- Support the protection of waters and soil with the establishment of farming structures adequate for production area features, environmentally aware farming
- The establishment of sustainable land use is also strongly supported.

Challenges

- Relatively high cost
- Need of professional knowledge

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP PA1	Medium	Low	Medium	Medium
BP PA2	High	Low	Short	Long
BP PA3	High	Medium	Medium	Long

BP PA4	High	Low	Short	Long
BP PA5	High	Low	Short	Long
BP PA6	High	High	Medium	Long
BP PA7	Medium	Medium	Medium	Medium

3.2 Grassland

BP PG1 Regulation of suitable locations and proportion of grassland cover inside DWPAs, selection of the appropriate management type

The Government Regulation 123/1997. prescribe, that within the inner protective zone, the terrain shall be levelled to prevent surface runoff from accumulating in stagnant pools. The terrain should be planted as continuously as practicable with grass. No fertilisers, manure and pesticides must be spread. The surfaces on which no grass can be planted shall be paved with durable, non-polluting material. Over aquifers close to the surface, further in the vicinity of pipelines and structures no trees and shrubs with roots reaching down to these must be planted.

Advantages

- Clear legislative background system
- Grassland may reduce quantitative and qualitative vulnerability of groundwater and surface water resources by retaining water, filtering and attenuating pollutants, reducing erosion.

BP PG2 Special good practices of grazing in protected areas

A significant portion of grasslands are over utilized by livestock. Although a parcel of land is not overgrazed there are some parts where signs of degradation can be found. These special areas are attractive for ungulates because there are water, supplement and salt sources, camps or shelters. Overgrazing has detrimental effects on soil and vegetation but changes are reversible. High grazing pressure decreases plant density, changes botanical composition, and often accelerates the invasion of unpalatable species. Moreover, overgrazing increases area covered by no vegetation, reduces infiltration, soil moisture and fertility, accelerates runoff and soil erosion, increases soil bulk density, penetration resistance, soil ammonia and nitrate content and changes soil microbial activity (▫Levente Czeglédi – Andrea Radácsi, 2005).

Nevertheless, all these negative impacts can be prevented and/or reversed by proper grassland management practices. According to the Government Regulation 123/1997. within the inner protective zone is prohibited grazing, but in particular instances (e.g. groundwater table deeper than 2 m) grazing may also be allowed inside the outher protective zone, only watering and noontime rest of the animals shall be outside the protective zone.

Advantages

- The measure preserves retention capacity, consequently ESSs, in the frame of general grassland management without considerable additional cost or loss of production: so increases cost efficiency.
- Appropriate grazing can efficiently contribute to weed control.

Challenges

- the correct information of farmers
- need increased awareness of the farmers

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP PG1	High	Medium	Low	High
BP PG2	Medium	Low	Low	High

3.3 Wetlands

Wetlands are complex ecosystems of paramount importance, not only because they have become so rare and are so threatened, but because they perform important environmental and economic functions. Naturally functioning wetlands reduce flooding events, improve water quality, store carbon, and represent a valuable cultural and natural heritage. Due to their complex composition and structure, they generate unique vegetal, wildlife, fisheries, forestry and recreational resources. The combination of these functions and products makes these ecosystems invaluable to us.

Inner, continental deltas are active in Hungary depositing riverine sediments along the rim of basin. Floodplain habitats can be found across the country, including active side-branches, temporarily flushed ox-bows, cut-off ox-bows, silted areas and riparian forests. This mix of habitats over a relatively short area makes these inland deltas very important for biodiversity.

In the Hungarian Great Plain salt steppes and marshes were common areas before river regulation. Wetlands have formed over the past ten thousand years through the unique combination of a continental climate, flat topography and spring flooding from the rivers running down from mountains to the plain area. Tussock meadows are widespread on the whole Pannonian lowland, moorland associations occur on the sand dunes of Kiskunság and Nyírség. Large areas of the plain are alkaline-saline "puszta", predominantly dry but containing many shallow waterbodies, as extensive marshes and soda lakes (IUCN, 1993).

In spring, the water from the river spreads over a huge area but is only ever a few centimeters deep because of the flatness of the area. These great shallow wetlands were perfect for hundreds of thousands of migrating birds. In summer the water ebbs away until almost all the shallow lakes had dried out, leaving a mosaic of alkaline, dry or wet grasslands in which unusual halophytic (salt-loving) plants, related to species normally found on the coast, could thrive. For centuries, traditional grazing with large herds of livestock further contributed to the maintenance of an open vegetation structure.

In the 20th century, especially during the socialist era, this remarkable ecosystem was dealt some hard blows. Grazing was largely abandoned, or replaced by highly intensive forms of farming. Much of the area the natural landscape has been replaced by arable lands.

BP PW1 Management of natural and constructed wetlands

Wetlands are complex ecosystems of paramount importance, not only because they have become so rare and are so threatened, but because they perform important environmental and economic functions. Naturally functioning wetlands reduce flooding events, improve water quality, store carbon, and represent a valuable cultural and natural heritage. Due to their complex composition and structure, they generate unique vegetal, wildlife, fisheries, forestry and recreational resources. The combination of these functions and products makes these ecosystems invaluable to us. Thus adequate management of wetlands

The Kisköre reservoir or Lake Tisza is one of the most important sites for preservation of biodiversity on Hungary. Kisköre reservoir is a constructed wetland and managed for ensuring drinking water resource of Szolnok city.

Advantages

- Wetlands are very efficient at removing excess nutrients from water.
- High water retention capacity with cost efficiency.
- Appropriate management can help in protection of drinking water sources.

Challenges

- several anthropogenic threats to wetlands cause degradation of them
- need increased awareness for the protection of relicts

BP PW2 Designation of wetlands

Many wetland habitat types and species in Hungary are now protected through the Natura 2000 network. Hungary adopted the Ramsar Convention too. The Convention entered into force in Hungary on 11 August 1979. Hungary currently has 29 sites designated as Wetlands of International Importance (Ramsar Sites), with a surface area of 260,682 hectares.

The Ramsar sites in Hungary include all characteristic types of wetland areas in the Carpathian Basin: lakes, marshes, alkaline lakes, bogs, backwaters, river stretches, wet meadows, man-made fish farms and reservoirs. Certain sites were qualified by fulfilling several of the criteria of international importance. These areas include: Hortobágy, Kardoskúti Fehértó, Lake Fertő and Gemenc. The other Ramsar sites in Hungary also meet at least two criteria.

One of the most important parts of the duties deriving from the basic obligations is the nature conservation management of the sites of international importance. Hungary is well positioned in this field, since the elaboration of the management plan of each site has already begun, and many of them are being implemented. The management plans are in line with the basic principles of the Convention, and are characterised by a clear, logical structure that enlists the given site's characteristics and assets and also determines the short-term objectives. The continuous monitoring of the ecological character and the regular review are very important parts of the plans.

Advantages

- Common and joint activities to protect wetlands promoted by international actions.

Challenges

- several anthropogenic threats to wetlands cause degradation of them

- need increased awareness for the protection of relicts

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP PW1	High	Medium	Medium	Long
BP PW2	Medium	Low	Medium	Long

3.4 Forest

Less than half of Hungary's forest area consists of natural, "real forests", mainly oak and beech forests. They nearly disappeared after the deforestation of the plains for agricultural reasons in the previous centuries and were replaced in the 20th century by plantations of acacia, pine, black locust and poplar. The forests that grew after the extensive clear-cutting during the wars and the intensive industrial forest management during socialism barely remind of their ancestors. Thus the actual forest stand composition is very much different from the natural vegetation in the plain areas of Hungary. On the Great Plain of Hungary there are only a few spots of vegetation which show the pristine state and there are many introduced/exotic forests (mainly Robinia pseudoacacia). Only a few "relicts" show the original natural vegetation (for example Convallario-Quercetum roboris, Festuco rupicolae-Quercetum roboris, Fraxino pannonicae-Ulmetum).

BP PF1 Protective forest management and afforestation of DWPA

Currently nearly 20% of the area of Hungary is used for forestry purposes. The forest cover of the country is improving but at international level it is still low when compared to the average of the EU (34.2%). Long term, by the
afforestation of approximately 700 000 hectares of arable land, forest cover can increased to 27% (according to the afforestation conception of Hungary).
The multifunctional and sustainable use of forests and the strengthening of their social and public welfare function can be continued under this measure. The significance and necessity of afforestation can be characterized by favorable impacts on the soil, water, air and biodiversity, in short on the environmental state, in addition to the economic benefits.

The most of the afforestation are implemented on the areas of the Plain, where the forest cover is under the national average. In this region the precipitation is low, and the climate is extreme, but the environmental effects of the new forest stands can ameliorate the mesoclimatical relations. The increase of the forested area changes the intensive agricultural areas with very important habitats considering the biodiversity.

Advantages

- The main aims of the measure is to increase the forest cover of the country, to increase the environmental protection, social, public welfare and economic role of forests and to improve the level of employment in rural areas by developing the forestry sector, to enable the agricultural restructuring, by the help of alternative use of areas.
- Objectives of forestry also include the establishment of high biodiversity natural forests, through a substantial increase in the ratio of indigenous tree species, particularly in protected areas.
- Environmental development objective is to enrich biodiversity by establishing close-to-nature forests, to preserve the natural components of the rural landscape, and to facilitate appealing landscape appearance.
- The whole area of afforestation contributes to protection against erosion (water or wind erosion) and combating climate change mitigation.

Challenges

- The provisions and the criteria for selecting afforestation areas to ensure that the planned measures are in line with the local conditions and the environment protection/biodiversity requirements.
- The afforestation of protected grasslands and wetlands may not comply with local conditions and environment requirements.

BP PF2 Forestry administration and control

The current structure of forest management has evolved due to social and economic changes deriving from the political system change in 1989. The legal bases also changed accordingly, creating new challenges for the administration and the forest managers too.

The legal background of forest management in Hungary is based on the Act No. XXXVII of 2009 on forests, on the protection and management of forests, which was passed in 2009, together with their implementation orders of No. 153/2009 (13 November) and 63/2012 (2 July, Ministry of Rural Development).

Forest administration belongs to the authority and responsibility of the Minister for Agriculture. It is the Directorate of Forestry of the National Food Chain Safety Office (NFCSO FD), which carries out tasks in general of forestry administration. The NFCSO FD's main activity is to ensure, through its administrative functions, the sustainable forest management in the country. During course of this it:

- creates a complete forest inventory on all forests in Hungary via scanning the total forest area during course of the process of regional forest management planning with 10-years return;
- maintains the national register of forest managers;
- carries out basic and thematic mapping works;
- manages and maintains the National Forest Inventory and Data Base;
- collects and processes statistical data on forests and forest management;
- coordinates the national assessment on forest health conditions;
- carries out the forestry authority tasks;
- runs the financial (caution) system of forest regenerations;
- co-operates with other authorities and state agencies in the execution of the forestry incentive system.

The above mentioned tasks are executed by NFCSO FD for all forests and all forest management units, within the respective legislative framework, independently of their ownership type. It must be stressed again that forestry authority organizations do not carry out any forest management activities in Hungary.

In Hungary in terms of forest management, it can be distinguished between state-owned and non-state-owned forests, mostly private ones. The non-state-owned areas are managed mostly by private management companies. These must be recorded by the forestry authorities. The management of the state forests is mainly carried out by 22 state forest management companies. However, there are also other state organizations – e.g. Water Management Authorities, National Parks – managing state forest areas. The share of community ownership on forests is low, usually municipal, town and city councils are the forest managers.

Advantages

- The control on Forestiers ensures to reach sustainable forest management objective.
- Clear legislative background system

Challenges'

Not managed forests also exist in Hungary most of them being in private property. At these areas there is no forest manager recorded in the register of the forestry

authority. It is a key objective of forest policy in Hungary to further reduce the size of unmanaged forests.

BP PF3 Establishment of agro-forestry systems (grazing) and wood-pastures

The agro-forestry systems are extensive land use systems where trees are attended and agricultural activities are pursued simultaneously, thus a mosaic of agricultural and forestry systems is created. The agro-forestry systems are of great ecological, landscape and social value since they combine extensive agricultural and forestry systems aimed at the production of excellent quality wood and other forestry products.

Concerning agro-forestry systems grazing forests have traditions in Hungary. The measure is considered as a great possibility to introduce new land use systems. For farming point of view, introducing agro forestry system in certain special regions of Hungary (floodplains, regions of threat to wind and water erosion) are expected to achieve major positive environmental effects.

The measure due to its multifunctional character extends the income gaining opportunities of the population, and it may secure the continuation of farming in previously intensively uses areas with unfavorable conditions and in case of Natura2000 areas.

Advantages

- The measure has major importance in reintroducing sustainable landscape management of plain areas. The environmental state of the areas affected by the creation and maintenance of agro-forestry systems will improve due to the strengthening of the mosaic character; biodiversity will grow and the permanent green cover will decrease the level of erosion significantly.
- The measure aids the protection of rural natural resources and improves their state.
- It contributes to the reaching of environmental targets, to the protection of the soil and to the prevention of disappearing biological diversity.
- The measure provides an good opportunity for integrated and ecological farming and the utilization of species that are typical of the region (geographical indications).
- The agro-forestry systems are perfect for making the rural area more attractive, for maintaining jobs and creating new ones, and for improving the living conditions of people in rural areas.

Challenges

The traditional use of woodlands and its essential influence on the land's structure and dynamics have become commonly known among the Hungarian ecologists only in the past few years. The view of the Carpathian-basin vegetation is significantly influenced by the effect of used and abandoned wood-pasturing. The wood-pasturing was one of the basic components of a highly varied pasturing system concerning the for coming season and weather, the whole activity was regulated by rules. The wood-pasturing occurred in all types of forests. In all cases the decrease of pasturing livestock was the reason for the abandonment of the areas. A consciously controlled and sustained landscape of woods evolved as a result of wood pasturing. In case of abandoning bushy shrubbier, saplings filled, low-diversified, closed shrubbier and woods were developed (Varga & Bölöni, 2009).

Although, wood pasturing which is based on the traditional knowledge has a great importance in conserving nature and landscape but for re-establishment of agro-forestry systems a lot of obstacles have to defeat, for example: intensive husbandry has replaced grazing or the last descendants of shepherd dynasties are already pensioners, etc.

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP PF1	High	Medium	Long	Long
BP PF2	Medium	Low	Long	Long
BP PF3	Medium	Medium	Long	Long

4. Special sites

4.1 Dry areas

BP SD1 Drought and Water Scarcity Management System

Expected long-term and recent years' trends in drought occurrence implied that there is a need to change our reactive approach towards a proactive and operative

way of thinking concerning drought management. Hungary is considered highly vulnerable from climate change point of view. All of the following projected changes will effect directly the domestic water management.

Temperature:

- average annual temperature increase significantly for each season
- largest changes in summer (1,4 - 2,6 °C) and autumn (1,6 - 2,0 °C) by 2050 compared to the reference period (1971-2000) and even a 4 °C rise by 2100
- decrease in the number of frosty days
- increasing number of heatwaves

Precipitation:

- no significant change in the total amount of annual precipitation for the period of 2021-2050
- decrease in the average of summer precipitation more than 5-10% by 2050 and even 20% by 2100
- longer dry periods in the summer by 2050 and also in autumn and spring by 2100
- increase in the number of days with heavy and intense precipitation (20 mm or more)
- possibility of water storage in soil needed for crop production has already been decreased

Facing these challenges it was decided that a national drought monitoring system should be elaborated with its integration into the existing water damage control system, involving currently flood and excess water management. Proper thresholds and respective drought stages will be estabilished as a basis for operative actions.

To this end the development of the Hungarian Operative Drought and Water Scarcity Monitoring System has been started. The system will provide farmers and decision makers with timely information on the extent of water scarcity (supporting irrigation) and the current drought stage in order to avoid or reduce drought damage. It will support also irrigation development and further research programmes.

The drought monitoring network was established with 16 stations in 2016 to be extended in the upcoming years. As the heart of the monitoring system the Hungarian Drought Index (HDI) based on meteorological parameters and soil's water content and a data processing software was also developed. The preparation of a freely accessible online platform for the dissemination and visualization of drought information is in the process now.

Measures ususally put in place by the water sector in case of serious droughts could be more planned and established after the system fully come to life. For instance: water retention in canals; filling reservoirs; water transfers; pumping due to low water levels; limiting regional water transfer between water directorates etc.

Advantages

The measure's biggest advantege is timely prevention. Instead of the current follow-up assessments it provides up-to-date data of the evolution of drought and the current water scarcity.
Prevention of drought losses has measurable effects on the national economic costs.
With the Hungarian Operative Drought and Water Scarcity Monitoring System water scarcity of soils will be expressed in mm which enable the determination of soil specific proper operative measures.
Nature of the HDI index (meteorological parameters and soil's water content) enable to characterize the drought/water scarcity on a daily basis. The index is modular, its meteorological parameter can be used alone where proper soil water content data is not availabe. Data needs can be satisfied from national monitoring systems up-to-date. Its calculation can be eased with algorithmization depending much less from subjective decisions.
Its integration into the existing water damage control system will ease the introduction and usage of the system and make it less expensive.
The system will continously support the agricultural sector by providing timely relevant data. It can be further developed with web tools, mobile applications etc.
The data stemming from the monitoring system can contribute to new developments in drought and agricultural research while it will also build a much needed new and detailed data base. There is the possibility to interpret the drought index and water scarcity for different crops.
Through the system's internet portal drought and water scarcity data will be available for free for users.

Challenges

In order to have an adequate drought picture in national level proper density of monitoring network should be ensured. Existing monitoring stations could be used if arrangement with their operators is concluded. Costs of long term maintenance should be provided.

BP SD2 Promote integrated ecosystem-based solutions of natural water retention measures

The Ministry of Interior as coordinating beneficiary applied for the Life Project titled 'Municipalities as integrators and coordinators in adaptation to climate change'. The General Directorate of Water Management would be also a project partner.
One of the main objective of the project is to raise awareness and increase knowledge of decision makers at Hungarian local governments, relevant public administration bodies and economic actors about the impacts of climate change and

about ecosystem-based natural water retention measures (NWRM) as a powerful tool to improve climate resilience.
It seeks ecosystem-based solutions for the mitigation of the water challenge. Water resources and ecosystems are primarily impacted by climate change, but water retention is also a key element in CCA (Climate Change Adaptation). The prototypes of NWRM that will be developed and implemented on the pilot sites will serve as a replicable model to other municipalities in the Danube basin, facing similar water and climate risks. The demonstrated water retention measures will build on ecosystem services and form part of the local green infrastructure, which serve as natural habitat and support biodiversity.

Advantages

The project will develop and promote integrated ecosystem-based solutions of natural water retention measures that support the sustainable land use practices and increase ecological flows, the quantity of water available for nature. Water retention in the landscape contributes to halting the loss of biodiversity and the restoration of ecosystem sevices through creating green infrastructure.
The project targets the pressures on biodiversity that are classified by the Prioritized Action Framework (2013) as the most significant threats on the status of the Natura 2000 network in Hungary, namely factors influencing the natural water regime and water supply, land use – especially farming and forestry – and biotic and abiotic natural processes, such us the drying out of natural ecosystems due to climate change.

Challenges

Action A.2 will be 'Preparation of NWRM pilot project in Püspökszilágy'. The location of the village is extraordinary, as it lies on the drainage divide between the Danube and Tisza river basins. The key surface water is the Szilágyi stream, which is a minor brook with a small catchment area (10 km^2). The annual mean precipitation is only ~600 mm/y. All these geographical characteristics make the village extremely exposed to droughts. Besides, the village has experienced record level flash floods in every two-three years in the last 10-20 years which had never happened before. Both flash floods and droughts cause many damages to agriculture, urban areas and infrastructure. In the upper watershed, the croplands and some forests dominate the landscape, covering steep slopes which significantly increased soil erosion and flash flood risks. Huge amount of sediment (soil loss) can be observed in certain creeks and gullies in case of flash floods. In the lower watershed, where the settlement is built, the floodplain along the Szilagyi stream does not fulfil its water retention role which leads to a broken balance between the stream and the valley bottom. In summer the valley bottom is completely dries, what has negative impacts on agriculture,

ecosystems and the groundwater level. On the other hand, flash floods cause damages to public and residential buildings.

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP SD1	High	Middle	Middle	Long
BP SD2	High	Low	Middle	Long

4.2 Riparian strips and floodplain

BP SR1 Protective forest management on floodplain

Riverine forests (mainly alders, willows and poplars) have been heavily transformed but important areas remain along the large rivers. The most of them show rather pristine state and they are Natura 2000 sites. Only a few “relicts” show the original natural vegetation because of the spread of invasive species of non-native plants and of weeds. These gallery forests can be divided in the parts: softwood and hardwood. The former are willow and poplar associations covering the lower, regularly inundated floodplains. The latter represent a transition between the former and climax dryland forest. Gallery forests have high biodiversity. The best stands are in the lowland reaches of the river Drava, near the tributaries of upper Tisza and on the Szatmar-Bereg plain (IUCN, 1993).

Man-made flood defenses – engineered embankments, flood walls and temporary structures – are an essential part of the fight against flooding. However forests/trees can provide a sustainable and low maintenance solution to lessening the risk of flooding as well as delivering other environmental and economic benefits when combined with other flood defenses on floodplain.
Establishing protective forests at banks of waters or in DWPAs prevents leaching of agricultural pollution to waters. Planting trees can be effective in increasing water infiltration, and reducing and slowing runoff. Woodland located on floodplains can mitigate large flood events by absorbing and delaying their progress downstream. Trees and green space could play a critical role in adaptation to climate change in addition to reducing flood risk.

BP SR2 Non-structural flood defense measures

In Hungary the preliminary flood risk assessment has been done based on the readily available information. Three types of flood were examined to establish maps on inundation hazards:

- Floods of large rivers protected by dykes (riverine floods);
- Floods of river and stream sections not protected by dykes (so called flash floods);
- Inland inundations (excess water).

Along the rivers in Hungary about 4,200 km of flood protection dykes have been built. Their establishment and protective ability are on different levels, so the hazard of flooding in the areas they protect varies as well. The hazard of inundation in these areas is fundamentally affected (apart from the hydrological load) by the protective ability of the dykes, and the by the defense potential (the human and material resources of the defense organization).

Flash floods on the small streams in mountainous and hilly areas were simulated by 1D hydraulic model. The risk calculation based on the inundation depth and the water velocity. Inland inundation can be interpreted as the opposite situation than that of the previous cases, as in this case the inundation of the area does not originate from the river, but directly from rainfall and high groundwater level. Consequently, the simulation of the process is based on the modeling of the soil water balance.

During the years 2014-2015 the hazard and risk maps were supervised and strategic risk management plan was prepared.

- Flood hazard maps, showing the extent and expected water depths/levels of an area flooded in three scenarios, a low probability scenario or extreme events, in a medium probability scenario (at least with a return period of 100 years) and if appropriate a high probability scenario.
- Flood risk maps, shall also be prepared for the areas flooded under these scenarios showing potential population, cultural economic activities and the environment at potential risk from flooding, and other information that Member States may find useful to include, for instance other sources of pollution.

Risk management plans include several structural and non-structural measures, like preparation of Flood Riverbed Management Plans.

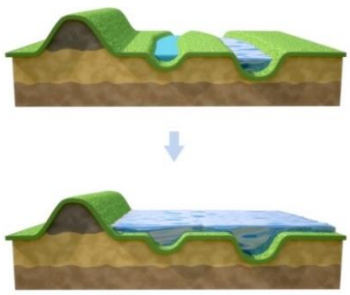
The negative process taking place in riverbed caused higher flood levels and decreased our flood protection facilities. This fact and high cost of flood protection developments needed to improvement of the conveyance capacity of the flood bed. Making of the Flood Riverbed Management Plans (FRMP) specify Act LVII of 1995 on water management and the preparation of the planning ordered by the 83/2014. (III.24.) Government regulation.

The aims of the FRMP are reducing flood levels, keeping or repairing capacity of riverbed and ensure the flood protection safety. FRMP includes

- Identification of flood hazard zones and consideration of their limitations;
- Identification, development and protection of flood retention volumes;
- Development of individual flood protection measures;
- Revision of the existing constructive flood protection measures;
- Maintenance of the watercourses, hydraulic works and river banks;
- Adequate management of hydraulic structures.

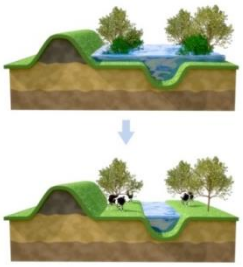
FRMP includes some measures on land use as well including changing, optimization of plant cultivation or land use on floodplain. The following pictures demonstrate these measures:

EVOLVING OF WETLANDS WITH FLOOD PROTECTION FUNCTIONS



Taking advantage of terrain conditions, the deeper areas are constructed of bands that remain in under water. This implementation helps to providing better run-off conditions, increasing biodiversity and operating like wetlands.

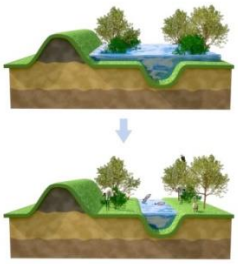
MODIFY LANDUSE IN FLOODPLAIN AND INUNDATION AREAS,



Liquidate flooding runoff barriers of landusing practice by cultivation changes and modifying land uses.

Criterias: ecological status, nature conservation, sediment and nutrient retention.

VEGETATION CONVERSION AND RESERVATION



Removing of the vegetation which caused run-off barriers. This implementation helps to provide better run-off conditions.

BP SR3 Structural flood defense measures

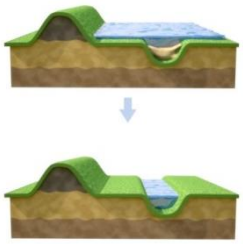
The implementations of the Flood Riverbed Management Plans are important tools for reducing effects of climate changes. The plans relied on technical viewpoints, hydrodynamic modellings which determine the flood river bed and indicate the flow zones. The river side was determined by supporting integrated digital terrain model. The flood riverbed management plans are made for 67 river section. In the plans determined in flood perspective primary, secondary, temporary, and dead zones in the flow.

There are several structural measures to reduce flood risk, like

- Deepening of riverbed by dredging
- Storage, and water retention in river bed
- Dyke relocation, building dykes, developing flood protection dykes
- Building flood channels or spillways
- Deepening of floodplains
- Demolition of river regulation structures
- Removal of buildings and other constructions from the flood area.
- Dredging and restoration of side branches
- Removal of summer dams from the flood area.
- River reef or river bend regulation

The following pictures demonstrate some of the above listed structural measures.

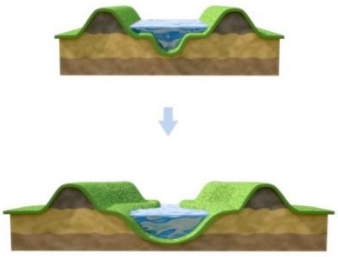
DREDGING, SHALLOW SETTLEMENT



Growing flood capacity in main river bed, and in sub-channels.

Increase the flow cross-section area by dredging

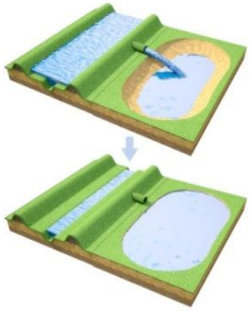
STORAGE, RETENTION IN RIVER BED



Dangerous flood situation occurs water surplus temporary storage in river bed.

Flood peak reduction under the storage section.

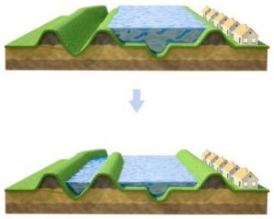
FLOOD PEAK REDUCTION BY RESERVOIRS



Diverting a part of flood discharge could reduce the water level.

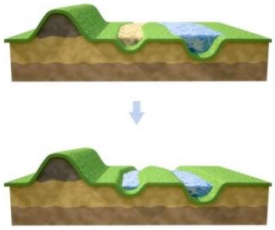
There are temporary inundated areas, and extra high flood waves can be diverted to reservoirs.

EVOLVING OF FLOOD CHANNEL



The flood channel main task is in flood situation divide the discharge which, caused lower water levels.

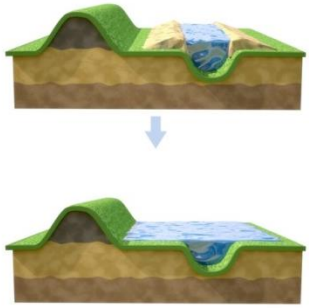
REHABILITION OF FLOODPLAIN'S SUB BRANCHES, OXBOWS,



The sub branches and oxbows should be connected and must be turned on the flood conduct.

Removing sub branches closing hydraulic structures, to provide the continuous water supply.

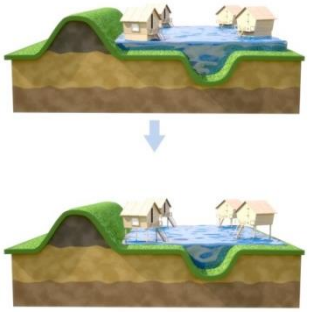
REMOVING SHALLOW SETTLEMENT



Removing shallows by cutting with related landscaping.

Cause of flooding in the inundation area more frequently, increasing biodiversity.

ORGANIZATION OF RECREATION AREAS



Removing or rebuilding of the buildings which caused run-off barriers.

Clearance of lower recreation building level and demolition of the fences

	Water protection functionality	Cost of the measure	Duration of implementation	Time interval of sustainability
BP SR1	High	Medium	Long	Long
BP SR2	Medium	Low	Short	Long
BP SR3	Low	High	Medium	Long

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